November 2021: NICE guidelines PH45 (June 2013) and PH48 (November 2013) have been updated and replaced by NG209. The recommendations labelled [2013] or [2013, amended 2021] in the updated guideline were based on these evidence reviews. See www.nice.org.uk/guidance/NG209 for all the current recommendations and evidence reviews.

matrix evidence

National Institute for Health and Clinical Excellence (NICE)

Smoking cessation in secondary care: cost-effectiveness review.

June 2012

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Acknowledgements

The cost-effectiveness review team would like to thank the team at NICE, including Lesley Owen, Peter Shearn, Tricia Younger, Amanda Killoran Linda Sheppard, Paul Levay and Daniel Tuvey, the information specialists at EPPI and the effectiveness review teams for this project for their support.

Declaration of authors' competing interests

No authors have competing interests.

Contents

1.0 Executive Summary

1.1 Introduction

This report summarises the literature on cost-effectiveness of interventions to increase smoking cessation or temporary abstinence for people attending or likely to attend acute, maternity or mental health secondary care services. The review also looked for cost-effectiveness studies relevant to smoking cessation interventions for family and visitors of these patients, and staff working in these settings.

The review also searched for evidence about the cost-effectiveness of interventions to encourage secondary care staff to identify patients who were smokers and to refer them to smoking cessation services, to record patients' smoking status, and to support smokefree workplace policies, regulations and legislation.

More specifically, the aim of the review was to answer the following questions:

- **Question 1:** How cost-effective are ***smoking cessation interventions*** in helping people admitted to secondary care acute, obstetric or mental health settings, their family members and visitors, and staff caring for them?
- **Question 2**: How cost-effective are ***interventions for temporary abstinence*** in helping people admitted to secondary care acute, obstetric or mental health settings, their family members and visitors, and staff caring for them?
- **Question 3:** How cost-effective are current approaches used by secondary care staff for ***identifying and referring patients*** admitted to acute, obstetric or mental health secondary care services, or their family members and visitors, to stop smoking services?
- **Question 4:** What approaches are cost-effective to encourage health professionals to ***record smoking status*** for patients admitted to acute, obstetric or mental health services and refer smokers to stop smoking services?
- **Question 5:** How cost-effective are strategies and interventions for ensuring ***compliance with smokefree legislation*** and local smokefree policies in secondary care settings?

Furthermore, subsidiary questions included:

- How does the cost-effectiveness vary for different population groups or speciality care services?
- Are certain interventions more cost-effective when used in combination?
- What impact do the following have on cost-effectiveness and acceptability of different interventions: deliverer, setting, timing (or point in the care pathway), frequency, duration, severity of dependence?

1.2 Methods

The review was conducted in accordance with the methodology laid out in the second edition of *Methods for the development of NICE public health guidance* (National Institute for Health and Clinical Excellence (NICE), 2009). We searched EconLit, HEED and NHS EED databases; we also searched the citations in studies included from the database searches and relevant NICE reports. In addition, we included relevant studies identified by the teams searching for effectiveness evidence for the other complementary reviews for this guidance. The search of economic databases for this review was adapted from that developed by EPPI for these effectiveness reviews and included studies published in English since 1990.

Abstracts identified by the search were each screened independently by two researchers and any differences were resolved by discussion. Studies were included if they were cost-benefit, cost-effectiveness or cost-utility analyses on the relevant population and settings and were carried out in any OECD country.

Studies included on abstract screening were retrieved and data extracted from those confirmed as meeting the inclusion criteria using a standard template. The applicability and quality of each included study were assessed using the template for economic studies from the NICE methods manual.

1.3 Findings

Sixteen studies met the inclusion criteria and are summarised in this report. Eight were of high quality and eight of moderate quality. Only one was based in the UK, with 10 from the US and the rest from France and Scandinavia.

Evidence statement 1: Cost-effectiveness of smoking cessation interventions for general in-patients and out-patients
ES1.0 Moderate evidence from three cost-effectiveness analyses (Prathiba et al., 1998 [+]; Meenan et al., 1998 [+]; Olsen et al., 2006 [+]) found that smoking cessation counselling and follow-up calls significantly increased quit rates in in-patients and out-patients attending a hospital in Wales, or any smoking patient admitted to hospitals in the US or Denmark. The UK study found that the cost per additional smoker who quit was £851, and the cost per life-year saved by the intervention compared with physician advice alone ranged from £340 to £426 (Prathiba et al., 1998 [+]). Sensitivity analysis showed that, if the total cost of the programme was doubled to include patients' costs and the proportion of patients who are assumed to stop smoking as a result of physician's advice alone increased to 10%, then the cost per success would be £3,540, and the cost per life year saved would range between £1,416 and £1,770. The US study found the incremental cost per incremental quitting patient was $3,697 and the

incremental cost per life-year saved was estimated to be $3,680 at a discount rate of 5% (Meenan et al., 1998 [+]). The Danish study found that the mean incremental cost-effectiveness ratio (ICER) with the intervention was €1,058 (95% confidence interval €1,036 to €1,081).

Applicability
Only one of the three studies was carried out in the UK, and that was based on data from 1992-94, which limits the applicability of the cost effectiveness analysis to current UK practice.

Evidence statement 2: Cost-effectiveness of smoking cessation interventions in patients with acute cardiovascular disease

ES2.0 Strong evidence from two cost-effectiveness or cost-utility analyses from the US found that smoking cessation counselling and information significantly reduced smoking rates in patients admitted with acute myocardial infarction. One study calculated a cost per smoker who quits to be $380, with a discounted 1.7 life-years gained, and incremental cost-effectiveness ratio of $220 (Krumholz et al., 1993 [++]) . The second study found the incremental cost-effectiveness ratio of $5,050 per quality-adjusted life year (QALY) gained based on 2008 US$ costs, and $4,350 per life-year gained (Ladapo et al., 2011 [++]).

ES2.1 Weak evidence from one moderate-quality cost-effectiveness and cost-utility analysis in Sweden suggested that smoking cessation counselling with cognitive behavioural methods for 8 weeks in patients diagnosed with abdominal aortic aneurysms could reduce the risk of needing repair or emergency treatment for rupture, with an ICER per life-year gained of €674, and €924 per QALY gained (Mani et al., 2011 [+])

ES2.2 Weak evidence from one moderate quality cost-effectiveness analysis suggests that smoking cessation advice and information delivered by non-specialist nurses for patients admitted to hospital in Norway for coronary artery bypass surgery would have an incremental cost-effectiveness ratio of €280 to €230 per life-year gained using a 3.5% discount rate in low-risk patients with stable coronary heart disease. In high-risk patients with acute myocardial infarction, the incremental cost-effectiveness ratio of the programme per life-year gained was calculated to be €1,200 at 5 years and €110 over a 25-year lifetime, using a 5% discount rate (Quist-Paulsen et al., 2006 [+]).

ES2.3 Moderate evidence from one high quality cost-utility analysis suggests that adding nicotine replacement therapy to counselling and information would increase quit rates but would also increase the cost per QALY because of higher costs of on-going care for a greater number of survivors (Ladapo et al., 2011 [++]).

Applicability

None of the studies were carried out in the UK, which limits the applicability of these cost effectiveness findings to the UK context. However, the patient groups and interventions followed in these studies are applicable to UK practice.

Evidence statement 3: Cost-effectiveness of smoking cessation interventions in patients awaiting surgery for lung cancer.

ES3.0 Weak evidence from one moderate quality cost-effectiveness analysis suggests that counselling plus nicotine replacement therapy for patients scheduled to have surgery for early lung cancer in the US might have an incremental cost-effectiveness ratio of $16,415 per QALY and $45,629 per life-year gained after 1 year, falling to $2,609 per QALY and $2,703 per life-year gained after 5 years, using a 3% discount rate (Slatore et al. (2009 [+]).

Applicability
The study was carried out in the US which limits the applicability of the cost effectiveness analysis in the UK context, but the patient subgroup and management approach are applicable to current UK practice.

Evidence statement 4: Cost-effectiveness of smoking cessation interventions in any pregnant women attending antenatal services

ES4.0 Moderate evidence from one cost-benefit and cost-effectiveness analysis in the US found that counselling and educational materials given to pregnant women attending antenatal clinics would cost $2,943 per life-year gained, discounted at 4%. The reduced need for neonatal intensive care (NICU) in babies of quitters would lead to savings of $3.31 for every $1 spent, and the decreased costs of care for disability in surviving babies were calculated to be a further $3.26 per $1 spent (Marks et al., 1990 [++]).

ES4.1 Weak evidence from a subsequent moderate quality cost-effectiveness analysis of this study suggested that the smoking cessation intervention would reduce the risk of sudden infant death syndrome in the babies of quitters, but that costs per death averted would be: $210,500 overall (95% confidence interval $119,200 to $224,400). Costs per death averted would be $235,400 for light smokers (95% CI $219,300 to $256,400); $177,300 for moderate smokers (95% CI $166,800 to $191,100); and $151,000 for heavy smokers (95% CI $137,200 to $174,500) (Pollack, 2001 [+]).

Applicability
All the studies were carried out in the US, which limits their applicability of the cost effectiveness analysis to the UK.

Evidence statement 5: Cost-effectiveness of interventions for smoking cessation in low-income pregnant women
ES5.0 Inconsistent evidence from four cost-effectiveness or cost-benefit analyses in the US is unclear as to whether smoking cessation counselling and educational materials increase quit rates in low-income pregnant smokers. One study found the incremental cost per quitter with the intervention at the end of pregnancy was $298.76, but that there was no significant difference in abstinence rates 6 months after delivery (Dornelas et al., 2006 [+]). A second study found higher quit rates and higher relapse rates in women given counselling and information compared with controls, but estimated that the cost benefit ratio estimates would range between $1:$11.95 and $1:$30.55 (Windsor et al., 1993 [++]). A third study found no difference in quit rates among women given motivational interviews and information about smoking cessation and a control group, although relapse rates were lower in the intervention group. The cost per relapse prevented was $1,217, with the cost per life-year saved estimated to be $851, and the cost per QALY for recent quitters who fail to relapse of $628 (Ruger et al., 2008 [+]).One high quality cost-effectiveness analysis of a motivational interview via telephone plus educational material intervention for pregnant women in the US, however suggested that the cost-effectiveness ratio per quitter may be higher with the intervention than in the control group: $140/5 ($28 per quit) for the control group; $732/12 ($61 per quit) with 1 call; $736/8 ($92 per quit) with 2 calls and $3192/38 ($84 per quit) with 3 calls (Parker et al., 2007 [++]). *Applicability* All four studies were carried out in the US and in low-income women whose access to healthcare differs substantially from the UK setting, limiting the applicability of these studies to the UK.

Evidence statement 6: Cost-effectiveness of smoking cessation interventions for patients attending mental health services
ES6.0 Moderate evidence from one high quality cost-effectiveness analysis found that psychological counselling plus nicotine replacement therapy offered to out-patients with depression had an incremental cost-effectiveness ratio of $6,204 per successful quit. Combining the costs of the intervention and the additional service costs meant the ICER was $11,496 per successful quit. (Barnett et al., 2008 [++]). *Applicability* The study was carried out in the US so may be less applicable to the UK context.

Evidence statement 7: Cost-effectiveness of interventions for smoking cessation for patients admitted to acute secondary care services
ES7.0 Moderate evidence from one high quality cost-benefit analysis suggests that pre-operative smoking cessation interviews plus nicotine replacement therapy in people scheduled for elective hip or knee replacement surgery in France would have a positive net monetary benefit of €117 for patients receiving the intervention compared with controls. The cost reduction was largely driven by a reduction in the number of postoperative days of intensive care required in smokers who quit before surgery compared with those who continued to smoke (Hejblum et al., 2009 [++]). *Applicability* The study was carried out in France which limits the applicability of the cost effectiveness analysis to the UK, but the patient group and management approaches are applicable to UK clinical practice.

No relevant studies were identified that addressed the cost-effectiveness of interventions to increase the identification and referral of smokers to smoking cessation services by staff working in acute, maternity or mental health services.

No relevant studies were identified that addressed interventions to increase recording of smoking status of patients attending acute, maternity or mental health services.

No relevant studies were identified that evaluated interventions to increase adherence to smokefree workplace policy, legislation or regulations in acute, maternity or mental health settings.

1.4 Discussion

We identified 15 studies that addressed the first research question on smoking cessation interventions in acute, maternity or mental health secondary care settings. Most used a combined multiple session advice/counselling intervention with educational materials and/or nicotine replacement therapy.

We found consistent evidence that interventions targeted at patients admitted to hospital were cost-effective at reducing smoking and adverse outcomes associated with smoking.

There is a suggestion based on inconsistent evidence that interventions in low income pregnant women may be less cost-effective than in more affluent women, and that interventions might be more cost-effective if they are targeted at patients who are

better able to link the reason for their need for hospital care to their smoking habit, such as those admitted for cardiovascular disease.

We identified one study that suggested that a smoking cessation intervention before elective orthopaedic surgery might be cost-saving because of a reduced need for intensive care support in quitters.

The studies suggest that these sort of interventions are likely to be cost-effective if applied to the UK acute secondary care patient population. However, we found no studies assessing the economic impact of interventions aimed at the family or visitors of these patients, or of staff working in these settings. We cannot be sure which, if any, smoking cessation intervention might be cost-effective for these populations.

1.4.1 Evidence gaps

Table 1 highlights the gaps in the evidence.

Table 1: Summary of evidence

	Smoking cessation	Temporary abstinence	Identification and referral	Recording smoking status	Smokefree workplace
Acute: all					
Acute: cardiovascular disease					
Acute: lung cancer					
Acute: elective orthopaedic surgery					
Maternity: all					
Maternity: low income					
Mental health					

Trellis = statistically significant difference in favour of the intervention group; Horizontal lines = inconsistent evidence, both differences and no differences; White = gaps in the evidence.

We found no study that was set out just to promote temporary abstinence in patients due to be admitted to hospital, or for the duration of an acute admission. It is, therefore, difficult to come to any conclusions about which interventions might be cost-effective in this context.

We also found no studies relevant to the final three research questions:

- The cost-effectiveness of interventions to increase the identification and referral of smokers to smoking cessation services by staff working in acute, maternity or mental health services.
- The cost-effectiveness of interventions to increase recording of smoking status of patients attending acute, maternity or mental health services.
- The cost-effectiveness of interventions to increase adherence to smokefree workplace policy, legislation or regulations in acute, maternity or mental health settings.

1.4.2 Conclusions

Fairly consistent evidence supports the promotion of counselling or advice-based interventions to help smokers quit in acute secondary care and antenatal settings. The interventions tested involved follow-up contact after hospital discharge and may involve also giving the patient educational material about smoking cessation, behavioural support and nicotine replacement therapy. Overall, the costs of the intervention were low and the benefits significant, so the interventions were usually cost-effective in terms of QALY or life-year gained.

2.0 Aims and background

2.1 Objectives

The National Institute for Health and Clinical Excellence (NICE) has been asked by the Department of Health (DH) to develop two pieces of complementary guidance 1) 'Smoking cessation in secondary care: mental health services' and 2) 'Smoking cessation in secondary care: acute and maternity services'.

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These guidance documents will address smokefree policies and smoking cessation, focusing on all patients and service users, (including family, carers, visitors and staff) in hospitals and other acute or maternity care settings, mental health care settings, outpatient clinics, community outreach and rural units, as well as intensive services in psychiatric units and secure hospitals.

Eight literature reviews have been commissioned to support this guidance in addition to economic modelling:

- Review of the effects of nicotine in secondary care.
- Effectiveness review on smoking cessation strategies in acute and maternity care services.
- Barriers and facilitators review on smoking cessation strategies in acute and maternity care services.
- Effectiveness review on smoking cessation strategies in mental health services.
- Barriers and facilitators review on smoking cessation strategies in mental health services.
- Effectiveness review on smokefree secondary care settings.
- Barriers and facilitators review on smokefree secondary care settings.
- Cost-effectiveness review on acute, maternity, mental health and smokefree secondary care settings.

This document reports the review of cost-effectiveness studies which forms part of the economic analysis for this project. For the economic analysis, we have produced economic models to evaluate the cost-effectiveness of the approaches to reduce smoking in secondary care settings.

2.2 Research questions

The primary research questions for this review were:

- **Question 1:** How cost-effective are ***smoking cessation interventions*** in helping people who are receiving emergency care, planned specialist medical care or surgery, and maternity or mental health services provided in hospitals,

maternity units, outpatient clinics and the community, their family members and visitors, and staff, volunteers or contractors caring for them?

- **Question 2**: How cost-effective are ***interventions for temporary abstinence*** in helping people who are receiving emergency care, planned specialist medical care or surgery, and maternity or mental health services provided in hospitals, maternity units, outpatient clinics and the community, their family members and visitors, and staff, volunteers or contractors caring for them?

- **Question 3:** How cost-effective are current approaches used by secondary care staff for ***identifying and referring patients*** admitted to acute, maternity or mental health secondary care services, or their family members and visitors, to stop smoking services?

- **Question 4:** What approaches are cost-effective to encourage health professionals to ***record smoking status*** for patients admitted to acute, maternity or mental health services and refer smokers to stop smoking services?

- **Question 5:** How cost-effective are strategies and interventions for ensuring ***compliance with smokefree legislation*** and local smokefree policies in secondary care settings?

Subsidiary questions were:

- How does the cost-effectiveness vary for different population groups or speciality care services?
- Are certain interventions more cost-effective when used in combination?
- What impact do the following have on cost-effectiveness and acceptability of different interventions: deliverer, setting, timing (or point in the care pathway), frequency, duration, severity of dependence?

3.0 Methods

The review was conducted in accordance with the methodology laid out in the second edition of *Methods for the development of NICE public health guidance* (NICE, 2009).

3.1 Searching

The following databases were searched for this review from 1990 to 2012:

- ECONLIT
- HEED
- NHS EED

The full search strategy and the results of the searches can be found in Appendix A. The search was adapted from that devised by EPPI for the teams carrying out the effectiveness reviews for this guidance.

The NICE website was also searched manually for relevant literature.

To supplement the database and website searches, the review also identified additional potentially relevant records using the following methods:

- scanning of citation lists of included studies obtained through database searching;
- scanning lists of included studies from all systematic reviews which met the inclusion criteria at the full text screening stage; and
- screening of studies identified by the teams carrying out searches for the effectiveness reviews.

The results of a call for evidence from all stakeholders, organised by NICE, were not available by the time this review was completed.

3.2 Screening

All records identified by the searches were uploaded into a database and duplicate records were removed. Inclusion criteria were developed (see below) to identify relevant studies for the three reviews. Initially, the records were screened on title and abstract. Where no abstract was available, a web search was first undertaken to locate one; if no abstract could be found, records were screened on title alone. A round of pilot screening was conducted on a random sample of ten abstracts to test and refine the inclusion criteria. Once the inclusion criteria were agreed upon, records were screened by four reviewers independently using the abstract inclusion checklist in Appendix B. Because of the small number of identified abstracts, double screening was conducted on 100% of the records, and any disagreement was resolved by discussion.

The inclusion criteria were as follows:

Study design

We included the following study types:

- cost-benefit analyses;
- cost-effectiveness studies; and
- cost-utility analyses.

Systematic reviews that included any of the study types listed above were identified; these were used as a source of further primary studies rather than included in the review in their own right.

We also identified other studies that reported useful cost and resource data. These costing studies were excluded from the cost-effectiveness review but were recorded separately and used to inform the development of the economic models.

Population

We included studies including any smoker, family members or visitors of patients, and staff caring for patients in secondary care acute, maternity or mental health settings.

We reported the findings with a particular focus on those who were at higher risk of smoking, or of suffering smoking-related diseases such as heart disease, chronic obstructive pulmonary disease, or cancer, or who were at risk of experiencing health inequalities. This included, but was not limited to, the following groups:

- pregnant women;
- people with mental illness;
- people with diabetes or other cardiovascular risk factors;
- drug users (especially cannabis smokers);
- people in lower socio-economic groups;
- immigrants from countries of high smoking prevalence, including refugees and asylum seekers;
- people with occupational exposure to asbestos; and
- homeless people.

Intervention

We included economic analyses of specific interventions (approaches, products or therapies) that aim to support people wishing to stop smoking before or during their acute admission, family and visitors of these people and staff and volunteers who help to care for them. These interventions included behavioural interventions, self-help approaches and pharmaceutical and nicotine replacement products. We also included economic studies exploring the impact of smokefree strategies, strategies that encourage compliance with smokefree policies, and approaches for identifying and referring people to stop smoking services implemented at an individual hospital/other secondary care setting or within secondary care healthcare organisations.

Individual studies were only included if they had a specific focus on the economic impact of smoking cessation interventions in acute, maternity and mental health secondary care settings.

Comparators

We selected studies that compare the intervention with no intervention, or with usual practice, or which compares two or more intervention types.

Settings

We included economic studies that were carried out entirely within secondary care acute, maternity or mental health settings, studies that were initiated in such settings but then continued in the community, and studies that were initiated in primary care but continued in acute, maternity and mental health secondary care settings. We only included studies where the focus was on interventions that were carried out in secondary care, or where the intervention was predominantly carried out in secondary care settings.

Outcomes

Relevant outcomes from the included studies included:

- successful quit attempts for patients, visitors and staff for interventions carried out in acute secondary care settings, measured as temporary (during the admission), and at 1, 6 and 12 months or longer after the quit attempt;
- number of referrals to and contacts with stop smoking services, and the costs of such referrals;
- number of violations of a smokefree policy, number of smokers who continue to violate such a policy, or number of cigarettes smoked on the premises of an acute healthcare organisation with a smokefree policy;
- use or uptake of NRTs and other smoking cessation interventions;
- costs of smoking cessation interventions and comparators;
- cost savings from health improvements by prevention of disease or complications of treatment for the patients, their babies, and their family and household members;
- health resource use in terms of consultations, days in hospital, costs of healthcare staff and services;
- health-related quality of life impacts;
- number of cigarettes smoked per day;
- relapse rates; and
- adverse clinical outcomes including incidence or prevalence of smoking-related diseases such as acute exacerbations of asthma, chronic obstructive pulmonary disease, acute myocardial infarctions, sudden cardiac death, lung cancer, or prevention of these events.

Country of study

Studies conducted in any OECD country or countries were included[1], although priority was given to studies from the UK or settings that are thought to be similar to the UK NHS.

[1] Members of the OECD in December 2011 were as follows: Australia; Austria; Belgium; Canada; Chile; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Israel; Italy; Japan;

In conducting the review, we assessed the applicability of non-UK studies to the UK context, and addressed any potential barriers to applicability.

Date of publication

Studies published in 1990 or later were included.

Language of study

Only studies published in the English language were included.

The full screening checklist is presented in Appendix B.

3.3 Quality assessment

All included studies were quality assessed using the tools in Appendix F (effectiveness studies) and Appendix I (cost-effectiveness) of the *Methods for the development of NICE public health guidance* (NICE, 2009). On the basis of the answers to the questions within these tools, and in line with the NICE guidance manual, each study was given an overall quality rating: [++] for high quality; [+] for medium quality; or [-] for low quality. One reviewer assessed all studies for quality, and a second reviewer independently duplicated the process for a 10% random sample. Any disagreements were small and quickly resolved by discussion. The results of the quality assessment are presented in section 4.3 below; two examples of completed quality assessment forms are presented in Appendix E.

3.4 Data extraction

Data were extracted from included studies using cost-effectiveness evidence tables (see Appendix K in NICE (2009)). Data extraction was completed independently by two reviewers for a randomly selected sample of 10% of included studies. For the other studies, data was extracted by one reviewer and checked by another; any disagreements were minor and were quickly resolved by discussion. When necessary, a third reviewer was consulted to achieve consensus. Data for each included study were extracted and are presented in the evidence tables (Appendix C).

3.5 Data synthesis and presentation

The studies of cost-effectiveness did not support meta-analysis and were reported narratively. Information on the study characteristics were first summarised and then the

Luxembourg; Mexico; the Netherlands; New Zealand; Norway; Poland; Portugal; South Korea; Slovak Republic; Slovenia; Spain; Sweden; Switzerland; Turkey; the UK; and the USA.

results were discussed taking into account the risk of bias for each individual study as determined by the results of the quality assessment (Section 4.3).

The results of the studies were synthesised into evidence statements. In addition to assessing the quality of the individual studies, the overall strength of the evidence statements took into account the quality, quantity, and consistency of the evidence. The evidence statements reflect the strength of the conclusions made by the studies, the quality of the studies (as determined in the quality assessment), and any inconsistencies in the findings across studies. The format for the summaries is that described in NICE (2009):

- **no evidence** – no evidence or clear conclusions from any studies;
- **weak evidence** – no clear or strong evidence/conclusions from high quality studies and only tentative evidence/conclusions from moderate quality studies or clear evidence/conclusions from low quality studies;
- **moderate evidence** – tentative evidence/conclusions from multiple high quality studies, or clear evidence/conclusions from one high quality study or multiple medium quality studies, with minimal inconsistencies across all studies;
- **strong evidence** – clear conclusions from multiple high quality studies that are not contradicted by other high quality or moderate quality studies; and
- **inconsistent evidence** – mixed or contradictory evidence/conclusions across studies.

4.0 Summary of included studies

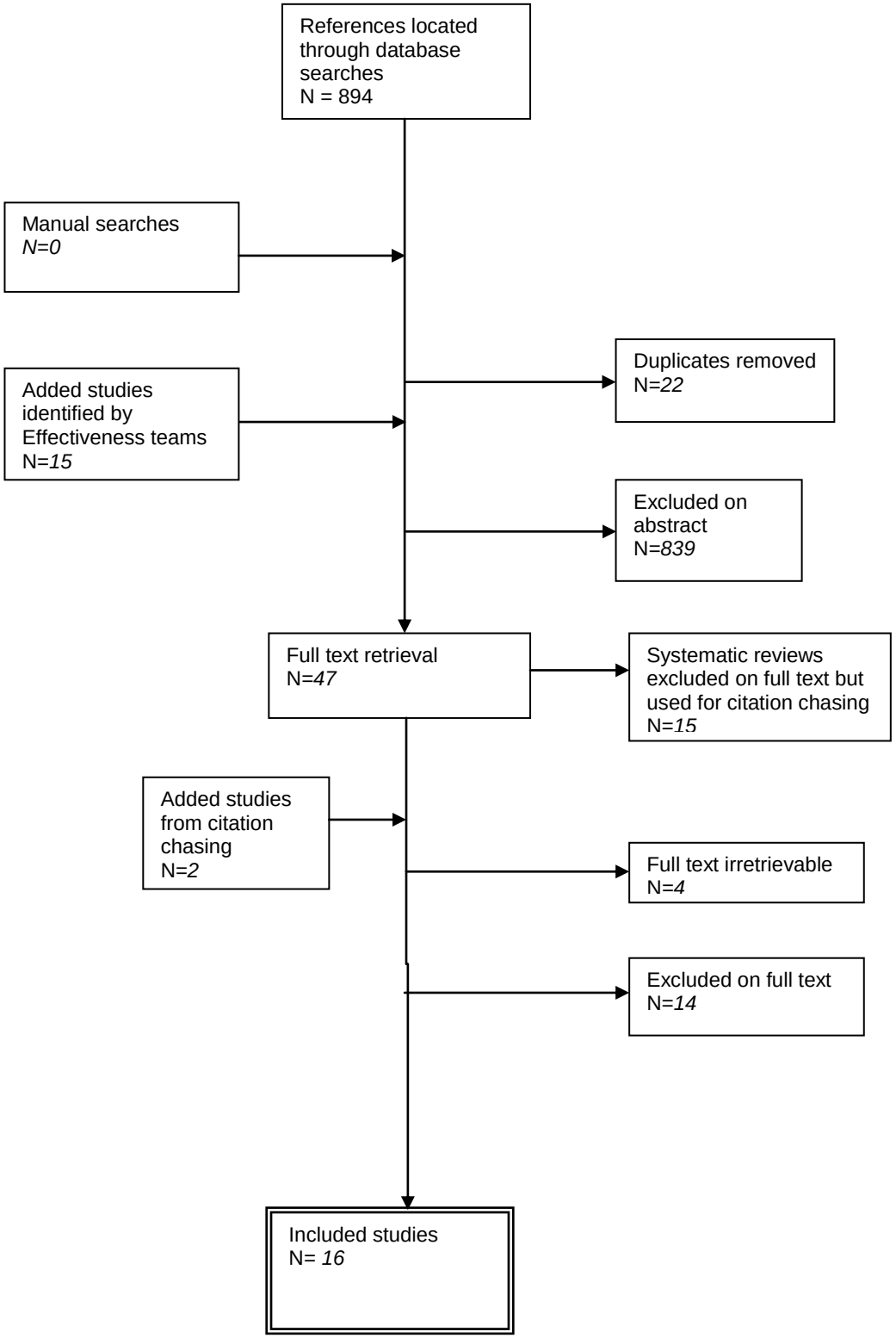
4.1 Flow of literature through the review

Database searches were conducted to locate references relevant for the review, and 894 records were found. No further records were located through manual searching of citations. Of the 894, 22 were duplicate records and were removed. The remaining 872 abstracts were screened for inclusion in the review. In addition, a further 15 studies identified by the other effectiveness team were also assessed using the agreed inclusion criteria(Appendix B), giving a total of 887 studies.

A total of 840 references were excluded, as they were considered irrelevant according to the inclusion criteria, following screening of titles and abstracts. Full texts of the remaining 47 references were ordered, after which full texts for four references were found to be irretrievable. 30 references were considered irrelevant based on the criteria.. The remaining 14 studies were included in the review.

Backward and forward citation chasing from the included studies yielded two additional references, for a total of 16 included references. The flow of literature through the review is illustrated in Figure 1, and Section 7 lists the citation details of all included studies.

Figure 1. Flow of literature



4.2 Summary of the included studies

The 16 included references report on 16 unique studies conducted in the following countries:

- UK: 1 study
- USA: 11 studies
- Denmark: 1 study
- France: 1 study
- Norway: 1 study
- Sweden: 1 study.

Study population characteristics consisted of the following:

- Acute and general secondary care: 9 studies:
  - Any in-patient: 3 studies
  - Cardiovascular disease: 4 studies
  - Lung cancer pre-operative: 1 study
  - Orthopaedic surgery pre-operative: 1 study
- Maternity: 6 studies
- Mental health outpatients: 1 study.

The types of studies were as follows:

- Cost-effectiveness analysis: 11 studies
- Cost-benefit analysis: 2 studies
- Cost-utility analysis: 1 study
- Cost-effectiveness and cost-benefit analysis: 1 study
- Cost-effectiveness and cost-utility analysis: 1 study.

A summary of the number of studies identified by population is given in Table 2.

Table 2. Summary of studies included for each research question

	Acute in-patients/ out-patients	Maternity	Mental health	Family or visitors	Staff
Q1. Smoking cessation interventions	**9**	**6**	**1**	0	0
Q2. Temporary abstinence interventions	0	0	0	0	0
Q3. Identification and referral interventions	0	0	0	0	0
Q4. Recording smoking status interventions	0	0	0	0	0
Q5. Smokefree workplace interventions	0	0	0	0	0

A summary of the included studies is provided in Tables 3 and 4. Full study details are presented in the evidence tables (Appendix C).

Table 3. Summary of included studies

	Aim	Study design	Setting	Population	Location	Quality score
Barnett et al. (2008)	To evaluate the cost-effectiveness of a smoking cessation programme directed at individuals receiving out-patient treatment for depression.	Cost-effectiveness	Mental health	Outpatients with depression	US	++
Domelas et al. (2006)	To evaluate whether one 90-minute counselling session in a prenatal clinic, with planned telephone follow-up, is efficacious and cost-effective for smoking cessation in an ethnically diverse sample of low-income women.	Cost-effectiveness	Maternity (antenatal)	Low income pregnant women	US	+
Hejblum et al. (2009)	To estimate the cost of preoperative intervention for smoking cessation (PISC) and its impact on hospitalisation costs for a given healthcare institution investing in it.	Cost-benefit	Acute (elective surgery)	People due for orthopaedic surgery	France	++
Krumholz et al. (1993)	To determine the cost-effectiveness of a reported smoking cessation programme for smokers hospitalised with an acute myocardial infarction and to compare it with that of other medical therapies.	Cost-effectiveness	Acute (cardiology)	People admitted with acute myocardial infarction	US	++
Ladapo et al. (2011)	To perform an up-to-date economic appraisal of smoking cessation counselling with follow-up supportive contact in patients with acute myocardial infarction (AMI).	Cost-utility	Acute (cardiology)	People admitted with acute myocardial infarction	US	++
Mani et al. (2011)	To evaluate the cost and effect of smoking cessation therapy among patients with screening-detected small abdominal aortic aneurysm (AAA).	Cost-effectiveness/ cost-utility	Acute (cardiovascular)	People with small abdominal aortic aneurysm	Sweden	+
Marks et al. (1990)	To estimate the cost-effectiveness of a smoking cessation program for pregnant women to reduce low birth weight and perinatal mortality.	Cost-effectiveness/ cost-benefit	Maternity	Pregnant women	US	++
Meenan et al.	To examine the cost-effectiveness of a smoking	Cost-	Acute (all)	In-patients	US	+

	Aim	Study design	Setting	Population	Location	Quality score
(1998)	cessation programme for a general population of hospitalised adults.	effectiveness				
Olsen et al. (2006)	To assess the relative cost-effectiveness of smoking cessation interventions implemented in Denmark between 1995 and 2001.	Cost-effectiveness	Acute (all)	In-patients	Denmark	+
Parker et al. (2007)	To evaluate the feasibility, cost, and cost-effectiveness of a proactive, telephone based motivational smoking cessation intervention for a large, underserved, urban population of pregnant women.	Cost-effectiveness	Maternity	Pregnant women	US	++
Pollack 2001	To assess the cost-effectiveness of prototypical smoking cessation programmes.	Cost-effectiveness	Maternity	Pregnant women	US	+
Prathiba et al. (1998)	To ascertain the smoking cessation rate in hospital patients who received a structured programme of advice and support from a counsellor; to compare it with the rate in those who received advice but failed to continue in the programme; and to assess the cost-effectiveness of the programme.	Cost-effectiveness	Acute	In-patients and out-patients referred for smoking cessation	UK (Wales)	+
Quist-Paulsen et al. (2006)	To determine the incremental cost-effectiveness of smoking cessation programmes in patients with low (i.e. stable coronary heart disease) and high cardiovascular risk (i.e. after myocardial infarction).	Cost-effectiveness	Acute (cardiology)	People admitted for coronary artery bypass surgery	Norway	+
Ruger et al. (2008)	To examine the cost-effectiveness of motivational interviewing in low-income pregnant women.	Cost-effectiveness	Maternity	Low income pregnant women	US	+
Slatore et al. (2009)	To evaluate the cost-effectiveness of a smoking cessation intervention initiated preoperatively for patients with non-small cell lung cancer (NSCLC).	Cost-effectiveness	Acute (thoracic surgery)	Patients due for lung cancer surgery	US	+

	Aim	Study design	Setting	Population	Location	Quality score
Windsor et al. (1993)	To evaluate the behavioural impact and cost benefit of a health education program for pregnant smokers in public health maternity clinics.	Cost-effectiveness	Maternity (public antenatal clinics)	Pregnant women	US	++

Table 4. Details of the smoking cessation interventions assessed

Intervention component	Written information	Simple advice	Counselling/ motivational interview	Video/ DVD	Follow-up contact	Pharmacothe-rapy	Objective testing of smoking (cotinine)	Delivered by trained smoking cessation staff?	Effective at reducing smoking?
Barnett (2000)	-	-	Yes	-	Yes	NRT with possibility of bupropion	-	Yes	Yes
Dornelas (2006)	-	-	Yes	-	Yes	-	CO testing	Yes	Yes
Hejblum (2009)	-	Yes	-	-	Yes	NRT	CO testing	Yes	Yes
Krumholz (1993)	Yes	Yes	-	-	Yes	-	-	Yes	Yes
Ladapo (2011)	Yes	-	Yes	-	Yes	-	-	Yes	Yes
Mani (2011)	Yes	-	Yes	-	Yes	NRT	-	Yes	Yes
Marks (1990)	Yes	-	Yes	-	Yes	-	-	Yes	Yes
Meenan (1998)	Yes	-	Yes	Yes	Yes	-	-	Yes	Yes
Olsen (2006)	-	-	Yes	-	Yes	-	-	Yes	Yes
Parker (2007)	Yes	-	Yes	Yes	Yes	-	**Cotinine testing**	Yes	Yes
Pollack (2001)	Yes	-	Yes	-	Yes	-	-	Yes	Yes
Prathiba (1998)	-	-	Yes	-	Yes	-	**Cotinine testing**	Yes	Yes
Quist-Paulsen	Yes	Yes	-	-	Yes	-	-	No	Yes

Intervention component	Written information	Simple advice	Counselling/ motivational interview	Video/ DVD	Follow-up contact	Pharmacothe-rapy	Objective testing of smoking (cotinine)	Delivered by trained smoking cessation staff?	Effective at reducing smoking?
(2006)									
Ruger (2008)	Yes	-	Yes	-	Yes	-	**Cotinine testing**	Yes	No
Slatore (2009)	-	-	Yes	-	-	NRT		Yes	Yes
Windsor (1993)	Yes	-	Yes	-	Yes	-	-	Yes	Yes

4.3 Quality of the included studies

The results of the quality assessment are presented in Tables 5 and 6. Eight studies were judged to be of high quality [++], eight of medium quality [+], and none of low quality [-], as follows:

Table 5. Summary of the quality of the included studies

Setting/ population	High quality [++]	Medium quality [+]	Low quality [-]
Acute	Hejblum et al. (2009) ; Krumholz et al. (1993) ; Lapado et al. (2011)	Mani et al. (2011) ; Meenan et al. (1998) ; Olsen et al. (2006) ; Prathiba et al. (1998) ; Quist-Paulsen et al. (2006) ; Slatore et al. (2009)	-
Maternity	Marks et al. (1990) Parker et al. (2007); Windsor et al. (1993)	Domelas et al. (2006); Pollack et al. (2001); Ruger et al. (2008)	-
Mental health	Barnett et al. (2008)	-	-

Table 6. Quality of the included studies

First author	Applicability (relevance to the specific topic)									Study limitations (level of methodological quality)											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Barnett (2000)	Y	Y	PA	Y	Y	NA	N	PA	PA	NA	Y	Y	NA	NA	Y	NA	PA	Y	Y	UC	Minor limitations [++]
Domelas (2006)	Y	Y	PA	N	Y	N	N	PA	PA	NA	Y	Y	Y	NA	Y	Y	Y	Y	N	UC	Potentially serious limitations [+]
Hejblum (2009)	Y	Y	PA	Y	Y	NA	NA	Y	PA	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	N	Minor limitations [++]
Krumholz (1993)	Y	Y	PA	N	Y	UC	N	PA	PA	Y	Y	Y	PA	PA	Y	UC	UC	Y	Y	UC	Minor limitations [++]
Ladapo (2011)	Y	Y	PA	Y	Y	PA	Y	Y	PA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Minor limitations [++]
Mani (2011)	Y	Y	PA	Y	Y	UC	Y	PA	PA	Y	Y	PA	PA	PA	PA	PA	PA	Y	Y	UC	Potentially serious limitations [+]
Marks (1009)	Y	Y	PA	N	Y	Y	Y	N	PA	PA	Y	UC	Y	Y	Y	Y	Y	NA	PA	N	Minor limitations [++]
Meenan (1998)	Y	Y	PA	Y	Y	PA	N	PA	PA	UC	UC	Y	PA	PA	Y	PA	PA	Y	N	UC	Potentially serious limitations [+]
Olsen(2006)	Y	Y	PA	PA	Y	UC	N	PA	PA	Y	UC	Y	PA	PA	Y	Y	PA	Y	NA	UC	Potentially serious limitations [+]
Parker (2007)	Y	Y	PA	Y	PA	NA	N	PA	PA	NA	Y	Y	Y	Y	PA	Y	Y	Y	PA	UC	Minor limitations [++]
Pollack (2001)	Y	Y	PA	N	UC	NA	N	PA	PA	Y	UC	PA	PA	PA	UC	PA	PA	N	N	UC	Potentially serious limitations [+]
Prathiba (1998)	Y	Y	Y	N	PA	N	N	UC	PA	UC	UC	Y	PA	Y	PA	PA	PA	PA	Y	N	Potentially serious limitations [+]
Quist-Paulsen (2006)	Y	Y	PA	N	N	PA	N	PA	PA	Y	Y	Y	PA	N	Y	UC	UC	Y	Y	UC	Potentially serious limitations [+]
Ruger (2008)	Y	Y	PA	Y	Y	UC	N	Y	PA	NA	UC	Y	PA	PA	Y	PA	Y	Y	Y	UC	Potentially serious limitations [+]
Slatore (2009)	Y	Y	PA	Y	Y	PA	Y	Y	PA	Y	Y	Y	PA	PA	PA	PA	Y	Y	Y	N	Potentially serious limitations [+]
Windsor (1993)	Y	Y	PA	Y	Y	NA	NA	Y	PA	NA	PA	Y	Y	Y	Y	Y	Y	NA	PA	UC	Minor limitations [++]

Y= Y; N=no; PA=partially; UC= unclear ; DA Directly Applicable; NA Not applicable

Key to questions:

1. Is the study population appropriate for the topic being evaluated?
2. Are the interventions appropriate for the topic being evaluated?
3. Is the system in which the study was conducted sufficiently similar to the UK context?
4. Were the perspectives clearly stated?
5. Are all direct health effects on individuals included, and are all other effects included where they are material?
6. Are all future costs and outcomes discounted appropriately?
7. Is the value of health effects expressed in terms of quality adjusted life years (QALYs)?
8. Are costs and outcomes from other sectors fully and appropriately measured and valued?
9. Overall judgement (no need to continue if NA).
10. Does the model structure adequately reflect the nature of the topic under evaluation?
11. Is the time horizon sufficiently long to reflect all important differences in costs and outcomes?
12. Are all important and relevant outcomes included?
13. Are the estimates of baseline outcomes from the best available source?
14. Are the estimates of relative "treatment" effects from the best available source?
15. Are all important and relevant costs included?
16. Are the estimates of resource use from the best available source?
17. Are the unit costs of resources from the best available source?
18. Is an appropriate incremental analysis presented or can it be calculated from the data?
19. Are all important parameters whose values are uncertain subjected to appropriate sensitivity analysis?
20. Is there any potential conflict of interest?
21. Overall assessment.

4.4 Applicability

Only one study (Prathiba et al., 1998 [+]) was carried out in the UK, and that was based on data that is now 20 years old, which means that its applicability to current UK costs and services is limited. Its assessment of a smoking cessation counselling programme for in- and out-patients in Wales found that the cost per additional smoker who quit was £851, and the cost per life-year saved by the intervention compared with physician advice alone ranged from £340 to £426.

The other studies included in the review were from the US or Northern Europe, and therefore have some applicability to the UK population and healthcare service. There are, however, significant cost differences between the European and US studies. This is possibly due to significant differences in healthcare costs between the US and Europe.

The interventions assessed were all similar and applicable to those currently or potentially available in the UK. Most involved general advice or more specialist counselling or motivational interviews, with almost all studies including several follow-up contacts in addition to an initial session. Several studies also gave patients educational materials and some offered nicotine replacement therapy. In most cases the intervention was delivered by a specialist nurse or counsellor.

The cost of providing the interventions ranged from £248.54 per quit, to £389.52 in 2011£ (Appendix F), and all but one study found that the intervention was significantly more effective and cost-effective than the control group at reducing smoking and improving associated outcomes.

5.0 Study findings

Full study characteristics can be found in Appendix C. All the studies identified involved interventions that were based on advice or more specialised counselling with follow-up, with or without educational materials or nicotine replacement therapy. The findings are therefore reported here according to setting and patient subgroup rather than by type of intervention.

5.1 Interventions for smoking cessation in acute hospital settings

Any in-patient or out-patient group

We identified three studies that evaluated the cost-effectiveness of smoking cessation interventions delivered to a general group of smokers who were in-patients or out-patients attending acute secondary healthcare services. One of these studies was carried out in the UK (Prathiba et al., 1998 [+]), and they were all of medium quality and applicability.

All three studies concluded that the interventions they evaluated were cost-effective.

Study id	Study design	Country	Population
Prathiba (1998) [+]	CEA	UK	All in-patients and out-patients
Meenan (1998) [+]	CEA	US	All hospital patients
Olsen (2006) [+]	CEA	Denmark	All hospital patients

Prathiba et al. (1998) [+] carried out a cost-effectiveness analysis of a smoking cessation counselling intervention for in-patients and out-patients in a hospital in Cardiff, Wales, based on data from an RCT. Participants were referred to a smoking cessation counsellor after being advised to stop smoking by their hospital doctor. The smoking cessation counsellor saw the patient, gave advice and written information about smoking cessation and invited the patient to join the programme. The programme involved an initial counselling session that lasted 45-60 minutes, with a weekly re-attendance for the first month, and subsequently at three, six and twelve months. The smoker's history was taken at first session and the counsellor explained the importance of stopping smoking in relation to individual patient's diagnosis. The risks of developing other smoking related diseases were also discussed. Baseline expired carbon monoxide tests were done at the out-patient clinic. Patients were encouraged to attempt to stop smoking with counselling only initially; if they were still smoking at 2 weeks, then nicotine replacement therapy was commenced. Four follow-up sessions lasting 15-20 minutes each were used to provide support, advice and encouragement. At the fifth appointment (one month after commencement of the

intervention), claims of smoking cessation were verified by measuring expired carbon monoxide. This was repeated at 3 months after commencement of the intervention and if necessary at 6 and 12 months. Patients were advised to contact their counsellor if they relapsed between the appointments.

Of 1,155 patients referred to the counsellor between January 1992 and June 1994, 114 (13%) failed to keep their initial appointment, 348 (30%) had advice and literature but declined the programme and 663 (57%) entered the programme. The self-reported quit rate after 1 year in patients who received just advice and literature was 5%. For programme participants, 140 of 663 participants (21%) were confirmed non-smokers after 1 year, and men were significantly more likely to quit than women (29% of men and 13% of women, $p<0.001$). Patients with cardiac diseases were more likely to stop smoking (31%) compared with those with respiratory disease (25%) or others (11%; $p<0.05$). Elderly patients aged 60 years and over were more likely to quit (32%) than younger patients (17%; $p<0.01$).

The model assumed a quit rate for a control, physician advice only, group of 7.5%. For the 1,155 study participants, this meant that the programme led to an additional 54 quitters than physician advice alone. The cost of the service overall for 30 months was £45,938, and the cost per additional success was £851. Using data from published research on the number of life-years saved from smoking cessation, the authors calculated that the programme cost was the equivalent of £340 to £426 per life-year saved.

Sensitivity analysis showed that, if the cost of the programme doubled to account for patient costs, the cost per successful quit would be £1,702 and the cost per life-year gained would be £681 to £851. If the total cost of the programme was doubled to include patients' costs and the proportion of patients who are assumed to stop smoking as a result of physician's advice alone increased to 10%, then the cost per success would be £3,540, and the cost per life year saved would range between £1,416 and £1,770.

This UK study was of direct relevance to the UK context, although the data was collected in 1992-1994, which may limit how applicable the results are to current UK practice and costs. The type of model used and the economic perspective were not clearly stated, and the study did not discount costs and benefits, which may all have added limitations to the study.

Meenan et al (1998) [+] performed a cost-effectiveness analysis of a smoking cessation programme for smokers cared for in hospital in the US compared with no intervention. Patients with a stay of less than 36 hours, hospice patients, postpartum patients and those admitted for substance abuse were excluded. Effectiveness data

were taken from a clinical trial of a 20-minute bedside counselling session with an experienced counsellor, a 12-minute video, self-help materials and one or two follow-up calls. By the end of the 12 month study period, 9.2% of the control group and 13.5% of the intervention group were considered abstinent (incremental quit rate 4.3%, p=0.023) based on an intent-to-treat analysis and regardless of patients' interest in quitting. The two Kaiser Permanente hospitals included in the study identified 453 smokers who were included in the analysis. The incremental cost of the intervention was $158.99 based on 1994 US$, and the incremental cost per incremental quitting patient was $3,697. The incremental cost per life-year saved was estimated to be $3,680 at a discount rate of 5%. At quit rates of 8% to 0.6%; ICER per life-year saved ranged from $1,978 to $26,374 at a 5% discount rate. At discount rates of 2% to 8%, the ICER per life-year saved ranged from $1,691 to $7,444 for a quit rate of 4.3%. The cost per discounted life-year saved based on 1994 US$ of $1,691 to $7,444 for the smoking cessation intervention compared well with costs of nicotine gum therapy ($5,885 to $13,555).

The study did not carry out any sensitivity analysis for different subgroups of patients so it is unclear whether there are specific groups who might benefit more than others from the intervention. The model assumed that the intervention would be delivered by readily-available and experienced health counsellors who would need minimal training, so the results may not apply to patients in hospitals without this resource.

Olsen et al (2006) [+] carried out a cost-effectiveness analysis of smoking cessation programmes for smokers in Denmark in a number of settings including hospitals, compared with no intervention. The study modelled the effects on 10,000 participants based on 8,181 who took part in a number of real-life smoking cessation programmes implemented from 1995 to 2001. Participants were aged 48.6 years on average, 37% were male, and 38% received the intervention in a hospital setting. Overall, 21% had 5 to 6 individual sessions with an instructor each lasting 2.5 hours, 76% participated in a group course of 7 to 10 people per group, 5 sessions lasting 2 hours each, and 3% were given a quick course in groups of 1 to 6 people, with 1 to 2 sessions lasting a total of 2.5 hours.

Data were taken from the Danish National Smoking Cessation Database. The study found that interventions carried out at hospitals were more effective than interventions carried out at pharmacies, but more hospital patients were lost to follow-up which may have led to an overestimate of smoking cessation rates in this group. The mean cost increase of the intervention was €426 per person, with a mean 0.41 life-year gained. The mean ICER with the intervention was therefore €1,058 (95% confidence interval €1,036 to €1,081). The study reports most of the data for the combined population group, so this is not reported further here.

The study is limited by assuming that the no intervention group incurred no costs, which may not reflect real life as smokers may initiate self-quitting attempts. This would have given a more conservative estimate for the ICER. The model did not include an estimate of lifetime health care costs and productivity losses or gains, so did not adjust for the higher costs incurred by former smokers who live longer than active smokers. The time horizon for the model was not reported.

Evidence statement 1: Cost-effectiveness of smoking cessation interventions for general in-patients and out-patients
ES1.0 Moderate evidence from three cost-effectiveness analyses (Prathiba et al., 1998 [+]; Meenan et al., 1998 [+]; Olsen et al., 2006 [+]) found that smoking cessation counselling and follow-up calls significantly increased quit rates in in-patients and out-patients attending a hospital in Wales, or any smoking patient admitted to hospitals in the US or Denmark. The UK study found that the cost per additional smoker who quit was £851, and the cost per life-year saved by the intervention compared with physician advice alone ranged from £340 to £426 (Prathiba et al., 1998 [+]). Sensitivity analysis showed that if the total cost of the programme was doubled to include patients' costs and the proportion of patients who are assumed to stop smoking as a result of physician's advice alone increased to 10%, then the cost per success would be £3,540, and the cost per life year saved would range between £1,416 and £1,770. The US study found the incremental cost per incremental quitting patient was $3,697 and the incremental cost per life-year saved was estimated to be $3,680 at a discount rate of 5% (Meenan et al., 1998 [+]). The Danish study (Olsen et al., 2006 [+]) found that the mean ICER with the intervention was €1,058 (95% confidence interval €1,036 to €1,081). *Applicability* Only one of the three studies was carried out in the UK, and that was based on data from 1992-94, which limits the applicability of the cost effectiveness analysis to current UK practice

Patients with cardiovascular disease

We identified four studies that evaluated the cost-effectiveness or cost-utility of smoking cessation interventions in patients with cardiovascular disease. Two high quality US studies concluded that interventions in patients admitted with acute myocardial infarction were cost-effective, one Swedish study of medium quality found that smoking cessation was cost-effective in patients with screening-identified abdominal aortic aneurysms, and one Norwegian study of medium quality found that a smoking cessation intervention was cost-effective in patients scheduled for coronary artery bypass surgery.

Study id	Study design	Country	Population
Krumholz (1993) [++]	CEA	US	Acute MI
Ladapo (2011) [++]	CUA	US	Acute MI
Mani (2011) [+]	CEA/CUA	Sweden	Abdominal aortic aneurysm
Quist-Paulsen (2006) [+]	CEA	Norway	Coronary artery bypass surgery

Krumholz et al. (1993) [++] determined the cost-effectiveness of a smoking cessation programme for smokers hospitalised with an acute myocardial infarction in the US, based on a clinical trial. The intervention involved a session with a nurse in hospital after the patient was clinically stable, to explain the risks of continued smoking and the benefits of quitting. The patients were given a manual on avoiding and coping with high-risk smoking situations and had follow-up calls after discharge every week for three weeks, then every month for four months. The treatment as usual group had advice from healthcare staff about stopping smoking.

The study estimated that 71% of smokers receiving the intervention would quit compared with 45% of the control group, so an additional 26 per 100 patients would quit as a result of the intervention. The programme was expected to require 3 hours of additional nurse time per patient, at an estimated cost of $100 per patient to include the cost of the manual. The cost per smoker who quit was calculated to be $380, with a discounted 1.7 life-years gained, and incremental cost-effectiveness ratio of $220 for each additional life-year saved.

In all sensitivity analyses carried out, the cost-effectiveness ratio was less than $20,000/year of life saved. These included the number of additional quitters falling from the baseline 26 per 100 to 3 per 1,000 smokers (CER would be $19,610); the discounted life-years gained falling from 1.7 to 0.10 (CER $3,850); the cost of the programme increasing from $100 to $2,000 (CER $4,520); and medical costs incurred during the years gained increasing from zero to $10,000 (CER $10,230).

This study used a conservative estimate of the cost-effectiveness of the intervention that would bias the analysis against the intervention, but was limited as it was based on data from large observational studies as no relevant RCT was identified. However, these uncertainties about outcomes and costs were explored as part of the sensitivity analyses.

Ladapo et al (2011) [++] performed a cost-utility analysis of an evidence-based smoking cessation intervention for 327,600 smokers hospitalised for acute myocardial infarction (AMI) in the US. The study was based on a meta-analyses of smoking cessation interventions for hospitalised patients and on deaths and non-fatal cardiac events in patients with myocardial infarction. The evidence-based intervention consisted of a behavioural counselling session before discharge, the American Heart

Association's *Active Partnership for the Health of Your Heart* workbook and DVD, and follow-up telephone calls at 2 days, 1 week, 3 weeks, 4 weeks, and 3 months after discharge. Patients receiving usual care had a standard smoking cessation consultation and provision of printed materials on smoking cessation such as the American Heart Association's *How Can I Quit Smoking?*
The sample assumed that 10% of patients were female. It was estimated that providing the intervention for the 2010 US cohort of smokers hospitalised with AMI would cost $27.3 million in nurse wages and educational materials, would generate 50,230 new quitters, and prevent 1,380 non-fatal AMIs and 7,860 all-cause deaths. The incremental cost-effectiveness was ratio $5,050 per QALY gained based on 2008 US$ costs, and $4,350 per life year gained.

The results were sensitive to a number of factors. If the incidence of nonfatal AMI increased in smokers from 2.2% to 4.0%, the number of AMIs avoided during the follow-up period of 10 years would increase from 1,380 to 7,580, and the cost-effectiveness ratio would fall from $5,050 to $1,700 per QALY. If the intervention was delivered by medical social workers instead of nurses, the cost per patient fell to $64 and the cost per quitter to $420. If the utility associated with recurrent non-fatal AMI fell from 0.83 to 0.70, there were an additional 1,550 QALYs gained and the cost-effectiveness ratio fell to $4,940 per QALY.

Adding pharmacotherapy to the counselling intervention would increase the number of quitters and reduce the number of AMIs and deaths, but would increase the cost per QALY because of higher costs of ongoing care. The additional number of quitters with nicotine replacement therapy, bupropion and varenicline (following sensitivity analysis) was estimated to be 104,000, 109,000 and 120,000 respectively, and the cost-effectiveness ratios would be $11,400, $11,600 and $13,700 per QALY, respectively.

The study did not allow for the effects of quitting smoking on co-morbidities other than AMI and all-cause mortality, did not use data on long-term smoking cessation rates, did not model dynamic changes in smoking, non-adherence and costs of adverse medication effects and used a 3% discount rate with no ICER thresholds. The study was set in the US and assumed that 90% of patients were male, so may not be generaliseable to the UK population.

Mani et al (2011) [+] modelled a cost-effectiveness and cost-utility analysis of a smoking cessation programme for 65 year old male patients with screening-detected abdominal aortic aneurysm (AAA) in Sweden. The intervention was an 8-week programme used in other clinical trials in a peri-operative setting, and involved weekly face-to-face motivational counselling sessions with a trained counsellor using cognitive behavioural methods for the first month, then weekly telephone calls for the second month, written information about smoking cessation and the telephone number of a hotline providing smoking cessation advice, and adjuvant nicotine replacement therapy

for 8 weeks, at a total cost of €225 per patient. The aim of the intervention was to increase smoking cessation and therefore reduce the need for elective repair or emergency management of a ruptured aneurysm in this population.

The total costs incurred by the intervention group for the 20 years that were modelled were €13,776 vs €13,692 for the control group. It was estimated that 0.124 life-years and 0.09 QALYs were gained from the intervention. The ICER per life-year gained was therefore €674, and €924 per QALY gained. Sensitivity analysis showed that the intervention was cost-effective in all scenarios (cost per life-year gained was less than €11,000 in all scenarios) and was dominant in all scenarios except if the intervention costs increased to more than €3,250, or if there was 1% or less difference in effectiveness of the intervention.

The study did not take into account the likely reduction in postoperative morbidity from the smoking cessation intervention, and did not account for likely reductions in cardiovascular and pulmonary medication and care.

Quist-Paulsen et al. (2006) [+] assessed the cost-effectiveness of a smoking cessation programme for patients admitted to hospital for coronary artery bypass surgery in Norway. The intervention consisted of a booklet that focused on fear arousal messages and positive feedback, and was delivered by cardiac nurses without special training in smoking cessation. The intervention was initiated in hospital and continued after discharge by follow-up calls for at least 5 months.

The model used data from other clinical trials for 12-month abstinence rates, which were 44/118 (37%) for the control group with no intervention and 57/100 (57%) for the smoking cessation intervention; p=0.004. The number needed to treat (NNT) therefore was 5 for the programme to yield one additional quitter (95%CI 3 to 16). Data from other trials were used to determine 20-year mortality rates for smokers and quitters. The costs of the programme were calculated in 2000 Euros, and were 510 NOK (€63) per participant.

For low-risk patients, defined as patients with stable coronary heart disease, the average 10-year mortality rate was 1.7%. The mean discounted life-years gained per patient who quit compared with those who continued to smoke was calculated to be 0.06 at 5 years; 0.97 at 20 years; 0.16 from 20 to 40 years; and 1.13 over a life-time (40 years). The incremental cost-effectiveness ratio of the programme per life-year gained was calculated to be €5,230 at 5 years and €280 over a 40-year lifetime, using a 5% discount rate, and €280 to €230 per life-year gained using a 3.5% discount rate. For high-risk patients, defined as those after a myocardial infarction, the average 10-year mortality rate was 4.5%. The mean discounted life-years gained per patient who quit compared with those who continued to smoke was calculated to be 0.26 at 5 years; 0.95 at 11 years; 1.83 from 11 to 25 years; 2.77 in the life-time (25 years). The

incremental cost-effectiveness ratio of the programme per life-year gained was calculated to be €1,200 at 5 years and €110 over a 25-year lifetime, using a 5% discount rate.
The study was limited by possibly overestimating the costs of the programme by including the time to fill in the questionnaires as part of the research project, which would not be required in a general healthcare context. Conservative data was used in the low-risk model and different timescales were used to calculate lifetimes in the high- and low-risk groups.

Evidence statement 2: Cost-effectiveness of smoking cessation interventions in patients with acute cardiovascular disease

ES2.0 Strong evidence from two cost-effectiveness or cost-utility analyses from the US found that smoking cessation counselling and information significantly reduced smoking rates in patients admitted with acute myocardial infarction, with a cost per smoker who quit calculated to be $380, with a discounted 1.7 life-years gained, and incremental cost-effectiveness ratio of $220/year of life saved (Krumholz et al., 1993 [++]) in one study. The second study found the incremental cost-effectiveness ratio of $5,050 per QALY gained based on 2008 US$ costs, and $4,350 per life year gained (Ladapo et al., 2011 [++]).

ES2.1 Weak evidence from one moderate-quality cost-effectiveness and cost-utility analysis in Sweden suggested that smoking cessation counselling with cognitive behavioural methods for 8 weeks in patients diagnosed with abdominal aortic aneurysms could reduce the risk of needing repair or emergency treatment for rupture, with an ICER per life-year gained of €674, and €924 per QALY gained (Mani et al., 2011 [+])

ES2.2 Weak evidence from one moderate quality cost-effectiveness analysis suggests that smoking cessation advice and information delivered by non-specialist nurses for patients admitted to hospital in Norway for coronary artery bypass surgery would have an incremental cost-effectiveness ratio of €280 to €230 per life-year gained using a 3.5% discount rate in low-risk patients with stable coronary heart disease. In high-risk patients with acute myocardial infarction, the incremental cost-effectiveness ratio of the programme per life-year gained was calculated to be €1,200 at 5 years and €110 over a 25-year lifetime, using a 5% discount rate (Quist-Paulsen et al., 2006 [+]).

ES2.3 Moderate evidence from one high quality cost-utility analysis suggests that adding nicotine replacement therapy to counselling and information would increase quit rates but would also increase the cost per QALY because of higher costs of ongoing care for a greater number of survivors (Ladapo et al., 2011 [++]).

Applicability
None of the studies were carried out in the UK, which limits the applicability of the cost

effectivenss findings to the UK context. However, the patient groups and management approaches followed in these studies are applicable to the UK population.

Patients with lung cancer

One medium quality study found that a smoking cessation intervention was cost-effective in patients scheduled for surgery for early lung cancer in the US.

Study id	Study design	Country	Population
Slatore (2009) [+]	CEA	US	Lung cancer surgery

Slatore et al. (2009) [+] carried out a cost-effectiveness analysis of a counselling programme plus nicotine replacement therapy in patients who were about to undergo surgery in the US for early stage lung cancer. Details of the intervention were not reported but were based on a previous study. By the time of surgery, 78% of the intervention group and 65% of usual care patients had quit smoking. After 3 months, 19% of the intervention group and 12% of the control group were still abstinent. The mean cost of the intervention was $199.96 (range $50 to $450 for different pharmacological treatments).

The incremental cost-effectiveness ratio was $16,415 per QALY and $45,629 per life-year gained after 1 year, falling to $2,609 per QALY and $2,703 per life-year gained after 5 years, using a 3% discount rate. Quitters were assumed to have no reduced risk of perioperative complications but would have a 12% lower risk of mortality at 1 year than continuing smokers.

Sensitivity analyses calculated that the ICER would be $49,985/QALY and $138,835/life-year gained at 1 year if the difference in perioperative complication rates was 24% higher in smokers than quitters, falling to $7938/QALY and $8224/life-year at 5 years. If the chance of achieving abstinence with the intervention increased by 5% at 3 months, the ICER would be $22,981/QALY and $63,881/life-year at year 1 and $3652/QALY and $3784/life-year at year 5. If the mortality increased to 10.1% for smokers compared with 5.1% for recent quitters, the ICER would be $18,368/QALY and $114,263/life-year after 1 year, and $3560/QALY and $6182/life year after 5 years. The intervention was cost-effective (at a threshold of $50,000/QALY) at 1 year if the utility of recent quitters was 0.03 higher than for smokers. Cost-effectiveness did not occur for any estimate of utility at 5 years post surgery.

This study did not include the costs of treating recurrent or metastatic disease, or costs of other smoking-related diseases, which would have reduced the cost per QALY. The model overestimated the QALYs and cost-effectiveness of the intervention for patients who die soon after surgery and the results are not applicable to patients with

inoperable lung cancer. The study was set in the US so may not be generaliseable to the UK.

Evidence statement 3: Cost-effectiveness of smoking cessation interventions in patients awaiting surgery for lung cancer.
ES3.0 Weak evidence from one moderate quality cost-effectiveness analysis suggests that counselling plus nicotine replacement therapy for patients scheduled to have surgery for early lung cancer in the US might have an incremental cost-effectiveness ratio of $16,415 per QALY and $45,629 per life-year gained after 1 year, falling to $2,609 per QALY and $2,703 per life-year gained after 5 years, using a 3% discount rate. *Applicability* The study was carried out in the US which limits the applicability of the cost effectiveness analysis in the UK context, but the patient subgroup and management approach are applicable to current UK practice.

5.2 Interventions for smoking cessation in antenatal and maternity settings

Any pregnant woman

Two studies assessed the cost-effectiveness or cost-benefit of interventions delivered at women attending antenatal clinics in the US. These studies carried out different analyses on the same study (Marks et al., 1990 [++]; Pollack, 2001 [+]) and found the smoking cessations would be cost-saving in terms of reduced need for neonatal intensive care (Marks et al., 1990 [++]), but may not be cost-effective at reducing the risk of sudden infant death syndrome (SIDS) (Pollack, 2001 [+]).

Study id	Study design	Country	Population
Marks (1990) [++]	CBA/CEA	US	Antenatal clinics
Pollack (2001) [+]	CEA	US	Antenatal clinics

Marks et al. (1990) [++] carried out a cost-benefit and cost-effectiveness analysis of a smoking cessation intervention for a modelled cohort of pregnant women attending antenatal clinics in the US. The modelled intervention consisted of a single 15-minute counselling session, instructional materials given to the patient and two follow-up telephone calls from a nurse or health educator. The cohort modelled were the 3,731,000 women giving birth in the US in 1986, of whom 783,510 were smokers. Maternal smoking was estimated to have led to an additional 39,176 low birth weight babies and to have led to 5% of the 55,840 perinatal deaths.

The intervention was calculated to have a 15% additional smoking cessation rate, to cost $30 per patient, and would prevent 388 perinatal deaths per year at a cost per death prevented of $69,542, compared with no intervention. Assuming a 75 year life expectancy for these babies, the cost of the intervention was $2,943 per life-year gained, discounted at 4%. Costs of neonatal intensive care (NICU) would decrease by almost $78 million per year, with savings of $3.31 for every $1 spent, and the decreased costs of care for disability in surviving babies were calculated to be almost a further $77 million, or $3.26 per $1 spent.

The authors modelled a worst-case scenario, with an expected smoking cessation rate of 5%, cost of intervention of $100 and relative risk of low birth weight of 1.5 for smoking. This would result in a ratio of NICU costs averted to programme costs of 0.17 to 1. A best-case scenario, with an expected smoking cessation rate of 25%, cost of intervention of $5 and relative risk of low birth weight of 2.5, would result in a ratio of 50 to 1 for NICU costs averted.

The study did not include lifetime productivity gains from infants who survived or had higher intelligence as a result of maternal smoking cessation, or benefits accruing to the mothers for their own better health. The study was based on US data so may not be generaliseable to the UK.

Pollack (2001) [+] evaluated the cost-effectiveness of the smoking cessation intervention reported in Marks et al. (1990) in pregnant women in the US to prevent SIDS. The intervention involved a single 15-minute counselling session, instructional materials and two follow-up telephone calls and was compared with no intervention. The study modelled the impact of the intervention in women giving birth in 1995 in the US, and assumed a 15% quit rate with the intervention at an average cost of $45 per participant based on 1998 US$.

The model assumed that 108 SIDS deaths could be averted per year if all pregnant smokers participated in the intervention (95% confidence interval 102 to 114). Of these deaths averted, 63 would be in babies born to light smokers of 1 to 10 cigarettes per day, 39 in moderate smokers of 11-20 cigarettes per day, and 7 in heavy smokers of more than 20 cigarettes per day. The costs per averted SIDS death were calculated to be $210, 500 overall (95% confidence interval $119,200 to $224,400), with costs lower for heavier smokers per death averted: $235,400 for light smokers (95% CI $219,300 to $256,400); $177,300 for moderate smokers (95% CI $166,800 to $191,100); and $151,000 for heavy smokers (95% CI $137,200 to $174,500).

Limitations of the study were that smoking cessation was based on self-report, which tends to estimate the amount and prevalence of smoking compared with objective analysis of cotinine levels. The study did not include estimates of postnatal maternal smoking or smoking by other household members, the value of reduced smoking

among pregnant women who relapse, or the impact of race or ethnicity on the results. The model focused on SIDS so did not assess other outcomes relevant to the infant such as low birth weight, childhood asthma, or maternal complications in pregnancy. The perspective and timeframe of the model are unclear.

Evidence statement 4: Cost-effectiveness of smoking cessation interventions in any pregnant women attending antenatal services

ES4.0 Moderate evidence from one cost-benefit and cost-effectiveness analysis in the US found that counselling and educational materials given to pregnant women attending antenatal clinics would cost $2,943 per life-year gained, discounted at 4%. The reduced need for neonatal intensive care (NICU) in babies of quitters would lead to savings of $3.31 for every $1 spent, and the decreased costs of care for disability in surviving babies were calculated to be a further $3.26 per $1 spent (Marks et al.,1990 [++]).

ES4.1 Weak evidence from a subsequent moderate quality cost-effectiveness analysis of this study suggested that the smoking cessation intervention would reduce the risk of SIDS in the babies of quitters, but that costs per averted SIDS death would be high: $210, 500 overall (95% confidence interval £119,200 to $224,400). Costs per death averted would be $235,400 for light smokers (95% CI $219,300 to $256,400); $177,300 for moderate smokers (95% CI $166,800 to $191,100); and $151,000 for heavy smokers (95% CI $137,200 to $174,500) (Pollack, 2001 [+]).

Applicability
Both studies were carried out in the US, which limits their applicability to the UK.

Low-income pregnant women
Four studies performed a cost-effectiveness or cost-benefit analysis of interventions in low income pregnant women in the US. Three of the studies found the intervention was cost-effective at reducing smoking (Dornelas et al., 2006 [+]; Parker et al (2007) [++]; Windsor et al., 1993 [++]), but one found that the intervention did not significantly reduce smoking rates and so the control group dominated for outcomes other than relapse prevention (Ruger et al., 2008 [+]).

Study id	Study design	Country	Population
Dornelas (2006) [+]	CEA	US	Low income pregnant women
Parker (2007) [++]	CEA	US	Urban antenatal clinics
Ruger (2008) [+]	CEA	US	Low income pregnant women
Windsor (1993) [++]	CBA	US	Public antenatal clinics

Dornelas et al. (2006) [+] carried out a cost-effectiveness analysis based on an RCT of a single, 90-minute psychotherapy session provided at public antenatal clinics in the US for 105 low-income pregnant women. Participants randomised to the intervention

group also received bi-monthly telephone calls from the therapist during the pregnancy and monthly calls for up to 6 months after delivery. The sessions were designed to identify the readiness to quit, engaging participants in treatment when appropriate, identifying possible psychological or social problems that might be barriers to quitting, and helping to set a quit date. The control group received usual antenatal care. Participants were largely (66%) Hispanic with a mean age of 26 years and smoked an average of 11 cigarettes per day at baseline (compared with a pre-pregnancy level of 21 per day).

Smoking quit rates were significantly higher in the intervention group at the end of pregnancy than in the control group (28.3% with 7 days or longer abstinence vs 9.6% in the control group, p=0.015), an incremental quit rate of 18.7%. However, this difference was no longer significantly different by 6 months after delivery (9.4% for the intervention group vs 3.8% in the control group, p value not reported but stated to be not significant). Subgroup analyses showed that women who were less than 25 years old and were less than 18 weeks into their pregnancy were most likely to quit, with a 60% end of pregnancy quit rate compared with 0% in the corresponding control group. The costs of the intervention were $56.37 per patient, and the incremental cost to produce a quitter at the end of pregnancy was $298.76. The cost of training and supervising the therapist per patient was $46.67 for the 53 patients who received the intervention.

This study is limited by the fact that only 68% of women allocated to the intervention group attended the counselling sessions. As the intervention was provided at a public antenatal clinic in the US, it is unclear whether the results are generaliseable to private healthcare settings, or to pregnant women in the UK. The study did not apply a discount rate, carry out a sensitivity analysis or report health effects in terms of QALYs.

Parker et al. (2007) [++] carried out a cost-effectiveness analysis of a motivational interviewing intervention for 358 pregnant women attending antenatal clinics in urban settings of the US. All participants received self-help materials including a guide to quitting smoking, a video about quitting, and were enrolled in a “quit and win” monetary incentive lottery. Three groups also received one, two or three motivational interviews to discuss their smoking, their readiness to change, the risks to themselves and their babies from continued smoking, and to support them in making decisions about their smoking.

The participants were on average 25 years old; between 10-20% were Black, 10-20% were Hispanic, and 57-67% were white. They smoked an average of 8 cigarettes a day and were around 11 weeks’ gestation at baseline.

Quit rates were 63/358 (18.0%) overall, with a dose-response based on the number of calls received: 5/52 (9.6%) for the control group with no calls; 12/92 (13.0%) for the

group with 1 call; 8/49 (16.3%) for the group with 2 calls and 38/165 (23.0%) for the group with 3 calls. The difference between the control group and the 3 calls group was statistically significant, p=0.03. The cost-effectiveness ratio per quitter was $140/5 ($28 per quit) for the control group; $732/12 ($61 per quit) with 1 call; $736/8 ($92 per quit) with 2 calls and $3192/38 ($84 per quit) with 3 calls.

Sensitivity analysis found that if the cost per patient of motivational interviewing increased from $20 to $25, the cost per quit was: $105 with 3 calls; $115 with 2 calls, and 1 $76 with 1 call. If the cost increased from $20 to $30, the cost per quit was: $138 with 3 calls; $138 with 2 calls, and 1 $92 with 1 call.

The study did not include the costs incurred by the patients or their time, or the costs of developing the quit kit they were given. The researchers attempted to verify quit rates by measuring cotinine levels, but many participants failed to give a sample and so quitting based on self-report may be overestimated. Costs and benefits were not discounted, not all participants in the intervention groups actually received calls, and the study was set in the US so it may not be generaliseable to the UK setting.

Windsor et al. (1993) [++] carried out a cost-benefit analysis of a health education intervention for 814 pregnant women attending public antenatal care clinics in the US. The intervention consisted of an initial visit, where a trained female health counsellor provided the participants with a standardised cessation skills and risk counselling session lasting approximately 15 minutes. Patients were taught how to use a 7-day self-directed cessation guide. There was also a 30 minute group prenatal education class, where the nurse discussed smoking risks and the importance of quitting. During follow-up visits, the information provided to the participant was reinforced, a chart reminder was put in the medical record and a medical letter was sent to the patient within 7 days. Social support was provided in the form of a buddy letter, a buddy contract, and a buddy tip sheet. Each patient was also sent a quarterly, one-page "newsletter" with testimonials from successful quitters, additional risk information and cessation tips. Participants were also given two pamphlets – *"Smoking and the Two of You"* and *"Where to Find Help if You Want to Stop Smoking"*. A control group received two minutes with the health counsellor at a first visit, plus brief contacts at follow-up visits, totalling 5 minutes spent discussing and reinforcing risk information. There was also a 30 minute group prenatal education class at the initial visit. Participants were also given two pamphlets – *"Smoking and the Two of You"* and *"Where to Find Help if You Want to Stop Smoking"*.

Participants were 24 years old on average and 52% were Black. Mean salivary cotinine levels were 114 ng/ml. The intervention led to significantly higher quit rates than the control, 14.3% vs 8.5% in the control group, p=0.01. Quit rates were significantly higher in Black than White patients, with 18% of Black women quitting compared with 10% of White women. However, relapse rates were significantly higher in the intervention

group (18%) than the control group (8%, p=0.001). Quit rates were also higher in women with lower cotinine levels than higher levels in both intervention and control groups, showing that lighter smokers were more likely to quit than heavier smokers.

The model assumed an 8% difference in quit rates with the intervention, and took data from other studies on the attributable risk for low birth weight due to smoking. There were an estimated 32 fewer low birth weight babies born as a result of the intervention if it had been implemented at a state level, with inflation adjusted estimates of the statewide healthcare costs of $387,328 to $989,920 attributable to these 32 infants as if they had been born as low birth weight infants. This is the net benefit minus cost difference in favour of the intervention. One-way sensitivity analyses that increased the cost of the intervention by 50% from $4.50 to $6.75 per participant estimated that the cost benefit ratio estimates would range between $1:$11.95 and $1:$30.55. If the costs of the intervention were doubled to $9.00, the cost benefit ratio would range between $1:$8.97 and $1:$22.91, with an equivalent net difference between benefit and cost of $344,128 to $946,720 respectively in favour of the intervention. Two-way sensitivity analysis estimated that, if the intervention cost was increased to 100% and the benefit was decreased by 25%, the cost benefit ratio would range between $1:$6.72 and $1:$17.18. This would result in $7 - $17 saved in medical costs for each $1 spent on the smoking cessation intervention. This has an equivalent economic benefit of $247,296 to $699,240 saved in favour of the intervention.

This study was carried out in the US which limits its generalisability to the UK. The modelling methods were not reported and different discount rates were used for different years.

Ruger et al. (2008) [+] performed a cost-effectiveness analysis of a motivational interviewing intervention for low-income pregnant smokers in the US. Participants were recruited by a nurse at the hospital or health clinic delivering antenatal care. The intervention involved an average of 3, 1-hour home visits delivering motivational interviews about smoking cessation, which gave information about the effects of smoking on the mothers and their babies, helped participants evaluate their smoking behaviour, helped increase their self-efficacy for smoking cessation and abstinence; provided information on reducing exposure to environmental tobacco smoke, set goals on changes in smoking; and provided feedback about household nicotine levels. Participants also received smoking cessation manuals. A control group received self-help manuals and had a 5-minute session on the harmful effects of smoking during and after pregnancy.

A total of 302 women participated in the study, with a mean age of 25 years. Between 64-70% were White, 8-11% Hispanic and 15-19% Black. The mean cost of the intervention was $309.20 compared with $4.85 for usual care, in 1997 US$. At 6 months post-partum, 7/110 of the intervention group and 8/100 of the control group had

quit smoking. Usual care dominated over the intervention for quitting smoking. However, there were fewer relapses in the intervention group, although this was of borderline statistical significance (9/21 for the intervention vs 5/28 for the controls, p=0.055). The cost per relapsed prevented was $1,217, with the cost per life-year saved estimated to be $851, and the cost per QALY for recent quitters who fail to relapse of $628.

There were no statistically significant differences in infant outcomes for the intervention group compared with controls.

Sensitivity analysis showed that usual care dominated over motivational interviewing if the quit rate from the intervention was 8 per 110 or less. If the effectiveness of motivational interviewing in current smokers increased to 10/110, or 9/110, the corresponding ICERs would be $19,500 or $117,100 per life-year gained, and cost per QALY gained would be $14,400 or $86,300 respectively.

This study was carried out in low income women in the US so the generalisability to the population of pregnant women in the UK is limited. The discount rate and time horizon were unclear, and the study did not consider long-term morbidity or mortality outcomes for the children.

Evidence statement 5: Cost-effectiveness of interventions for smoking cessation in low-income pregnant women
ES5.0 Inconsistent evidence from four cost-effectiveness or cost-benefit analyses in the US is unclear as to whether smoking cessation counselling and educational materials increase quit rates in low-income pregnant smokers. One study found the incremental cost per quitter with the intervention at the end of pregnancy was $298.76, but that there was no significant difference in abstinence rates by 6 months after delivery (Dornelas et al., 2006 [+]). A second study found higher quit rates and higher relapse rates in women given counselling and information compared with controls, but estimated that the cost benefit ratio estimates would range between $1:$11.95 and $1:$30.55 (Windsor et al., 1993 [++]). A third study found no difference in quit rates among women given motivational interviews and information about smoking cessation and a control group, although relapse rates were lower in the intervention group. The cost per relapse prevented was $1,217, with the cost per life-year saved estimated to be $851, and the cost per QALY for recent quitters who fail to relapse of $628 (Ruger et al., 2008 [+]).The fourth, a high quality cost-effectiveness analysis of a motivational interview via telephone plus educational material intervention for pregnant women in the US suggested, however, that cost-effectiveness ratio per quitter may be higher with the intervention than in the control group: $140/5 ($28 per quit) for the control group; $732/12 ($61 per quit) with 1 call; $736/8 ($92 per quit) with 2 calls and $3192/38 ($84 per quit) with 3 calls (Parker et al., 2007 [++]).

Applicability
All the studies were carried out in the US and in low-income women whose access to healthcare differs substantially from the UK setting, limiting the applicability of these studies to the UK.

5.3 Interventions for smoking cessation in mental health settings

Out-patients with depression
One high quality study found a smoking cessation intervention for out-patients with depression in the US to be cost-effective.

Study id	Study design	Country	Population
Barnett (2008) [++]	CEA	US	Out-patients with depression

Barnett et al. (2008) [++] carried out a cost-effectiveness analysis based on an RCT of 322 out-patient smokers with depression attending mental health clinics in the US. Participants were randomised to either a stepped care smoking cessation intervention or information only. The intervention consisted of three scheduled assessments of readiness to quit smoking using a computer-mediated evaluation that was reviewed by a smoking cessation counsellor. If the participant was at the contemplation of quitting stage or requested treatment then the participant moved on to stage 2 of the intervention. This provided six sessions of psychological counselling plus up to 10 weeks of nicotine replacement therapy as a dermal patch. Participants who continued to smoke were offered a further two counselling sessions plus sustained-release bupropion. The control group received information only, via a printed stop-smoking guide and a list of smoking cessation programmes. Smoking abstinence, depression scores and incremental cost-effectiveness per successful quit were calculated over 18 months, with a bootstrap method to estimate the uncertainty of the incremental cost-effectiveness.

Approximately two-thirds of participants were female and Caucasian, with a mean age of 42 years, and smoked 15 cigarettes a day on average. At the end of the treatment phase, the likelihood of having been abstinent from smoking for 7 days or more was significantly higher for the intervention group than the control group (odds ratio 4.55, 95% confidence interval 1.04 to 19.9, absolute numbers not reported). After 18 months of follow up, more of the intervention group had been abstinent for 7 days (24.6%, compared with 19.1% of the control group). However, the statistical significance of this difference was not reported.

The additional costs of the smoking cessation intervention were $346 per patient, and the intervention led to an additional 5.5% abstinence from smoking. The incremental cost-effectiveness ratio of the smoking cessation service itself was $6,204 per successful quit. Seventy five percent of the bootstrap replicates had an ICER of less than $20,000 in direct costs per successful quitter. If the threshold for willingness to pay was increased to $40,000 per successful quitter, the stepped care smoking cessation programme was cost-effective in 79% of replicates using the bootstrap method. However, the intervention group also incurred mental health service costs, in addition to the costs of the intervention. Combined costs of the intervention and the additional service costs meant the incremental cost-effectiveness ratio (cost per successful quit) was $11,496 per successful quit. Seventy four percent of bootstrap replicates had an ICER less than $40,000 per successful quit, and 81% had an ICER less than $100,000.

This study was limited by being set in the US, which may limit its generalisability to equivalent services in the UK.

Evidence statement 6: Cost-effectiveness of smoking cessation interventions for patients attending mental health services
ES6.0 Moderate evidence from one high quality cost-effectiveness analysis found that psychological counselling plus nicotine replacement therapy offered to out-patients with depression had an incremental cost-effectiveness ratio of $6,204 per successful quit. Seventy five percent of the bootstrap replicates had an ICER of less than $20,000 in direct costs per successful quitter. Combining the costs of the intervention and the additional service costs meant the ICER was $11,496 per successful quit. Seventy four percent of bootstrap replicates had an ICER less than $40,000 per successful quit, and 81% had an ICER less than $100,000 (Barnett et al., 2008 [++]). *Applicability* The study was carried out in the US so may be less applicable to the UK context.

5.4 Interventions for temporary abstinence in acute hospital settings

Pre-operative patients

One high quality study carried out a cost-benefit analysis on a smoking cessation intervention delivered prior to elective orthopaedic surgery in France and found it to be cost-effective. The study aimed to cause smoking cessation rather than temporary abstinence, but only outcomes relevant to the hospital admission and complications were reported, so the study has been included in this section of the report.

Study id	Study design	Country	Population
Hejblum (2009) [++]	CBA	France	Orthopaedic surgery

Hejblum et al (2009) [++] carried out a cost-benefit analysis of a pre-operative smoking cessation intervention in a simulated population of 1 million patients scheduled to undergo hip or knee arthroplasty surgery in France. Data was taken from one RCT identified in a literature review of 120 patients who were randomised to either a pre-operative intervention for smoking cessation (PISC) or a control group not offered the intervention. The intervention involved an initial interview and brief weekly contacts with a specialised nurse to measure exhaled carbon monoxide levels to evaluate smoking status plus nicotine replacement therapy, and began 6 to 8 weeks before surgery. The study focused only on costs of hospitalisation, not on longer quit rates.

The RCT on which the model was based found that 64% of the PISC group stopped smoking compared with 7.7% of the control group. The total cost of the PISC was estimated to be €196 per patient, and the average cost of hospital stay estimated to be €6,246 for the intervention group compared with €6,559 for the control group. There was therefore expected to be a positive net monetary benefit of €117 for patients receiving PISC compared with controls. The difference in hospital costs was largely caused by a reduced number of days spent in intensive care (2 days for the PISC group vs 32 days for the control group, p value not reported), as the intervention group had a 1 in 56 risk of complications compared with a 6 in 56 risk in the control group. Both groups had similar lengths of stay on the orthopaedic ward (11 days for the PISC group vs 13 days for the control group, not significantly different).
Sensitivity analyses found that there would be a positive cost benefit for PISC if the risk of developing a complication increased with PISC up to 3 in 56, but no higher; if the mean number of days spent in intensive care decreased from 5 to 4 days, but no lower; if the cost per average hospital stay increased to €7,218.68 for a 6 to 38 day stay, or fell to €5,702.27 for 4 to 29 day stay; and if the cost per day of intensive care decreased to €419.58 or increased to €838.16.

This study was limited as it did not include discounting and the data came from one small French RCT that may not reflect outcomes in a wider context or in the UK.

We identified no other studies that assessed the cost-effectiveness of interventions for temporary abstinence of smoking in patients admitted to other secondary care settings including maternity or mental health settings.

Evidence statement 7: Cost-effectiveness of interventions for smoking cessation for patients admitted to acute secondary care services
ES7.0 Moderate evidence from one high quality cost-benefit analysis suggests that pre-operative smoking cessation interviews plus nicotine replacement therapy in people scheduled for elective hip or knee replacement surgery in France would have a positive net monetary benefit of €117 for patients receiving the intervention compared with controls. The cost reduction was largely driven by a reduction in the number of postoperative days of intensive care required in smokers who quit before surgery compared with those who continued to smoke (Hejblum et al., 2009 [++]). *Applicability* The study was carried out in France which limits the applicability of the cost effectiveness analysis to the UK, but the patient group and management approaches are applicable to UK clinical practice.

5.5 Interventions for increasing identification and referral of smokers

No relevant studies were identified that addressed the cost-effectiveness of interventions to increase the identification and referral of smokers to smoking cessation services by staff working in acute, maternity or mental health services.

5.6 Interventions for increasing recording of smoking status

No relevant studies were identified that addressed interventions to increase recording of smoking status of patients attending acute, maternity or mental health services.

5.7 Interventions for increasing adherence to smokefree workplace policy

No relevant studies were identified that evaluated interventions to increase adherence to smokefree workplace policy, legislation or regulations in acute, maternity or mental health settings.

5.8 Subsidiary questions

This review sought to answer a number of subsidiary questions.

How does the cost-effectiveness vary for different population groups or speciality care services?

The one UK study we identified assessed smoking cessation interventions for all in-patients and out-patients attending a hospital in Wales (Prathiba et al., 1998 [+]). This study found that patients with cardiac diseases were more likely to stop smoking (31%) compared with those with respiratory disease (25%) or others (11%; $p < 0.05$). Elderly patients aged 60 years and over were more likely to quit (32%) than younger patients (17%; $p<0.01$).

It is not feasible to compare cost-effectiveness results across different studies identified in this review as the populations, contexts and interventions are too heterogeneous. However, the studies we identified suggested that the effectiveness of smoking cessation counselling and educational materials may be less effective in low-income pregnant women than in a more affluent and general pregnant population (see sections 5.2 and 5.3).

Are certain interventions more cost-effective when used in combination?

Most of the studies we identified used a combination of different approaches, usually involving giving educational information as well as offering general advice or more specialist counselling. It is therefore not possible to say from this evidence whether combination treatment is more or less effective or cost-effective than single methods.

One high quality study looking at behavioural counselling, educational material and a supportive DVD in smokers hospitalised with an acute myocardial infarction in the US found that the cost per QALY gained increased if nicotine replacement therapy was added compared with counselling and information alone (Ladapo et al., 2011 [++]). The authors suggested that this was because the costs of the intervention increased, the quit rates decreased further, and so the costs of ongoing health care for a high risk population who had longer survival were higher.

What impact do the following have on cost-effectiveness and acceptability of different interventions?

<u>The deliverer</u>

Only one study stated that the intervention was delivered by a non-specialist smoking cessation nurse or counsellor (Quist-Paulsen et al., 2006 [+]). This study found that

cardiac nurses could deliver effective smoking cessation interventions to patients in Norway having coronary artery bypass surgery. However, as the study did not compare outcomes for different types of staff member, it is not possible to determine whether the cost-effectiveness varies by type of person delivering the intervention.

The setting

We identified studies set in a range of in-patient, out-patient and antenatal settings. However, as most of the studies suggested that the smoking cessation service they offered was cost-effective, and none of the studies compared outcomes in different secondary care settings, it is not possible to determine whether the setting makes a difference.

One study compared smoking cessation interventions among smokers in Denmark and found that interventions carried out at hospitals were more effective than interventions carried out at pharmacies, but more hospital patients were lost to follow-up which may have led to an overestimate of smoking cessation rates in this group (Olsen et al., 2006 [+]).

Timing (or point in the care pathway)

We found no studies that compared the cost-effectiveness of interventions delivered at different points in the clinical pathway. We also found no studies that separately assessed the effectiveness of interventions delivered at different times to patients with the same condition, so we are not able to make an indirect comparison.

Frequency or duration of intervention

All the studies we identified offered multiple contacts with patients, but only one reported differences in quit rates related to frequency of intervention. It found that motivational interviews plus educational material cost more per low income pregnant woman who quit smoking than a control that offered information only, but that there was no clear relationship between the number of motivational calls offered and the cost per additional person who quit. The cost-effectiveness ratio per quitter was $140/5 ($28 per quit) for the control group; $732/12 ($61 per quit) with 1 call; $736/8 ($92 per quit) with 2 calls and $3192/38 ($84 per quit) with 3 calls (Parker et al., 2007 [++]).

Severity of dependence

Quit rates in one US study of smoking cessation counselling and educational material were higher in pregnant women with lower cotinine levels than in women with higher cotinine levels in both intervention and control groups, showing that lighter smokers were more likely to quit than heavier smokers (Windsor et al., 1993 [++]).

A second study in pregnant women in the US found that the costs of a smoking cessation counselling plus educational material intervention per averted SIDS death were lower for heavier smokers than for lighter smokers (Pollack 2001 [+]). Costs per death avoided were calculated to be $210,500 overall (95% confidence interval $119,200 to $224,400), with costs lower for heavier smokers per death averted: $235,400 for light smokers (95% CI $219,300 to $256,400); $177,300 for moderate smokers (95% CI $166,800 to $191,100); and $151,000 for heavy smokers (95% CI $137,200 to $174,500).

6.0 Discussion and summary

The primary research questions for this review were:

- **Question 1:** How cost-effective are ***smoking cessation interventions*** in helping people who are receiving emergency care, planned specialist medical care or surgery, and maternity or mental health services provided in hospitals, maternity units, outpatient clinics and the community, their family members and visitors, and staff, volunteers or contractors caring for them?

We identified 15 studies that addressed this question. Most used a combined multiple session advice/counselling intervention with educational materials and/or nicotine replacement therapy, and most found that the intervention was significantly more effective than a control group at reducing smoking and usually had a low cost per quitter, per QALY and per life-year gained.

The studies suggest that this sort of intervention is likely to be cost-effective if applied to the UK acute secondary care patient population. However, we found no studies assessing the economic impact of interventions aimed at the family or visitors of these patients, or of staff working in these settings. We cannot be sure which, if any, smoking cessation intervention might be cost-effective for these populations.

There is a suggestion based on inconsistent evidence that interventions in low income pregnant women may be less cost-effective than in more affluent women, and that interventions might be more cost-effective if they are targeted towards patients who are better able to link the reason for their need for hospital care to their smoking habit, such as those admitted for cardiovascular disease.

We found no studies relevant to the final four research questions, and so can come to no conclusions about which approaches might be cost-effective.

- **Question 2**: How cost-effective are ***interventions for temporary abstinence*** in helping people who are receiving emergency care, planned specialist medical care or surgery, and maternity or mental health services provided in hospitals,

maternity units, outpatient clinics and the community, their family members and visitors, and staff, volunteers or contractors caring for them?

- **Question 3:** How cost-effective are current approaches used by secondary care staff for ***identifying and referring patients*** admitted to acute, maternity or mental health secondary care services, or their family members and visitors, to stop smoking services?

- **Question 4:** What approaches are cost-effective to encourage health professionals to ***record smoking status*** for patients admitted to acute, maternity or mental health services and refer smokers to stop smoking services?

- **Question 5:** How cost-effective are strategies and interventions for ensuring ***compliance with smokefree legislation*** and local smokefree policies in secondary care settings?

The secondary research questions for this review were:

- How does the cost-effectiveness vary for different population groups or speciality care services?

Only one study reported resulted by subgroups. One UK study found that patients with cardiac diseases were more likely to stop smoking compared with those with respiratory disease or others and elderly patients aged 60 years and over were more likely to quit than younger patients (Prathiba et al., 1998 [+]).

It is not feasible to compare cost-effectiveness results across different studies identified in this review as the populations, contexts and interventions are too heterogeneous. However, the studies we identified suggested that the effectiveness of smoking cessation counselling and educational materials may be less effective in low-income pregnant women than in a more affluent and general pregnant population (see sections 5.2 and 5.3).

- Are certain interventions more cost-effective when used in combination?

Most of the studies we identified used a combination of different approaches, usually involving giving educational information as well as offering general advice or more specialist counselling. It is therefore not possible to say from this evidence whether combination treatment is more or less effective or cost-effective than single methods.

- What impact do the following have on cost-effectiveness and acceptability of different interventions: deliverer, setting, timing (or point in the care pathway), frequency, duration, severity of dependence?

The deliverer: we found no studies to determine whether the cost-effectiveness of interventions varies by type of person delivering the intervention.

The setting: none of the studies compared outcomes in different secondary settings. Therefore it is not possible to determine whether the setting makes a difference.

Timing (or point in the care pathway): we found no studies that compared the cost-effectiveness of interventions delivered at different points in the clinical pathway or at different times to patients with the same condition.

Frequency or duration of intervention: only one study reported outcomes by frequency of contact and no clear pattern was observed in the results (Parker et al., 2007 [++]).

Severity of dependence: one study of smoking cessation in pregnant women found that lighter smokers were more likely to quit than heavier smokers and one study found that cost per SIDS death avoided was lower for heavier smokers than for lighter smokers (Pollack et al., 2001 [+]).

6.1 Strengths and weaknesses of the review

The review was carried out in full accordance with the NICE methods manual, and is therefore robust and transparent. Sixteen studies were identified and provide generally consistent evidence of benefit and cost-effectiveness of smoking cessation interventions in acute secondary care and antenatal settings.

Only one of the studies was set in the UK, and that used data from 1992-94, which means that the evidence is not directly applicable to the current UK context. However, all the studies were carried out in the UK, US or Northern Europe and used interventions of direct applicability to what can be offered in the UK.

The substantial gaps in the cost-effectiveness evidence base means that most of the research questions cannot be answered from the review of the literature.

6.2 Gaps in the evidence

No studies were found that addressed the cost-effectiveness of interventions for temporary abstinence during pregnancy or childbirth, or during admission to a mental health setting.

No studies addressed the research questions about the cost-effectiveness of interventions to identify and refer smokers from secondary care to smoking cessation services, to increasing the number of patients who have their smoking status recorded, or to increasing adherence to smokefree workplace policies.

No studies assessed the cost-effectiveness of interventions targeted at people other than the smoker patients, such as family, visitors or staff. Neither did we find any study that measured outcomes in these groups following an intervention targeted at the primary smoker.

6.3 Conclusions

Fairly consistent evidence supports the promotion of counselling or advice-based interventions to help smokers quit in an acute secondary care and antenatal setting. The interventions tested involved follow-up contact after hospital discharge and may involve also giving the patient educational material about smoking cessation and nicotine replacement therapy. Overall, the costs of the intervention were low and the benefits significant, so the interventions were usually cost-effective in terms of QALY or life-year gained.

7.0 References

7.1 Studies included in the review

Barnett PG, Wong W, & Hall S, (2008). The cost-effectiveness of a smoking cessation program for out-patients in treatment for depression. *Addiction (Abingdon, England)*, *103*(5), 834–840. doi:10.1111/j.1360-0443.2008.02167.x

Bolin K, Wilson K, Benhaddi H, de Nigris E, Marbaix S, Mork AC, & Aubin H,. (2009). Cost-effectiveness of varenicline compared with nicotine patches for smoking cessation--results from four European countries. *European Journal of Public Health*, *19*(6), 650–654. doi:10.1093/eurpub/ckp075

Dornelas E A, Magnavita J, Beazoglou T, Fischer E H, Oncken C, Lando H, Greene J, et al. (2006). Efficacy and cost-effectiveness of a clinic-based counseling intervention tested in an ethnically diverse sample of pregnant smokers. *Patient Education and Counseling*, *64*(1-3), 342–349. doi:10.1016/j.pec.2006.03.015

Hejblum G, Atsou K, Dautzenberg B, & Chouaid C, (2009). Cost-benefit analysis of a simulated institution-based preoperative smoking cessation intervention in patients undergoing total hip and knee arthroplasties in France. *Chest*, *135*(2), 477–483. doi:10.1378/chest.08-0897

Krumholz HM, Cohen BJ, Tsevat J, Pasternak RC., & Weinstein MC. (1993). Cost-effectiveness of a smoking cessation program after myocardial infarction. *Journal of the American College of Cardiology*, *22*(6), 1697–1702.

Ladapo JA, Jaffer FA., Weinstein MC, & Froelicher ES, (2011). Projected cost-effectiveness of smoking cessation interventions in patients hospitalized with myocardial infarction. *Archives of Internal Medicine*, *171*(1), 39–45. doi:10.1001/archinternmed.2010.479

Mani K, Wanhainen A, Lundkvist J, & Lindström D, (2011). Cost-effectiveness of intensive smoking cessation therapy among patients with small abdominal aortic aneurysms. *Journal of Vascular Surgery: Official Publication, the Society for Vascular Surgery [and] International Society for Cardiovascular Surgery, North American Chapter*, *54*(3), 628–636. doi:10.1016/j.jvs.2011.02.055

Marks JS, Koplan, JP, Hogue CJR, & Dalmat ME. (1990). A cost-benefit/ cost-effectiveness analysis of smoking cessation for pregnant women. *American Journal of Preventive Medicine,* 6(5), 282-289.

Meenan RT, Stevens VJ, Hornbrook MC, La Chance PA, Glasgow RE, Hollis JF, Lichtenstein E, et al. (1998). Cost-effectiveness of a hospital-based smoking cessation intervention. *Medical Care*, *36*(5), 670–678.

Olsen KR, Bilde L, Juhl HH, Kjaer NT, Mosbech H, Evald T, Rasmussen M, et al. (2006). Cost-effectiveness of the Danish smoking cessation interventions: subgroup analysis based on the Danish Smoking Cessation Database. *The European Journal of Health Economics: HEPAC: Health Economics in Prevention and Care*, *7*(4), 255–264. doi:10.1007/s10198-006-0362-1

Parker DR, Windsor RA, Roberts MB, Hecht J, Hardy NV, Strolla LO, & Lasater TM, (2007). Feasibility, cost, and cost-effectiveness of a telephone-based motivational intervention for underserved pregnant smokers. *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco*, *9*(10), 1043–1051. doi:10.1080/14622200701591617

Pollack HA. (2001). Sudden infant death syndrome, maternal smoking during pregnancy, and the cost-effectiveness of smoking cessation intervention. *American Journal of Public Health*, *91*(3), 432–436.

Prathiba BV, Tjeder S, Phillips C, & Campbell, IA. (1998). A smoking cessation counsellor: should every hospital have one? *The Journal of the Royal Society for the Promotion of Health*, *118*(6), 356–359.

Quist-Paulsen P, Lydersen S, Bakke PS, & Gallefoss F. (2006). Cost-effectiveness of a smoking cessation program in patients admitted for coronary heart disease. *European Journal of Cardiovascular Prevention and Rehabilitation: Official Journal of the European Society of Cardiology, Working Groups on Epidemiology & Prevention and Cardiac Rehabilitation and Exercise Physiology*, *13*(2), 274–280. doi:10.1097/01.hjr.0000192742.81231.91

Ruger JP, Weinstein M, Hammond K, Kearney MH, & Emmons KM (n.d.). Cost-Effectiveness of Motivational Interviewing for Smoking Cessation and Relapse Prevention Among Low-Income Pregnant Women: A Randomized Controlled Trial. *SSRN eLibrary*. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1078262

Slatore CG, Au DH, & Hollingworth W, (2009). Cost-effectiveness of a smoking cessation program implemented at the time of surgery for lung cancer. *Journal of Thoracic Oncology: Official Publication of the International Association for the Study of Lung Cancer*, *4*(4), 499–504. doi:10.1097/JTO.0b013e318195e23a

Windsor RA, Lowe JB. Perkins LL, Smith-Yoder D, Artz L, Crawford M, Amburgy K, Boyd NR; (1993). Health Education for Pregnant Smokers: Its Behavioural Impact and Cost Benefit. *American Journal of Public Health*, 83(2), 201–206.

7.2 Studies excluded on full text

Systematic reviews not included in the review, but used for citation chasing (N=15)

Cohen DR, Fowler GH. Economic implications of smoking cessation therapies. A review of economic appraisals. Pharmacoeconomics. 1993 Nov;4(5):331-44.

Coleman T, Agboola S, Leonardi-Bee J, Taylor M, McEwen A, McNeill A. Relapse prevention in UK Stop Smoking Services: current practice, systematic reviews of effectiveness and cost-effectiveness analysis. Health Technol Assess. 2010 Oct;14(49):1-152, iii-iv.

Hoogendoorn M, Feenstra TL, Hoogenveen RT, Rutten-van Mölken MP. Long-term effectiveness and cost-effectiveness of smoking cessation interventions in patients with COPD. Thorax. 2010 Aug;65(8):711-8.

Hurley SF, Matthews JP, Guymer RH. Cost-effectiveness of smoking cessation to prevent age-related macular degeneration. Cost Eff Resour Alloc. 2008 Sep 11;6:18.

Kupersmith J, Holmes-Rovner M, Hogan A, Rovner D, Gardiner J. Cost-effectiveness analysis in heart disease, part II: preventive therapies. Prog Cardiovasc Dis. 1995 Jan-Feb;37(4):243-71.

Law M, Tang JL. An analysis of the effectiveness of interventions intended to help people stop smoking. Arch Intern Med. 1995 Oct 9;155(18):1933-41.

Max W. The Financial Impact of Smoking on health-related costs: a review of the literature. Am J Health Promot. 2001 May-Jun;15(5):321-31.

Parrott S., Godfrey C., Raw M., West R., McNeill A. Guidance for commissioners on the cost-effectiveness of smoking cessation interventions. Thorax 1998, 53(Suppl 5):S2-S37.

Ronckers ET, Groot W, Ament AJ. Systematic review of economic evaluations of smoking cessation: standardizing the cost-effectiveness. Med Decis Making. 2005 Jul-Aug;25(4):437-48.

Ruger JP, Emmons KM. Economic evaluations of smoking cessation and relapse prevention programs for pregnant women: a systematic review. Value Health. 2008 Mar-Apr;11(2):180-90. Epub 2007 Sep 13.

Song F, Raftery J, Aveyard P, Hyde C, Barton P, Woolacott N. Cost-effectiveness of pharmacological interventions for smoking cessation: a literature review and a decision analytic analysis. Med Decis Making. 2002 Sep-Oct;22(5 Suppl):S26-37.

Wang D, Connock M, Barton P, Fry-Smith A, Aveyard P, Moore D. 'Cut down to quit' with nicotine replacement therapies in smoking cessation: a systematic review of effectiveness and economic analysis. Health Technol Assess. 2008 Feb;12(2):iii-iv, ix-xi, 1-135.

Warner KE. Cost-effectiveness of smoking-cessation therapies. Interpretation of the evidence-and implications for coverage. Pharmacoeconomics. 1997 Jun;11(6):538-49.

Windsor R. Smoking cessation or reduction in pregnancy treatment methods: a meta-evaluation of the impact of dissemination. Am J Med Sci. 2003 Oct;326(4):216-22.

Woolacott NF, Jones L, Forbes CA, Mather LC, Sowden AJ, Song FJ, Raftery JP, Aveyard PN, Hyde CJ, Barton PM. The clinical effectiveness and cost-effectiveness of bupropion and nicotine replacement therapy for smoking cessation: a systematic review and economic evaluation. Health Technol Assess. 2002;6(16):1-245

Studies excluded on full text (N=14)

Akehurst RL., Piercy J. Cost-effectiveness of the use of transdermal Nicorette patches relative to GP counselling and nicotine gum in the prevention of smoking related diseases. *Br J Med Economics* 1994; 7: 115-122.

Bolin K., Wilson K., Benhaddi B., de Nigris E., Marbaix S., Mork AC., et al. Cost-effectiveness of varenicline compared with nicotine patches for smoking cessation - results from four European countries. *Eur J Public Health* 2009; 19(6):650-654.

Bradford WD. Pregnancy and the Demand for Cigarettes. *American Economic Review* 2003; 93(5): 1752-1763.

Cromwell J, Bartosch W J, Fiore M C, Hasselblad V, Baker T. Cost-effectiveness of the clinical practice recommendations in the AHCPR guideline for smoking cessation. *JAMA* 1997; 278(21): 1759-1766.

Godfrey C., Parrott S., Coleman T., Pound E. The cost-effectiveness of the English smoking treatment services: evidence from practice. *Addiction* 2005; 100(Suppl 2): 70-83.

Haile MJ., Wiggers JH., Spigelman AD., Knight J., Considine RJ., Moore K. Novel strategy to stop cigarette smoking by surgical patients: pilot study in a preadmission clinic. *ANZ J Surg* 2002; 72: 618-622.

Hurley SF. Short-term impact of smoking cessation on myocardial infarction and stroke hospitalisations and costs in Australia. *MJA* 2005; 183:13-17.

Jones TE., Crocker H., Ruffin RE. Smoking habits and cessation programme in an Australian teaching hospital. *Aust NZ Med J* 1998; 28: 446-452.

Lightwood, J. M., Phibbs, C. S., Glantz, S. A. (1999). Short-term health and economic benefits of smoking cessation: low birth weight. *Pediatrics*, *104*(6), 1312–1320.

Ong M K, Glantz S A. Free nicotine replacement therapy programs vs implementing smoke-free workplaces: a cost-effectiveness comparison. *Am J Public Health* 2005; 95(6): 969-975.

Ruger JP., Emmons KM., Kearney MH., Weinstein MC. Measuring the costs of outreach motivational interviewing for smoking cessation and relapse prevention among low-income pregnant women. *BMC Pregnancy and Childbirth* 2009; 9: 46.

Severson HH., Andrews JA., Lichtenstein E., Wall M., Akers L. Reducing maternal smoking and relapse: long-term evaluation of a pediatric intervention. *Preventive Medicine* 1997; 26: 120-130.

Stapleton J. Cost-effectiveness of NHS smoking cessation services. Accessed from www.ash.org.uk/files/documents/ASH_427.pdf on 11/05/2012

Xenakis J G, Kinter E T, Ishak K J, Ward A J, Marton J P, Willke R J, et al. A discrete-event simulation of smoking-cessation strategies based on Varenicline Pivotal Trial data. *Pharmacoeconomics* 2011; 29(6): 497-510.

Studies for which full text was irretrievable (N=4)

Croghan IT, Offord KP, Evans RW, Schmidt S, Gomez-Dahl LC, Schroeder DR, Patten CA, Hurt RD. Cost-effectiveness of treating nicotine dependence: the Mayo Clinic experience

Eddy D M, Peskin B, Shcheprov A, Pawlson G, Shih S, Schaaf D. Effect of smoking cessation advice on cardiovascular disease.

Hill A Cost-effectiveness evaluation of single and combined smoking cessation interventions in Texas.

Hueston A cost-benefit analysis of smoking cessation programs during the first trimester of pregnancy for the prevention of low birthweight.

8.0 Appendix A: Search strategies and results

8.1 Database searches

The search strategy was written by Rupert Lee at the British Library, in partnership with Matrix Reviews and NICE, and based on the search strategies developed by EPPI for the effectiveness reviews for this guidance. All results were imported into a bibliographic management tool for screening and management.

The search approach was systematic and exhaustive.

Table A1. Database searches results

Database	Search date	Hits
1. EconLit	02/03/2012	219
2. HEED	02/03/2012	355
3. NHS EED	02/03/2012	320
Total		*894*

Note: After de-duplication, there were a total of 872 unique studies.

8.1.1 Searching of electronic databases: strategy

Searches were based on the strategies developed by EPPI for the effectiveness reviews for this project.

1. HEED

1. AX=(smoking OR smoker* OR tobacco OR nicotine OR cigar*)

2. AX=(cessation OR quit OR quitting OR smoke free OR smokefree OR 'tobacco free' OR 'cigarette free' OR 'give up' OR 'giving up' OR abstinen* OR nonsmok* OR antismoking OR 'anti smoking' OR 'no smoking')

3. AX=('secondary care' OR 'secondary healthcare' OR 'secondary health' OR 'acute care' OR 'acute settings' OR 'acute services' OR 'acute wards' OR 'acute departments' OR 'acute units' OR 'maternity care' OR antenatal OR perinatal

4. AX=(prenatal OR 'maternal health' OR obstetric* OR gynaecolog* OR gynecolog* OR 'mental health services' OR psychiatric OR 'mental health units' OR 'secure units' OR 'day centres' OR 'day centers' OR 'day units' OR 'prison healthcare')

5. AX=('prison health' OR postdischarge OR specialist OR 'staff residencies' OR 'staff accommodation' OR hospital* OR ambulance* OR 'health centres' OR 'health centers' OR 'care centres' OR 'care centers' OR inhospital OR 'clinical care')

6. AX=(hospice* OR inpatient* OR outpatient* OR patient* OR rehabilitation OR residential OR 'long term care OR 'long term healthcare' OR 'community care')

7. CS=(1 AND 2)

8. CS=(3 OR 4 OR 5 OR 6)

9. CS=(7 AND 8)

2. NHS-EED

1. (smoking OR smoker* OR tobacco OR nicotine OR cigar* OR hand roll* OR handroll* OR bidi* OR beedi* OR rolie* OR paan OR gutkha OR snuff OR betel OR smoke free OR smoking free OR smokefree OR antitobacco OR smoker* OR nonsmoker*) in All Text
   OR
   Smoking in Keywords

   AND

2. (cessation OR cease* OR ceasing OR quit OR quitting OR smoke free OR smokefree OR tobacco free OR cigarette free OR give up OR giving up OR abstinen* OR nonsmok* OR antismoking OR anti smoking OR no smoking OR reduce* OR reducing OR reduction OR restrict* OR polic* OR rule* OR law* OR regulation* OR ordinance* OR zone* OR spaces OR environment* OR facilit* OR area* OR bans OR ban OR banning OR second hand OR secondhand OR passive OR environmental smoke OR involuntary smoking OR pollution* OR workplace* OR place* OR space* OR facility OR facilities OR area* OR location* OR premises OR propert* OR site* OR building* OR campus* OR ground* OR establishment* OR room* OR shelter* OR environment* OR strategy OR strategies OR initiative* OR program* or intervene* OR scheme OR schemes OR outreach OR communicat* OR support* OR incentive* OR act OR acts OR policy OR policies OR rule* OR hospital guideline* OR law* OR regulation* OR ordinance* OR legislat* OR code* OR compliance OR restrict* OR prohibit* OR control OR sanction* OR eliminat* OR remov* OR restrict* OR eradicat* OR curb* OR enforce* OR enforcing) in Title, abstract or keywords
   OR

Social Control Policies OR Social Control, Formal OR Legislation as Topic OR Legislation, Hospital OR Organizational Policy" OR Public Policy OR Health Policy) in Keywords

3. (smoking cessation OR tobacco use cessation OR Tobacco Smoke Pollution) in Keywords

4. (1 AND 2) OR 3

5. (secondary care OR secondary healthcare OR secondary health care OR acute care OR acute setting* OR acute service* OR acute health service* OR acute ward* OR acute department* OR acute unit* OR surgical OR surgery OR maternity care OR antenatal OR perinatal OR prenatal OR maternal health OR primip* OR primigravid OR mental health service* OR psychiatric service* OR psychiatric unit* OR mental health unit* OR secure unit* OR day centre* OR day center* OR day unit* OR prison healthcare OR prison health OR acutely ill OR postdischarge* OR specialist unit* OR staff residenc* OR staff accommodation) in all fields
OR
(hospital OR hospitals OR acute trust* OR ambulance* OR health centre* OR health center* OR care centre* OR care center* OR inhospital OR surgical OR national health service* OR accident OR emergency OR emergencies OR health authorities OR health board* OR clinical care OR clinical unit* OR care facilities OR care facility OR care unit* OR care trust OR elective care OR medical care OR health system* OR health trust* OR PCTs OR NHS Trust* OR healthcare unit* OR heath authority OR hospice* OR hospital OR hospitals OR admitted OR admission* OR maternity OR obstetric* OR gynaecolog* OR gynecolog* OR pregnan* OR inpatient* OR outpatient* OR patient* OR hospitaliz* OR hospitalis* OR rehabilitation OR psychiatric OR residential care OR long term care OR long term health care OR long term healthcare OR specialist care OR speciality care OR specialised care OR specialized care OR special care OR readmitted OR re-admitted OR ward* OR community care) in title
OR
(Administrative Personnel OR Adolescent, Hospitalized OR Cancer Care Facilities OR Cardiac Care Facilities OR Child, Hospitalized OR Emergency Medical Services OR Emergency Service, Hospital OR Home Care Services OR Home Care Services, Hospital-Based OR Hospices OR Hospital Administration OR Hospital Administrators OR Hospital Communication Systems OR Hospital Design and Construction OR Hospital Units OR Hospitalization OR Hospitals, Chronic Disease OR Hospitals, Community OR Hospitals, Convalescent OR Hospitals, County OR Hospitals, District OR Hospitals, Federal OR Hospitals, General OR Hospitals, Isolation OR Hospitals,

Maternity OR Hospitals, Municipal OR Hospitals, Osteopathic OR Hospitals, Pediatric OR Hospitals, Private OR Hospitals, Proprietary OR Hospitals, Psychiatric OR Hospitals, Public OR Hospitals, Religious OR Hospitals, Rural OR Hospitals, Satellite OR Hospitals, Special OR Hospitals, State OR Hospitals, Teaching OR Hospitals, University) in Keywords
OR
(Hospitals, Urban OR Hospitals, Voluntary OR Hospitals OR Inpatients OR Legislation, Hospital OR Maintenance and Engineering, Hospital OR Maternal Health Services OR Medical Staff, Hospital OR Nurse-Patient Relations OR Nursing Staff, Hospital OR Obstetrics and Gynecology Department, Hospital OR Outpatient Clinics, Hospital OR Outpatients OR Patient Acceptance of Health Care OR Patient Admission OR Patient Advocacy OR Patient Compliance OR Patients OR Personnel, Hospital OR Physician-Patient Relations OR Psychiatric Department, Hospital OR Psychiatric Nursing OR Surgicenters OR Visitors to Patients OR Health Facilities OR Health Facility AdministrationOR Health Facility Environment OR Psychiatric Department, Hospital OR Hospitals, Psychiatric OR Psychiatric Nursing OR Mentally Ill Persons OR Mental Health Services OR Community Mental Health Services OR Emergency Services, Psychiatric OR Social Work, Psychiatric) in Keywords

6. 4 AND 5

3. EconLit

1. (smoking OR smoker* OR tobacco OR nicotine OR cigarette* OR cigar* OR hand roll* OR handroll* OR bidi* OR beedi* OR rolie* OR paan OR gutkha OR snuff OR betel)

   AND

2. (cessation OR cease* OR ceasing OR quit OR quitting OR smoke free OR smokefree OR tobacco free OR cigarette free OR give up OR giving up OR abstinen* OR nonsmok* OR antismoking OR anti smoking OR no smoking OR reduce* OR reducing OR reduction OR restrict* OR polic* OR rule* OR law* OR regulation* OR ordinance* OR zone* OR spaces OR environment* OR facilit* OR area* OR bans OR ban OR banning OR second hand OR secondhand OR passive OR environmental smoke OR involuntary smoking OR pollution* OR workplace* OR place* OR space* OR facility OR facilities OR area* OR location* OR premises OR propert* OR site* OR building* OR campus* OR ground* OR establishment* OR room* OR shelter* OR environment* OR

strategy OR strategies OR initiative* OR program* or intervene* OR scheme OR schemes OR outreach OR communicat* OR support* OR incentive* OR act OR acts OR policy OR policies OR rule* OR hospital guideline* OR law* OR regulation* OR ordinance* OR legislat* OR code* OR compliance OR restrict* OR prohibit* OR control OR sanction* OR eliminat* OR remov* OR restrict* OR eradicat* OR curb* OR enforce* OR enforcing)

AND

3. secondary care OR secondary healthcare OR secondary health care OR acute care OR acute setting* OR acute service* OR acute health service* OR acute ward* OR acute department* OR acute unit* OR surgical OR surgery OR maternity care OR antenatal OR perinatal OR prenatal OR maternal health OR primip* OR primigravid OR mental health service* OR psychiatric service* OR psychiatric unit* OR mental health unit* OR secure unit* OR day centre* OR day center* OR day unit* OR prison healthcare OR prison health OR acutely ill OR postdischarge* OR specialist unit* OR staff residenc* OR staff accommodation OR hospital OR hospitals OR acute trust* OR ambulance* OR health centre* OR health center* OR care centre* OR care center* OR inhospital OR surgical OR national health service* OR accident OR emergency OR emergencies OR health authorities OR health board* OR clinical care OR clinical unit* OR care facilities OR care facility OR care unit* OR care trust OR elective care OR medical care OR health system* OR health trust* OR PCTs OR NHS Trust* OR healthcare unit* OR heath authority OR hospice* OR hospital OR hospitals OR admitted OR admission* OR maternity OR obstetric* OR gynaecolog* OR gynecolog* OR pregnan* OR inpatient* OR outpatient* OR patient* OR hospitaliz* OR hospitalis* OR rehabilitation OR psychiatric OR residential care OR long term care OR long term health care OR long term healthcare OR specialist care OR speciality care OR specialised care OR specialized care OR special care OR readmitted OR re-admitted OR ward* OR community care

8.2 Website searches

We searched the NICE website for cost-effectiveness reviews on smoking cessation. The citation lists of these reviews were searched for additional studies of relevance to this review. No additional studies were identified.

8.3 Other sources

We also screened economic studies identified by the teams carrying out the effectiveness reviews for relevance to the cost-effectiveness review. A total of 15 citations were screened but none were added to the review.

8.4 Citation chasing

After full-text screening was completed, the citation lists of included studies and relevant systematic reviews were scanned for relevant titles, which were then screened for inclusion. This yielded two new studies that were included in the review (Windsor et al., 1993; Marks et al., 1990).

9.0 Appendix B. Screening checklist

Table B1. Screening checklist

	CRITERIA	INCLUSION CODE	NOTES
Q1	**ENGLISH LANGUAGE PAPER**	If not **1_EX.LANG**	
Q2	**DATE** • 1990 +	If not 2_**EX.DATE**	
Q3	**COUNTRY** • UK and OECD countries	If not 3_**EX.COUNTRY** **Tick the relevant box to indicate if it is UK or OECD (non-UK).**	**OECD countries**: Australia; Austria; Belgium; Canada; Chile; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Israel; Italy; Japan; Korea; Luxembourg; Mexico; Netherlands, Norway; New Zealand; Poland; Portugal; Slovak Republic; Slovenia; Spain; Sweden; Switzerland; Turkey; United Kingdom, United States.
Q4	**POPULATION** **Any smoker of any age** who: • uses acute and maternity services or secondary care mental health services, • lives in the same household as someone who is using acute and maternity services or secondary care mental health services, such as partners, parents, other family members and carers; • visits acute or maternity settings or secondary care	If not **4_EX.POP**	**Also include:** • those who are in the process of being referred to or are recently discharged from acute and maternity hospitals and units; • child, adolescent, adult and older people's mental health services; community mental health teams; inpatient, residential and long-term care for severe mental illness in a hospital, psychiatric and specialist unit or secure hospital 1. All staff… including support staff, volunteers, agency/locum staff, staff

	mental health settings; • works in acute, maternity care or secondary care mental health settings, in particular those who have direct contact with people using the services (including support staff, volunteers, those working for agencies or as locums and people employed by contractors).		employed by contractors, office, coffee shop, grounds staff etc
Q5	**INTERVENTION** • Specific interventions (approaches, products or therapies) that aim to support people to stop smoking or abstain temporarily before or during their acute admission or attendance at a secondary care setting or other settings outlined below; family and visitors of these people and staff and volunteers working in these settings or providing secondary care services to patients. • Individual studies will be included if they have a specific focus on the economic impact of smoking cessation interventions,	If not **5_EX.INT**	These interventions will include **behavioural interventions, self-help approaches and pharmaceutical and nicotine replacement products**. We will also include economic studies exploring the impact of **smokefree strategies**, strategies that encourage compliance with **smokefree policies**, and **approaches for identifying and referring people to stop smoking** services implemented at an individual hospital/other secondary care setting or secondary care healthcare organisations. Studies will also be included if they may contain useful cost and resource data, which will be flagged for the economic model, and relevant effectiveness studies will be flagged for the attention of the effectiveness review teams.

	temporary abstinence and smokefree approaches in acute, maternity and mental health secondary care settings.		
Q6	**SETTING** • economic studies that were carried out entirely within **secondary care acute, maternity or mental health settings**, studies that were initiated in such settings but then continued in other settings, and studies that were initiated in primary care or other settings but continued in acute, maternity and mental health secondary care settings, or provided in other settings by secondary care staff.	If not **6_EX.SETTING**	We will only include studies where the focus was on interventions that were carried out in secondary care; where the intervention was predominantly carried out in secondary care settings; or where the intervention was carried out in other settings for people on the basis that they have recently had, or are due to receive, care in a relevant secondary care setting. Relevant community settings will include private residences, care homes, community-based services and other community settings where specific reference is made to secondary care professionals' impact on the implementation of smokefree policies within that setting. **NB:** If it is not clear, rather include for a decision to be made on FTS.
Q7	**OUTCOMES** • Studies will be included if they report relevant outcomes for the economic model or cost-effectiveness review. These include, but are not limited to:: • successful quit attempts for patients, visitors and staff for interventions carried out in acute secondary care settings, measured as temporary (during the	If not **7_EX. OUTCOME**	As it is difficult to be sure from abstract what outcomes are reported, only exclude studies that do not report on any clinically or economically relevant outcomes.

	admission), and at 1, 6 and 12 months or longer after the quit attempt; • number of referrals to and contacts with stop smoking services, and the costs of such referrals; • number of violations of a smokefree policy, number of smokers who continue to violate such a policy, or number of cigarettes smoked on the premises of an acute healthcare organisation with a smokefree policy; • use or uptake of NRTs and other smoking cessation interventions; • costs of smoking cessation interventions and comparators; • cost savings from health improvements by prevention of disease or complications of treatment for the patients, their babies, and their family and household members; • health resource use in terms of consultations, days in hospital, costs of healthcare staff and services; • health-related quality of life impacts; • number of cigarettes smoked per day; • relapse rates; and adverse clinical outcomes including incidence or prevalence of smoking-related diseases such as acute exacerbations of asthma, chronic obstructive pulmonary		

Q8	**STUDY DESIGN** • cost-benefit analyses; • cost-effectiveness studies; and • cost-utility analyses • studies that compare the intervention with no intervention, or with usual practice, or which compares two or more intervention types	Studies that meet all inclusion criteria: **8_IN.ECON** Systematic reviews that include any of the study types: **9_IN.SYSTREV** If not but looks at effectiveness: **10_IN.EFFECT** If relevant to the topic but does not contain data but is an opinion piece include as: **11_IN.BACKGROUND** Studies that report useful cost and resource data include as: **12_IN.COST** If unclear: **Q_Query**	Systematic reviews that include any of the study types listed above will be identified; these will be used as a source of further primary studies rather than included in the review in their own right. Studies that report useful cost and resource data: These costing studies will be excluded from the cost-effectiveness review but will be recorded separately and used to inform the development of the economic models.

For cases where inclusion is unclear, code as **Q_QUERY** and save to discuss with screening team.

10.0 Appendix C: Evidence tables

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Barnett *et al.* **Year:** 2008 **Citation:** Barnett, P. G., Wong, W., & Hall, S. (2008). The cost-effectiveness of a smoking cessation program for out-patients in treatment for depression. *Addiction (Abingdon, England)*, *103*(5), 834–840. **Aim of study:** To evaluate the cost-effectiveness of a smoking cessation programme directed at individuals receiving out-patient treatment for depression. **Type of economic analysis:** cost-effectiveness analysis. **Economic perspective:** health-	**Source population/s:** Smokers receiving secondary care mental health services. **Setting:** Out-patient mental health clinics in the US. **Data sources:** Data collected as part of this study (RCT): • Number of smoking cessations services used (self-report by patients). • Time spent delivering services (delivering intervention, scheduling follow-up visits, follow-up reminders) (as logged by the counsellor). Used retail cost of nicotine patches; estimated the cost of the brief smoking cessation contact (as $6 per patient). **Sample characteristics:** **Age, mean (S.D)**: control 42.2 (12.8); treatment 41.5 (12.4). **Female:** control 71.1%; treatment 68.1%. **Ethnicity**:	**Intervention/s description:** Stepped care intervention: stepped care approach, patients were given treatment in the following sequence: 1. x3 scheduled assessment of readiness to quit smoking using a computer mediated evaluation that was reviewed by a smoking cessation counsellor. If the participant was at the contemplation of quitting stage or requested treatment then treatment commenced in stage 2. 2. x6 sessions of psychological counselling; plus up to 10 weeks of nicotine replacement therapy with a dermal patch. 3. Those who continued smoking after this treatment were offered sustained-release bupropion; plus 2 additional counselling sessions. **Comparator/control/s description:** Brief contact control: received a printed stop-smoking guide and a list of smoking cessation programmes from the smoking study staff.	**Primary outcomes:** Smoking: abstinence for 7 days (self-report, verified by a carbon monoxide level > 10p.p.m). Depression: Beck Depression Inventory (BDI-II). Incremental cost-effectiveness: cost per successful quit (costs, 2003 US$). **Secondary outcomes:** NR. **Time horizon:** Four assessments over 18-months. **Modelling method:** Used bootstrap method to estimate the uncertainty of the incremental cost-effectiveness. Assumptions tested included how much society would be willing to spend per successful quit. No further information provided on the modelling method.

care payer. **Applicability: +** **Overall quality score: ++** **Intensity: 5**	Caucasian: control 64.8%, treatment 71.8%; African American: control 11.3%, treatment 9.2%; Latin American: 7.6%, control 7.4%; Asian Pacific Islander: control 3.1%, treatment 1.2%; and Other: control 13.2%, treatment 10.4%. **Number of cigarettes smoked per day, mean (S.D.):** control 15.3 (10.3); treatment 15.8 (10.0). **Expired air carbon monoxide concentration (p.p.m.), mean (S.D.)**: control 15.2 (10.2); treatment 15.5 (9.9).	**Sample sizes:** **Total:** N=322, **Intervention:** N=163. **Control:** N=159.	

Results

Primary results:

Smoking (abstinence for 7 days): End of treatment: OR = 4.55 (95% CI 1.04 to 19.9); percentages in each group not reported (in favour of the treatment group)). 18-month follow-up: 24.6% stepped-care group, 19.1% brief contact group; OR/p-values not reported.

Depression (BDI-II): no statistically significant differences reported; no further data provided.

Incremental cost-effectiveness ratio (cost per successful quit): It cost an additional $341 of smoking cessation services to achieve an additional 5.5% quit rate, = $6,204 per successful quit ($341/0.055).
75% of the bootstrap replicated had an ICER less than $20,000 in direct costs per successful quit. If the threshold for willingness to pay was increased to $40,000 per successful quit, the stepped care smoking cessation programme was cost-effective in 79% of replicates using the bootstrap method.

The intervention group incurred an additional $291 in mental health service utilisation compared with the control group, meaning the total additional cost was $632 in the stepped care group to achieve an additional 5.5% quitting. Combined costs of the intervention and the additional service costs meant the Incremental cost-effectiveness ratio (cost per successful quit was $11,496 per successful quit ($632/0.055:). 74% of bootstrap replicates had an ICER less than $40,000 per successful quit, and 81% had an ICER less than $100,000.

Secondary results: N/A.
Notes **Limitations identified by author:** NR. **Limitations identified by review team:** The study was conducted in the USA which may limit the generalisability of the studies to the UK context. **Evidence gaps and/or recommendations for future research:** NR. **Source of funding:** Supported by grants from the National Institute on Drug Abuse.

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Dornelas *et al.* **Year:** 2006 **Citation:** Dornelas EA, Magnavita J, Beazoglou T, Fischer EH, Oncken C, Lando H, Greene J, Barbagallo J, Stepnowski R, & Gregonis E. (2006). Efficacy and cost-effectiveness of a clinic-based counseling intervention tested in an ethnically diverse sample of pregnant smokers. *Patient Educ Couns. 64*(1-3):342-349.	**Source population/s:** Pregnant women who are current smokers receiving tertiary antenatal care services. **Setting:** Out-patient prenatal clinics in the US.. **Data sources:** Data collected as part of this study (RCT): • Point prevalence abstinence (self-report of smoking abstinence for the previous 7 days, confirmed with a carbon monoxide reading and measured at the end of pregnancy and 6 months post-partum). • Quit rate • Cost estimates from Bureau of	**Intervention/s description:** Counselling intervention plus usual care: (a) A 90-minute psychotherapy session provided at the clinic, followed by bi-monthly prenatal telephone calls from the therapist during pregnancy, and monthly telephone calls after delivery. Sessions aimed to (1) assess readiness to quit smoking, (2) quickly engage the participant in treatment, (3) identify potential psychological or social problems that might pose as barriers to quitting, and (4)	**Primary outcomes:** Smoking (abstinence for 7 days): Point prevalence abstinence was measured by self-report but verified by a carbon monoxide level <8 p.p.m. Incremental quit rate at the end of pregnancy: percentage abstinence rate for intervention group – percentage abstinence rate for usual care Incremental cost of producing a quitter at the end of pregnancy: total cost of counselling intervention/incremental number of quitters **Secondary outcomes:** Cost of training and supervising the therapists per patient: cost of training for mental health counsellors/the number of patients who received

Aim of study: To evaluate whether one 90-minute counselling session in a prenatal clinic, with planned telephone follow-up, is efficacious and cost-effective for smoking cessation in an ethnically diverse sample of low-income women. **Type of economic analysis:** cost-effectiveness analysis. **Economic perspective:** Unclear. Study methods suggest a health care payer perspective **Applicability: +** **Overall quality score: +** **Intensity: 4**	Labour and Statistics (2002) **Sample characteristics:** **Age, mean (S.D)**: Whole sample 26.1 (5.8); range 18-42. **Female:** 100.0% **Ethnicity**: (whole sample) Hispanic: 66%; Caucasian: 17%; African American: 11%, Multi-racial or other ethnic category: 6% **Number of cigarettes smoked per day, mean (S.D.):** At baseline 10.93 (8.9); pre-pregnancy 20.8 (12.37).	set a quit date (b) Usual care **Comparator/control/s description:** Usual care: Provision of an educational booklet and insertion of a chart prompt reminding providers to give a personalised quit message at each visit. **Sample sizes:** **Total:** N=105. **Intervention:** N=53. **Control:** N=52.	intervention Quit rate (at the end of pregnancy). **Time horizon:** 15 months; two assessment points - at pregnancy and at 6 months postpartum. **Modelling method:** No information provided on the modelling method.
Results **Primary results:** Smoking (abstinence for 7 days): • End of pregnancy abstinence rates (intervention group): 28.3%; End of pregnancy abstinence rates (control group): 9.6%; x^2=5.94(1), p=0.015. • 6-months post partum abstinence rates (intervention group): 9.4%, 6-months post partum abstinence rates (control group) 3.8%; x^2=NR; p=0.251. Incremental quit rate at the end of pregnancy: 18.7%			

Incremental cost-effectiveness ratio (cost per successful quitter): total cost of counselling intervention = $298.76 per successful quit ($56.37 X 53 subjects/10: it costs an additional $298.76 of counselling intervention services to get an additional quitter).

Secondary results:
Cost of training and supervising the therapists per patient: $46.67/patient

Subgroup analyses showed that women who were less than 25 years old and were less than 18 weeks into their pregnancy were most likely to quit, with a 60% end of pregnancy quit rate compared with 0% in the corresponding control group. Older women, and women later in their pregnancy, were not significantly more likely to quit with the intervention than the corresponding controls.

Notes

Limitations identified by author:

- Only 68% of the intervention group attended the counselling sessions, so it cannot be confirmed that the counselling session was effective.
- Results may not be generalisable to women treated in private practice medical offices.
- The intervention is designed for an environment where comprehensive prenatal care is delivered on site.

Limitations identified by review team:

- The study was conducted in the USA which may limit the generalisability of the study to the UK context.
- A discount rate was not used.
- Health effects were not expressed in terms of QALYs.
- There was no description of the economic model used and as such no sensitivity analysis was reported.

Evidence gaps and/or recommendations for future research:

- Further research may be required to ascertain if the results are generalisable to pregnant smokers who are from a higher socio-economic class treated in a similar setting.
- Also, there will be a need for the modification of identification and referral system if the intervention were to be applied in pregnant smokers in private practice medical offices.
-

Source of funding:

- Patrick and Catherine Weldon Donaghue Medical Research Foundation
- Hartford Hospital Research Endowment Funds

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Hejblum *et al.* **Year:** 2009 **Citation:** Hejblum G, Atsou K, Dautzenberg B, Chouaid C. (2009) Cost-benefit analysis of a simulated institution-based preoperative smoking cessation intervention in patients undergoing total hip and knee arthroplasties in France. *Chest. 135*(2):477-83 **Aim of study:** To estimate the cost of preoperative intervention for smoking cessation (PISC) and its impact on hospitalisation costs for a given healthcare institution investing in it. **Type of economic analysis: C**ost-benefit analysis. **Economic**	**Source population/s:** simularted population of patients admitted for total hip and knee arthroplasties in France. **Setting:** Hospital **Data sources:** • Probability of stopping smoking with PISC intervention • Probability of complications in a given patient • Median length of stay in an orthopaedic hospital – whether with complications or not • Number of days spent in intensive care • Cost of hospital stay per patient (in 2008 Euros) • Cost of PISC per patient (in 2008 Euros) **Sample characteristics:** **Age, mean (S.D)**: NR **Female:** NR **Ethnicity**: NR	**Intervention/s description:** Preoperative intervention for smoking cessation (PISC): • Initial interview and brief weekly contacts with specialised nurse, which includes measurement of carbon monoxide in expired air to evaluate smoking status • Nicotine replacement therapy • Intervention commences 6 to 8 weeks prior to surgery (arthroplasties) **Comparator/control/s description:** Patients not subjected to preoperative intervention for smoking cessation **Sample sizes:** **Total:** 1000000 **Intervention:** NR **Control:** NR	**Primary outcomes:** • Average cost of hospital stays per patient (across different scenarios) **Secondary outcomes:** Sensitivity analysis: • Length of stay in orthopaedic hospital • Probability of a patient developing a complication • Length of stay in the intensive care unit for a patient with complications • Cost of hospital stay per patient • Cost per day of intensive care unit **Time horizon:** 6 to 8 weeks **Modelling method:** • Multistate Markov-type model was used to simulate hospital course for a hypothetical cohort of 1 million patients • Monte Carlo simulations were simulated as a four-step process

perspective: Institutional payer's perspective **Applicability: +** **Overall quality score: ++** **Intensity: 4**			

Results

Primary results:

The RCT on which the model was based found that 64% of the PISC group stopped smoking compared with 7.7% of the control group.

Average cost of hospital stay per patient (2008 Euros):

Intervention €6246; control €6559 respectively. This would result in a cost benefit of €313 per patient compared to the €196 estimated cost of the PISC. Consequently, there is a positive net monetary benefit of €313 - €196 = €117 between the cost and the benefit of PISC

Secondary results:

Sensitivity analysis

- *If the mean length of orthopaedic hospital stay for PISC patients becomes the same as for patients in the control group, the average total cost of hospital stay per patient (2008 Euros)*

  Intervention €6248; control €6559 respectively. This would result in a cost benefit of €311 per patient compared to the €196 estimated cost of the PISC.

- *If the probability of a PISC patient developing complications increases to 2 in 56 from 1 in 56, the average total cost of hospital stay per patient (2008 Euros)*

  Intervention €6304; control €6559 respectively. This would result in a positive cost benefit of €255 per patient compared to the €196 estimated cost of the PISC.

- *If the probability of a PISC patient developing complications increases to 3 in 56 from 1 in 56, the average total cost of hospital stay per patient (2008 Euros)*

  Intervention €6361; control €6559 respectively. This would result in a positive cost benefit of €198 per patient compared to the €196 estimated cost of the PISC.

- *If the probability of a PISC patient developing complications increases to 4 in 56 from 1 in 56, the average total cost of hospital stay per patient (2008 Euros)*

  Intervention €6417; control €6559 respectively. This would result in a negative cost benefit of €142 per patient compared to the €196 estimated cost of the PISC.

- *If there is a mean decrease of the number of days spent in the intensive care unit from 5 days to 4 days in any group of patients with complications, the average total cost of hospital stay per patient (2008 Euros)*

  Intervention €6233; control €6484 respectively. This would result in a positive cost benefit of €251 per patient compared to the €196 estimated cost of the PISC.

- *If there is a mean decrease of the number of days spent in the intensive care unit from 5 days to 3 days in any group of patients with complications, the average total cost of hospital stay per patient (2008 Euros)*

  Intervention €6224; control €6412 respectively. This would result in a negative cost benefit of €187 per patient compared to the €196 estimated cost of the PISC.

- *If the cost of hospital stay for a 6 to 38 days admission for patients in any group is €7218.68, then €349.25/additional day, the average total cost of hospital stay per patient (2008 Euros)*

  Intervention €7407; control €7718 respectively. This would result in a positive cost benefit of €311 per patient compared to the €196 estimated cost of the PISC.

- *If the cost of hospital stay for a 4 to 29 days admission for patients in any group is €5702.27, then €361.85/additional day, the average total cost of hospital stay per patient (2008 Euros)*

  Intervention €5999; control €6313 respectively. This would result in a positive cost benefit of €314 per patient compared to the €196 estimated cost of the PISC.

- *If the cost per day in the intensive care unit for patients in any group decreases to €419.58, the average total cost of hospital stay per patient (2008 Euros)*

  Intervention €6227; control €6438 respectively. This would result in a positive cost benefit of €211 per patient compared to the €196 estimated cost of the PISC.

- *If the cost per day in the intensive care unit for patients in any group increases to €838.16, the average total cost of hospital stay per patient (2008 Euros)*

  Intervention €6263; control €6680 respectively. This would result in a positive cost benefit of €415 per patient compared to the €196 estimated cost of the PISC.

Notes

Limitations identified by author:

- The cost benefit analysis did not include a discounting correction.
- The data came from a single randomized control trial that may not reflect outcomes in general practice.

Limitations identified by review team:

- The study was conducted in the France which may limit the generalisability of the study to the UK context.

Evidence gaps and/or recommendations for future research:

- There is no data on any period of optimal preoperative smoking cessation.

Source of funding:

- Office Français de Prévention du Tabagisme and Direction Générale de la Santé .

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Krumholz *et al.* **Year:** 1993	**Source population/s:** Smokers hospitalised with an acute myocardial infarction.	**Intervention/s description:** Smoking cessation programme: nurse-managed; for smokers once they become clinically stable. Nurse	**Primary outcomes:** Cost-effectiveness ratio: cost of the programme per life-year of life saved.

Citation: Krumholz, H. M., Cohen, B. J., Tsevat, J., Pasternak, R. C., & Weinstein, M. C. (1993). Cost-effectiveness of a smoking cessation program after myocardial infarction. *Journal of the American College of Cardiology*, *22*(6), 1697–1702. **Aim of study:** To determine the cost-effectiveness of a reported smoking cessation programme for smokers hospitalised with an acute myocardial infarction and to compare it with that of other medical therapies. **Type of economic analysis:** cost-effectiveness. **Intensity: 5**	**Setting:** Hospitals in the US. **Data sources:** Efficacy results: from a trial (Taylor *et al.*, 1990)[3]. Survival data: 5 year mortality rates calculated from Aberg *et al.* (1983)[4]. Costs: unclear what source was used for cost data but included intervention and professional costs. It did not include the costs of training the nurses to deliver the intervention and the cost of setting up the program. **Sample characteristics:** N/A	reviews with the patient the risks of continued smoking and the benefits of smoking cessation. A manual is provided that explains how to identify high risk smoking situations and provides coping strategies to minimise risk. Intervention provided in hospital plus weekly follow-up calls in the community for three weeks; and then monthly for four months. **Comparator/control/s description:** Treatment as usual (TAU): usual smoking cessation counselling for survivors of acute myocardial infarction. Included usual post-myocardial infarction care for smokers, consisting of a firm, unequivocal message from doctors and nurses to the patients to stop smoking. **Sample sizes:** N/A **Total:** N/A **Intervention:** N/A **Control:** N/A	**Secondary outcomes:** NR. **Time horizon:** Intervention follow-up: one year; survival data: 8 years. **Modelling method:** Efficacy outcomes: 71 /100 smokers in the intervention group would stop smoking; and 45/100 in TAU group would stop smoking. Assumed that intervention programme would help an additional 26/100 smokers quit smoking. Sensitivity analysis: effectiveness of the programme; discounted life-years gained; discounted life-years saved; intervention costs; annual discounted medical costs.

[3] Taylor, C. B., Houston-Miller, N., Killen, J. D., & DeBusk, R. F. (1990). Smoking cessation after acute myocardial infarction: effects of a nurse-managed intervention. *Annals of Internal Medicine*, *113*(2), 118–123.

[4] Aberg, A., Bergstrand, R., Johansson, S., Ulvenstam, G., Vedin, A., Wedel, H., Wilhelmsson, C., et al. (1983). Cessation of smoking after myocardial infarction. Effects on mortality after 10 years. *British Heart Journal*, *49*(5), 416–422.

Economic perspective: NR. **Applicability:** [+] **Quality score:** [++]			

Results:

Primary results:

Cost per smoker who quits: : $380 (cost per participant: $100 x the number of participants needed to produce an ex-smoker: 3.8).
Discounted life-years gained: 1.7 years.
Incremental cost-effectiveness ratio (cost of the programme per discounted life-years saved): $220.

Secondary results:

Sensitivity analysis on the cost-effectiveness ratio (cost of the programme per discounted life-years saved):
In all sensitivity analyses, the cost-effectiveness ratio was <$20,000.00:

- If the effectiveness of the programme decreased to 3 quitters per 1,000 smokers: $19,610.00 (baseline: 26/100).
- If the discounted life-years gained decreased to 0.10: $3,850.00 (baseline: 1.7).
- If the cost of the programme increased to $2,000.00: $4,520.00 (baseline $100.00).
- Medical care costs incurred during the years gained to $10,000.00: $10,230.00 (baseline $0.00).

Notes

Limitations identified by author: The model used a conservative estimate of the cost-effectiveness of the smoking cessation programme that tended to bias the analysis against the intervention. For example, the model did not incorporate savings from the expected decrease in the incidence of cancers, stroke and other related diseases.

Based the effectiveness of smoking cessation programmes on large observational studies as no RCT had been published. Within these observation studies, there were differences between treatment groups as baseline which may have biased the results. However, this was explored in a sensitivity analysis.

Baseline estimate of the discounted survival benefit was calculated based on a single declining exponential model of survival in both groups; this may have overestimated the survival benefit overtime. However, this was explored in a sensitivity analysis.

Limitations identified by review team: Unclear reporting of the economic perspective.

Evidence gaps and/or recommendations for future research: NR.

Source of funding: NR.

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Ladapo *et al.* **Year:** 2011 **Citation:** Ladapo JA, Jaffer FA, Weinstein MC, Froelicher ES. (2011). Projected cost-effectiveness of smoking cessation interventions in patients hospitalized with myocardial infarction. *Arch Intern Med. 171*(1):39-45 **Aim of study:** To perform an up-to-date economic appraisal of smoking cessation counselling with follow-up supportive contact in patients with acute myocardial infarction (AMI). **Type of economic analysis:** cost-utility analysis.	**Source population/s:** Smokers hospitalised with myocardial infarction. **Setting:** Hospitals in the US. **Data sources:** • Probability of successful quitting (meta-analysis of smoking cessation interventions in hospitalised patients) • Probability of death and nonfatal AMI (meta-analysis of observational studies enrolling patients with cardiac heart disease – CHD- most of which were hospitalised for AMI). • Utility weights for health states (Euro-QoL-5D utilities from a nationally representative sample in the United States) • Medical cost of smoking cessation and follow-up contact (national average wage of nurses and price of *Active Partnership for the Health of*	**Intervention/s description:** Counselling and supportive follow-up option: (c) An evidence-based smoking cessation regimen consisting of a behavioural counselling session before discharge, the American Heart Association's *Active Partnership for the Health of Your Heart* workbook and DVD, and follow-up telephone calls at 2-days, 1 week, 3 weeks, 4 weeks, and 3 months after discharge. (d) Usual care **Comparator/control/s description:** Usual care: Standard smoking cessation consultation, including advice to quit smoking and provision of printed materials on smoking cessation, from the American Heart Association like *How Can I Quit Smoking?*	**Primary outcomes:** • Incremental cost-effectiveness: cost per QALY (costs, 2008 US$). • Incremental cost-effectiveness: cost per LY (costs, 2008 US$). **Secondary outcomes:** Sensitivity analysis: • Incidence of nonfatal AMI • Annual risk of mortality • Cost of counselling (varied to reflect the mean wage of a medical social worker – lower costs - or increased time/material requirements for a nurse performing counselling and follow-up- higher costs) • Utility after a recurrent AMI • Probability of quitting smoking (including the odds of success in patients who received treatment with nicotine replacement therapy, bupropion hydrochloride, or varenicline). **Time horizon:** 10 years.

Economic perspective: Societal **Applicability: +** **Overall quality score: ++** **Intensity: 4**	*Your Heart* workbook and DVD) • Cost of nonfatal AMI (Healthcare Cost and Utilisation Project Nationwide Inpatient Sample) • Cost of baseline healthcare and CHD-related care (model derived by Centres for Medicare and Medicaid Services) • Nonmedical expenditures (Consumer Expenditure Survey 2008 for the general 55-year old population) **Sample characteristics:** **Age, mean (S.D)**: NR **Female:** whole sample - 10%. **Ethnicity**: N/A	**Sample sizes:** **Total:** N=327,600 **Intervention:** N=NR **Control:** N=NR	**Modelling method:** • Outcomes projected for a hypothetical US cohort of smokers hospitalised for AMI • Time horizon limited to a range for which there was less certainty • Model used a Monte-Carlo simulation framework • Base care analysis was conducted • Discount rate of 3% was used for outcomes for each year • Sensitivity analyses conducted for changes in incidence of nonfatal AMI, annual risk of mortality, cost of counselling (varied to reflect lower costs or higher costs), utility after a recurrent AMI, and probability of quitting smoking (including pharmacotherapy).

Results
It was estimated that providing the intervention for the 2010 US cohort of smokers hospitalised with AMI would cost $27.3 million in nurse wages and educational materials, would generate 50,230 new quitters, and prevent 1,380 non-fatal AMIs and 7,860 all-cause deaths.

Primary results:
Incremental cost-effectiveness: $5050/QALY (costs, 2008 US$) – It costs an additional $5050 to achieve an extra QALY

Incremental cost-effectiveness: $4350/LY (costs, 2008 US$) – It costs an additional $4350 to achieve an extra LY

Secondary results:
Incidence of nonfatal AMI (if varied from 2.2% to 4%): The number of AMIs increased from 1380 to 7580 and ICER decreased to $1700/QALY from $5050/QALY

Annual risk of mortality : NR

Cost of counselling (when using medical social workers): Fell to $64 and cost per patient who quit fell to $420

Utility after a recurrent nonfatal AMI (when utility fell from 0.83 to 0.70): An additional 1550 QALYs were gained compared to the base case, and ICER fell to $4940/QALY

Incremental cost-effectiveness (for including pharmacotherapy):
Pharmacotherapy would increase the numbers of quitters and reduce the number of AMIs and deaths, but would increase cost per QALY by increasing costs of on-going healthcare:

- Nicotine replacement therapy: quitters would increase by 104,000 at a cost-effectiveness ratio (CER) of $11,400/QALY
- Bupropion: quitters would increase by 109,000, at CER of $11,600/QALY
- Varenicline: quitters would increase by 120,000, at CER of $13,700/QALY

Notes

Limitations identified by author:

- Outcomes do not incorporate the effects of smoking cessation on other co-morbidities associated with smoking e.g. stroke, lung disease, cancer etc
- Model's follow-up time was limited to 10 years as this was the period for which data on the effect of quitting smoking on survival were available
- There is also no data on long term smoking cessation rates
- Dynamic changes in smoking, non-adherence and costs related to adverse medication effects were not modelled
- Productivity costs and non-medical expenditures were not specific to AMI patients
- 90% of the study population were male and as such results may not be generalisable to women

Limitations identified by review team:

- The study was conducted in the USA which may limit the generalisability of the study to the UK context.
- Discount rate used was 3% and no ICER thresholds were used

Evidence gaps and/or recommendations for future research:

- The actual effects of pharmacotherapy combined with counselling and follow-up on quit rates in the AMI population has not been well

studied.

- Further research may be required whether the results are generalisable to pregnant smokers who are from a higher socio-economic class treated in a similar setting.
- Also, there will be a need for the modification of identification and referral system if the intervention were to be applied in pregnant smokers in private practice medical offices

Source of funding:

- NR

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Mani *et al.* **Year:** 2011 **Citation:** Mani, K., Wanhainen, A., Lundkvist, J., & Lindström, D. (2011). Cost-effectiveness of intensive smoking cessation therapy among patients with small abdominal aortic aneurysms. *Journal of Vascular Surgery;*	**Source population/s:** 65 year old male smokers with small AAA in Sweden. **Setting:** Patients who may need access to secondary services for elective AAA repair or treatment of rupture. **Data sources:** Literature review and analysis of available data from the Swedish Vascular Registry (Swedvasc) and from local registries were used.	**Intervention/s description:** Smoking cessation programme: 8 week smoking cessation programme utilised in former trials in perioperative setting (Moller *et al.*, 2002[5]; Lindstrom *et al.*, 2008[6]): • weekly face-to-face motivational counselling sessions with a trained counsellor using cognitive behavioural methods for the first month, then weekly telephone calls for the second month,	**Primary outcomes:** Cost per life year gained. **Secondary outcomes:** Cost per quality adjusted life-year. **Time horizon:** 20 years (from 65 to 85 years) **Modelling method:** Markov model with Monte-Carlo with 100,000 stimulations. An incremental cost per effect of

[5] Møller, A. M., Villebro, N., Pedersen, T., & Tønnesen, H. (2002). Effect of preoperative smoking intervention on postoperative complications: a randomised clinical trial. *Lancet*, *359*(9301), 114–117.

[6] Lindström, D., Sadr Azodi, O., Wladis, A., Tønnesen, H., Linder, S., Nåsell, H., Ponzer, S., et al. (2008). Effects of a perioperative smoking cessation intervention on postoperative complications: a randomized trial. *Annals of Surgery*, *248*(5), 739–745.

54(3), 628–636. **Aim of study:** To evaluate the cost and effect of smoking cessation therapy among patients with screening-detected small abdominal aortic aneurysm (AAA). **Type of economic analysis:** cost-effectiveness and cost-utility analysis. **Economic perspective:** Healthcare providers' perspective. **Applicability:** [+] **Quality score:** [+] **Intensity: 4**	Costs: included cost of smoking cessation intervention; pre-operative follow-up of small AAA; intact AAA repair; and follow-up after AAA repair. **Sample characteristics:** N/A.	• written information about smoking cessation and the telephone number of a hotline providing smoking cessation advice, and • adjuvant nicotine replacement therapy for 8 weeks. **Comparator/control/s description:** No smoking cessation intervention. **Sample sizes:** N/A **Total:** N/A **Intervention:** N/A **Control:** N/A	<€25,000.00 was regarded as acceptable. Costs set at 2009 Euro value.
Results: Total cost of the smoking cessation intervention was €225 per patient. **Primary results:** Costs incurred in the model: intervention group: €13,776; control group: €13,692. Life years gained in the intervention group (compared with the control group): 0.124 QALYs gained in the intervention group (compared with the control group): 0.090 ICER per life year gained: €674.00 **Secondary results:** ICER per QALY gained: €924.00			

Sensitivity analyses: Smoking cessation intervention was cost-effective in all scenarios and was dominant in all scenarios except for: • If the intervention cost were >€3,250. • If there was ≤1% difference in effect.
Notes **Limitations identified by author:** The analysis does not account for the reduction in postoperative morbidity that will occur from preoperative smoking cessation. In addition, the model does not account for the cost-saving effect of smoking cessation in the reduced need for general cardiovascular and pulmonary medication and care. **Limitations identified by review team:** None in addition to the above. **Evidence gaps and/or recommendations for future research:** NR. **Source of funding:** NR.

Study Details	**Population and setting**	**Intervention/ comparator**	**Outcomes and methods of analysis:**
Authors: Marks *et al.* **Year:** 1990 **Citation:** Marks JS, Koplan JP, Hogue CJ, Dalmat ME. (1990). A cost-benefit/cost-effectiveness analysis of smoking cessation for pregnant women. *Am J Prev Med.* Sep-Oct; 6(5):282-9. **Aim of study:** To estimate the cost-effectiveness of a	**Source population/s:** Smokers receiving prenatal health services. **Setting:** Maternal health clinic **Data sources:** Smoking rates: Estimated from the 1985-86 Behavioural Risk Factor Surveillance system (BRFSS). Cost of cessation program: Estimated based on previous programs. Cost of low birth weight hospitalization: From Office of	**Intervention/s description:** **a)** Single 15 minute counselling session by nurse or health educator. **b)** Instructional materials given to patient **c)** Two follow-up phone calls. **Comparator/control/s** **Description:** No treatment programme. **Sample sizes:** **Total:** 3,731,000 (1986 birth cohort), 783,510 with smoking mothers.	**Primary outcomes:** Annual number of low birth weight babies (LBW) Prevention of perinatal deaths Cost-savings: reductions in hospital costs **Secondary outcomes:** Sensitivity analysis: Cost per LBW prevented Costs per participant Proportion of LBW infants requiring NICU care. Relative risk of perinatal death.

smoking cessation program for pregnant women to reduce low birth weight and perinatal mortality. **Type of Economic analysis:** Cost-benefit and cost-effectiveness. **Economic perspective:** NR **Applicability:** + **Quality score:** ++ **Intensity**: 2	Technology Assessment 1984 report (adjusted to 1986 dollars). **Sample characteristics:** theoretical sample of all pregnant women in the US giving birth in 1986.	**Intervention:** N/A **Control:** N/A	**Time horizon:** 75 years **Modelling method**: Costs of smoking cessation program. Also includes costs and savings from preventable LBW infants and perinatal death due to smoking. Costs in 1986 $US. Discounted at 4%

Results
Costs of the intervention were estimated to be $30 per patient.

Primary results:
Additional annual number of LBW caused by maternal smoking: 39,176

Prevention of perinatal deaths (given relative risk of 1.2 for smoker mothers): Estimates that nearly 5% of the 55,840 perinatal deaths in the US in 1985 were caused by maternal smoking. A typical smoking cessation programme with a 15% cessation rate would prevent 388 deaths a year at a cost of an estimated $69,542/death prevented. With a life expectancy of 75 years, costs are $2,943/LY gained (discounted at 4%).

Cost-savings: Net savings of NICU hospitalization costs $77,807,054 (US total) – savings of $3.31 for every $1 spent on the programme. Additional $76,858,080 (total) savings in long term costs by preventing disability in LBW infants who survive, at an average of $3.26 per $1 spent.

Secondary results:

Sensitivity analysis of cost-effectiveness			
Factor considered	Range	Cost/LBW prevented (US$)	Ratio of NICU costs averted

			to costs of program
Percentage cessation	5%	12,000	1.1:1
	25%	2,400	5.5:1
Costs per participant	$5	667	19.8:1
	$100	13,333	1:1
Baseline risk of LBW	3%	6,667	2:1
	12%	1,667	7.9:1
Relative risk of LBW	1.5	8,000	1.7:1
	2.5	2,667	5:1
Worst case[a]		80,000	0.17:1
Best case[b]		267	50:1

[a]Worst case: cessation rate = 5%, cost = $100, RR of LBW = 1.5.
[b]Best case: cessation rate = 25%, cost = $5, RR of LBW = 2.5.

Notes

Limitations identified by author:

They did not consider two sources of possible monetary benefits:

- Lifetime productivity of infants who would have survived or would be born with normal intelligence instead of being retarded and requiring long-term care.
- Benefits accruing from health benefits to the mothers themselves.

Limitations identified by review team:

- The study was conducted in the US which may limit the generalisability of the study to the UK context.

Evidence gaps and/or recommendations for future research: NR

Source of funding: NR

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Meenan *et al.* **Year:** 1998 **Citation:** Meenan, R. T., Stevens, V. J., Hornbrook, M. C., La Chance, P. A., Glasgow, R. E., Hollis, J. F., Lichtenstein, E., et al. (1998). Cost-effectiveness of a hospital-based smoking cessation intervention. *Medical Care*, *36*(5), 670–678. **Aim of study:** To examine the cost-effectiveness of a smoking cessation programme for a general population of hospitalised adults. **Type of economic analysis:** cost-effectiveness. **Economic perspective:** Hospital provider.	**Source population/s:** Smokers cared for in hospital settings in the USA. Patients with a stay of less than 36 hours, hospice patients, postpartum patients and those admitted for substance abuse were excluded. **Setting:** Hospitals (managed by Kaiser Permanente Northwest). **Data sources:** Effectiveness data: based on a clinical trial.[7] Cost data: collected as part of the trial from project surveys, expense reports, retrospective labour estimates; and the health organisation's financial staff. Included the costs for developing the intervention and delivering the intervention including equipment cost. **Sample characteristics:** N/A	**Intervention/s description:** Smoking cessation programme: 20 minute bedside counselling with an experienced counsellor; 12 minute video; self-help materials; and one or two follow-up calls. **Comparator/control/s description:** No intervention. **Sample sizes:** The two Kaiser Permanente hospitals included in the study identified 453 smokers who were included in the analysis. **Total:** N/A **Intervention:** N/A **Control:** N/A	**Primary outcomes:** Cost per person who quit. Costs per life-years saved. **Secondary outcomes:** NR. **Time horizon:** NR. **Modelling method:** Simulated an implementation scenario to replicate an intervention conducted as part of a clinical trial to a non-research environment. Simulations are hypothetical. Cost in 1995 $US. Effectiveness data: Abstinence from smoking was self-reported as consecutive abstinence from all tobacco used at both 3 and 12 month follow-ups. Those lose to follow-up were considered smokers (ITT). Costs and quits were not discounted because they occurred in the first year. Life-years saved were discounted at 5%. Alternative discount rates were applied in a sensitivity analysis (4.3%, 0.6% and 8%).

[7] Stevens, V. J., Glasgow, R. E., Hollis, J. F., Lichtenstein, E., & Vogt, T. M. (1993). A smoking-cessation intervention for hospital patients. *Medical Care*, *31*(1), 65–72.

Applicability: [+] **Quality score:** [+] **Intensity: 3**			
Results After 12 months' follow-up, 9.2% of the control group and 13.5% of the intervention group were considered abstinent (p=0.023). The incremental cost of the intervention was $158.99 based on 1994 US$. **Primary results:** Incremental cost per quit: $3,697.00. Incremental cost per life-years saved: $3,680.00(at an incremental quit rate of 4.3%); at quit rates of 8% to 0.6%; ICER per life-years saved ranged from $1,978.00 to $26,373.00. The cost per discounted life-year saved based on 1994 US$ of $1,691 to $7,444 for the smoking cessation intervention compared well with costs of nicotine gum therapy ($5,885 to $13,555). **Secondary results:** N/A			
Notes **Limitations identified by author:** Estimates assume readily available and experienced health counsellors who require minimal training. This assumption may not be generalisable to smaller hospitals that may not have easy access to counselling services and may need to train internal staff to conduct the smoking cessation intervention. **Limitations identified by review team:** Hypothetical simulation based on one clinical trial, but the effectiveness parameters were tested in a sensitivity analysis. It is unclear whether any subgroups are more likely to benefit or fail to benefit from the intervention. **Evidence gaps and/or recommendations for future research:** Replication of the research to other institution settings. **Source of funding:** NR.			

Study Details	**Population and setting**	**Intervention/ comparator**	**Outcomes and methods of analysis:**
Authors: Olsen *et al.* **Year:** 2006	**Source population/s:** Smokers in Denmark who participated in smoking cessation programmes.	**Intervention/s description:** Smoking cessation programmes: sessions typically involved an	**Primary outcomes:** Incremental cost-effectiveness ratio: costs and gain in life-years due to participation

Citation: Olsen, K. R., Bilde, L., Juhl, H. H., Kjaer, N. T., Mosbech, H., Evald, T., Rasmussen, M., et al. (2006). Cost-effectiveness of the Danish smoking cessation interventions: subgroup analysis based on the Danish Smoking Cessation Database. *The European Journal of Health Economics: HEPAC: Health Economics in Prevention and Care*, *7*(4), 255–264. **Aim of study:** To assess the relative cost-effectiveness of smoking cessation interventions implemented in Denmark between 1995 and 2001. **Type of economic analysis:** cost-effectiveness. **Economic perspective:** "The	**Setting:** Hospital, pharmacy or other settings. Only data for hospital settings were extracted for this review. **Data sources:** Data collected as interventions were delivered. All data stored on the Danish National Smoking Cessation Database (DNSCD).Data that was not routinely collected included: the probability of enrolling in a smoking cessation programme after failing to quit (assumption); life-time risk of relapse (assumption); and natural cessation rate in the smoking population (literature sources). Cost of intervention: included time spent on preparation, direct intervention, follow-up, NRT provided by the intervention and bough by individuals outside of the intervention, salary costs (based on pharmacists delivering the intervention) and social costs to pharmacists (details not provided). **Sample characteristics:** *Participants who participated in smoking cessation programme:* Age: 48.6 years. Sex, male: 37%. Type of interventions: individual, 21%; group course, 76%; quick	instructor and smoker who met face-to-face to discuss the clinical and motivation aspects of smoking and smoking cessation. Interventions were either delivered in groups (7-10 people, 5 sessions, 2 hours each); individual (5-6 sessions, 2.5 hours each); or quick interventions (1-6 people, 1-2 sessions, total of 2.5 hours). **Comparator/control/s description:** No smoking cessation programme. **Sample sizes:** N/A* **Total:** N/A **Intervention:** N/A **Control:** N/A *I0, 000 participants were modelled based on 1, 8181 individuals who participated in the smoking cessation programme.	in smoking cessation interventions. Data collected via self-report. Participants who did not completed follow-up questionnaire were considered as smokers (ITT). **Secondary outcomes:** N/A **Time horizon:** NR. **Modelling method:** Markov model. Monte Carlo model of 10.000 ICERS was calculated. Cost data in 2003 Danish kroner (€1=7.45 crowns). Sensitivity analyses: not restricted to hospital settings and are therefore not extracted for the purpose of this review.

perspective of the analysis was the smoking cessation units providing the interventions and to some extent the smokers participating in the intervention as participation costs and individual NRT costs were included (page 225)." **Applicability:** [+] **Quality score:** [+] **Intensity: 5**	course, 3%; other, <1%). Setting: hospital, 38%; pharmacy, 33%; other, 29%.		
Results: The study found that interventions carried out at hospitals were more effective than interventions carried out at pharmacies, but more hospital patients were lost to follow-up which may have led to an overestimate of smoking cessation rates in this group. Abstinence rates in hospital patients who were followed up were 0.38% compared with 0.25% for pharmacy patients. **Primary results:** *Hospital setting only:* Mean cost increase per person: €426. Mean increase in life-years gained 0.41. Mean ICER: €1,058.00 (95% CI €1,036 to €1,081). **Secondary results:** N/A			
Notes: **Limitations identified by author:** The model assumed that the comparator group "no intervention" incurred zero costs which may not reflect real life settings, as smokers may initiate in self-quitting attempts. Not including these costs for the comparator group resulted in a more conservative estimate of the ICER. The model did not include an estimate of life-time health care costs and productivity losses and gains for present and former smokers. Non-smokers and former smokers live longer and therefore incur higher life time health care costs.			

Limitations identified by review team: The time horizon was not clearly reported. **Evidence gaps and/or recommendations for future research:** NR. **Source of funding:** NR.

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Parker *et al.* **Year:** 2007 **Citation:** Parker DR, Windsor RA, Roberts MB, Hecht J, Hardy NV, Strolla LO, Lasater TM. (2007) Feasibility, cost, and cost-effectiveness of a telephone-based motivational intervention for underserved pregnant smokers. *Nicotine & Tob Res. 9*(10):1043-51 **Aim of study:** To evaluate the feasibility, cost, and cost-effectiveness of a proactive, telephone based motivational smoking cessation intervention for a large,	**Source population/s:** Pregnant women in an urban population in the USA. **Setting:** Attending prenatal and antenatal clinics. **Data sources:** (Data collected as part of the study) • Self reported smoking status • Motivational interviewing costs (unit price of specific staff and non-staff resources) • Cost per patient (cost of implementing • Urine cotinine levels (more than 80ng/ml for active smokers) • Number of calls received • Number of attempted calls • Number of completed calls **Sample characteristics:** **Age, mean (S.D)**: intervention group 3, three calls 25.1 (18.9-31.3);	**Intervention/s description:** Motivational interviewing Group 3: • Participants received self-help materials, which included a quit kit (A Smoker's Guide to Quit Smoking) and a video (Commit to Quit) • They were enrolled in a "Quit and Win" (Q&W) monetary incentive lottery program plus • Three motivational interviewing telephone calls to discuss the participant's smoking habits, enhance their perception of maternal and foetal risks, determine their readiness to change, encourage participants to use intervention materials, and provide support for personal decision making Motivational interviewing Group 2: • Participants received self-help	**Primary outcomes:** • Quit attempts (self report of cessation for at least 7 days – for those women who did not quit) • Quits rates • Cost-effectiveness ratios: cost per quit **Secondary outcomes:** Sensitivity analysis: • Change in motivational interviewing counselling cost per patient **Time horizon:** three assessment points – at 32 weeks gestation, and at 6 weeks and 6 months postpartum **Modelling method:** • No information provided on the modelling method • Sensitivity analysis applied to change in cost per patient of implementing motivational

underserved, urban population of pregnant women. **Type of economic analysis: C**ost-effectiveness analysis. **Economic perspective:** Agency perspective **Applicability: +** **Overall quality score: ++** **Intensity: 2**	intervention group 2, two calls 25.0 (18.9- 31.1); intervention group 1, one call 18.9-31.3); control, no calls 25.3 (19.6-31) **Female:** 100%. **Ethnicity**: Black: intervention group 3, three calls 33/165 (20%); intervention group 2, two calls 5/49 (10.2%); intervention group 1, one call 18/92 (19.6%); control, no calls 6/52 (11.5%); Hispanic: intervention group 3, three calls 32/165 (19.4%); intervention group 2, two calls 12/49 (24.5%); intervention group 1, one call 10/92 (10.9%); control, no calls 11/52 (21.2%); White: intervention group 3, three calls 95/165 (57.6%); intervention group 2, two calls 31/49 (63.3%); intervention group 1, one call 62/92 (67.4%); control, no calls 35/52 (67.3%); Other: intervention group 3, three calls 5/165 (3.0%); intervention group 2, two calls 1/49 (2.0%); intervention group 1, one call 2/92 (2.1%); control, no calls 0/52 (NA); **Gestational age (weeks):** Intervention group 3, three calls 10.8 (6.6-15); intervention group 2, two calls 10.6 (6.8-14.4); intervention	materials, which included a quit kit (A Smoker's Guide to Quit Smoking) and a video (Commit to Quit) • They were enrolled in a "Quit and Win" (Q&W) monetary incentive lottery program plus • Two motivational interviewing telephone calls to discuss the participant's smoking a=habits, enhance their perception of maternal and foetal risks, determine their readiness to change, encourage participants to use intervention materials, and provide support for personal decision making Motivational interviewing Group 1: • Participants received only self-help materials, which included a quit kit (A Smoker's Guide to Quit Smoking) and a video (Commit to Quit) • They were enrolled in a "Quit and Win" (Q&W) monetary incentive lottery program plus • One motivational interviewing telephone calls to discuss the participant's smoking a=habits, enhance their perception of	interviewing

	group 1, one call 10.6 (6.4-14.8); control, no calls 10.9 (6.5-15.3); **Number of cigarettes smoked per day, mean (S.D.):** Intervention group 3, three calls 7.9 (1.6-14.2); intervention group 2, two calls 8.5 (2.5-14.5); intervention group 1, one call 8.1 (1.7-14.5); control, no calls 8.7 (2.9-14.5); **Baseline cotinine (mg/ml), mean (S.D.)**: Intervention group 3, three calls 869 (-170-2178); intervention group 2, two calls 1239 (-410-2888); intervention group 1, one call 956 (-668-2589); control, no calls 1133 (7-2229). **** Baseline cotinine was only available for 114/358 (31.8%) of the study population	maternal and foetal risks, determine their readiness to change, encourage participants to use intervention materials, and provide support for personal decision making **Comparator/control/s description:** <u>No calls:</u> • Participants received only self-help materials, which included a quit kit (A Smoker's Guide to Quit Smoking) and a video (Commit to Quit) • They were enrolled in a "Quit and Win" (Q&W) monetary incentive lottery program plus **Sample sizes:** **Total:** 358 **Motivational interviewing group 3:** 165 **Motivational interviewing group 2:** 49 **Motivational interviewing group 1:** 92 **Control:** 52	

Results
Primary results:

Variable	No calls, n=52	One call, n=92	Two calls, n=49	Three calls, n=165	Total, N=358
Quit attempts (self report of cessation for at	7/47 (14.9%)	10/80 (12.5%)	14/41 (34.1%)	25/127 (19.7)	56/295 (19.0%)

least 7 days – for those women who did not quit)					
Quit rates	5/52 (9.6%)	12/92 (13.0%)	8/49 (16.3%)	38/165 (23.0%)	63/358 (18.0%)
Cost-effectiveness ratios (cost per quit)	$140/5 ($28 per quit)	$732/12 ($61 per quit)	$736/8 ($92 per quit)	$3192/38 ($84 per quit)	$5355/63 ($85 per quit)

The quit rate for women receiving all three calls was significantly higher than for those who did not receive any calls: 23% and 9.6% respectively; x^2=4.47; p-value=0.03

Secondary results:

Sensitivity analysis

Change in motivational interviewing counselling cost per patient

If the motivational interviewing counselling cost per patient increased from $20 to $25, the cost per quit was: intervention group 3 $105; intervention group 2 $115, and intervention group 1 $76. Analysis did not include the control group.

If the motivational interviewing counselling cost per patient increased from $20 to $30, the cost per quit was: intervention group 3 $138; intervention group 2 $138, and intervention group 1 $92. Analysis did not include the control group.

Notes

Limitations identified by author:

- There might have been selection bias i.e. there is no evidence that the quit rates attained might have been attributable to the increased intensity of the motivational counselling or to baseline differences for salient variables that were not measured
- The patient cost and time, and the cost of developing the quit kit were not included in the cost estimates
- Not all of the women in the telephone counselling groups received telephone calls
- Many participants did not provide samples for cotinine verification smoking status, which may affect the risk of participation bias

Limitations identified by review team:

- The study was conducted in the USA which may limit the generalisability of the study to the UK context.
- Costs and benefits were not discounted and there was no mention on the type or description of model used for the analysis

Evidence gaps and/or recommendations for future research:

- Future evaluation research trial that will aim to randomise pregnant smokers from various settings to different levels of motivational interviewing to document the effectiveness rates attributable to the systematic variation in the number of calls

Source of funding:

- National Heart, Lung and Blood Institute

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Pollack **Year:** 2001 **Citation:** Pollack, H. A. (2001). Sudden infant death syndrome, maternal smoking during pregnancy, and the cost-effectiveness of smoking cessation intervention. *American Journal of Public Health*, *91*(3), 432–436. **Aim of study:** To assess the cost-effectiveness of prototypical smoking cessation programmes. **Type of economic analysis:** cost-effectiveness. **Economic perspective:** NR. **Applicability:** [+] **Quality score:** [+]	**Source population/s:** Pregnant smokers in the USA. **Setting:** Services for pregnant women. **Data sources:** Birth cohort: 1995 birth cohort from the 1995 and 1996 Perinatal Mortality Files. Birth certificates: average daily maternal smoking during pregnancy (self-report). **Sample characteristics:** NR.	**Intervention/s description:** Smoking cessation intervention: intervention and effectiveness results reported in Marks *et al. (*1990) for pregnant smokers. No further information provided on the description of the intervention. **Comparator/control/s description:** No intervention. **Sample sizes:** **Total:** N/A **Intervention:** N/A. **Control:** N/A.	**Primary outcomes:** Sudden Infant Deaths (SIDS) averted. Cost per averted SIDS death: for a typical smoking cessation programme. **Secondary outcomes:** NR. **Time horizon:** NR. **Modelling method:** Mid-1998 $US. Assumptions: typical prenatal smoking cessation intervention would result in 15% quite rates at a cost of $45 (based on Marks *et al.*, 1990).

Intensity: 2			

Results
Primary results:
Smoking cessation compared with no intervention:
Sudden Infant Deaths (SIDS) averted:
All pregnant smokers: 108 (95% CI 102 to 114).
Pregnant smokers: 1-10 cigarettes/day: 63 (95%CI 58 to 68).
Pregnant smokers: 11-20 cigarettes/day: 39 (95%CI 36 to 41).
Pregnant smokers: ≥ 21 cigarettes/day: 6.9 (95%CI 5.9 to 7.6).

Cost per averted SIDS death:
All pregnant smokers: $210,500 (95%CI $119,200 to $224,400).
Pregnant smokers: 1-10 cigarettes/day: $235,400 (95%CI $219,300 to $256,400).
Pregnant smokers: 11-20 cigarettes/day: $177,300 (95%CI $166,800 to $191,100).
Pregnant smokers: ≥ 21 cigarettes/day: $151,000 (95%CI $137,200 to $174,500).

Secondary results: N/A.

Notes
Limitations identified by author: Maternal smoking is self-reported; previous studies have shown that when smoking was verified with cotinine level assessment, self-reporting tends to underestimate the prevalence and intensity of maternal smoking.

The analysis does not include:

- Information on postnatal maternal smoking or smoking at anytime by other household members.
- The value of reduced smoking among pregnant women who relapse.
- Impact of race/ethnicity.

More intensive/targeted smoking cessation programmes might be more cost-effective than the programme modelled by this study.

The analysis only considers SIDS prevention; other outcomes such as low birth weight, maternal complications during pregnancy, childhood asthma etc would have additional benefits.

Limitations identified by review team: In addition to the above, the perspective and time horizon are not clearly stated.

Evidence gaps and/or recommendations for future research: NR.

Source of funding: Funded by a grant from the Robert Wood Johnson Substance Abuse Policy Research Program.

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Prathiba *et al.* **Year:** 1998 **Citation:** Prathiba BV, Tjeder S, Phillips C, Campbell IA. (1998). A smoking cessation counsellor: should every hospital have one? *J R Soc Promot Health. 118*(6):356-9 **Aim of study:** To ascertain the smoking cessation rate in hospital patients who received a structured programme of advice and support from a counsellor; to compare it with the rate in those who received advice but failed to continue in the programme; and to assess the cost-effectiveness of the programme.	**Source population/s:** In-patients and out-patients at Llandough Hospital, Cardiff, Wales who were referred to the smoking cessation counsellor after being advised to stop smoking by their hospital doctor **Setting:** Hospital. **Data sources:** Data collected as part of this study (RCT): • Cost of smoking cessation service over the period of thirty months (sum of the salary of the counsellor, including superannuation, national insurance and the overhead costs) • The direct cost of the programme/intervention (from financial and personnel records) • Self reported cessation rate at one year • Level of carbon monoxide in expired air (used to validate claims of cessation each time a	**Intervention/s description:** Smoking cessation counselling (e) First session in the programme lasted 45-60 minutes, with a weekly re-attendance for the first month, and subsequently at three, six and twelve months (f) Smoker's history is taken at first session and the counsellor explains the importance of stopping smoking in relation to individual patient's diagnosis. The risks of developing other smoking related diseases are also discussed. (g) Baseline expired carbon monoxide test is done at the out-patient clinic (h) Patients are encouraged to attempt to stop smoking with counselling only	**Primary outcomes:** • Cessation rates at one year • Cost per additional success as a result of the specialist counselling service • Cost per life year saved (as a result of the counselling) **Secondary outcomes:** Sensitivity analysis (one-way): • Inclusion of patient and indirect costs: cost per success and cost per life year gained • Change in the proportion of patients that stop smoking as a result of physician's advice Sensitivity analysis (two-way): • Inclusion of patient and indirect costs and change in the proportion of patients that stop smoking as a result of physician's advice **Time horizon:** unclear; eight assessment points - at baseline, first week, second week, third week,

Type of economic analysis: cost-effectiveness analysis. **Economic perspective:** NR **Applicability: ++** **Overall quality score: +** **Intensity: 5**	claim was made) **Sample characteristics:** **Age, mean (S.D)**: NR **Female:** NR **Ethnicity**: NR	initially; if they are still smoking at 2 weeks, then nicotine replacement therapy is commenced (i) The follow-up sessions last 15-20 minutes each; support, advice and encouragement were given at this points (j) At the fifth appointment (one month after commencement of intervention), claims of cessation are verified by measuring expired carbon monoxide. This is repeated at 3 months post-commencement of intervention and if necessary at 6 and 12 months respectively. **(k)** Patients are advised to contact their counsellor if they relapse between the appointments. **Comparator/control/s description:** <u>No service:</u> This involves the physician's advice only.	fourth week, 3 months, 6 months and 12 months; programme period was over 30 months **Modelling method:** • No information provided on the modelling method. • Sensitivity analysis performed to assess the impact of including patient and indirect costs

		Sample sizes: **Total:** N=663 **Intervention:** NR **Control:** NR	

Results

Of 1,155 patients referred to the counsellor between January 1992 and June 1994, 114 (13%) failed to keep their initial appointment, 348 (30%) had advice and literature but declined the programme and 663 (57%) entered the programme.

Primary results:

Cessation rates at one year

The self reported cessation rate at the end of one year in patients who received usual care was 5%. The model assumed a quit rate for a control, physician advice only, group of 7.5%.

The cumulative probability of being a verified, sustained non-smoker at the end of one year was 21%±3.9
Men were more likely to succeed (29%) than women (13%); p-value: <0.001
Patients with cardiac diseases were more likely to stop smoking (31%) compared with those with respiratory disease (25%) or others (11%); p-value <0.05
Elderly patients aged 60 years and over were more likely to quit (32%) than younger patients (17%); p<0.01
Number of quitters at the end of one year in patients who participated in the intervention: 140/663 (21%)

Cost per additional success as a result of the specialist counselling service compared with physician's advice

£851

Cost per life year saved (as a result of the counselling)

£340/LY - £426/LY

Secondary results:

Sensitivity analysis (one-way):

Inclusion of patient and indirect costs: cost per success and cost per life year gained

If the total cost of the programme was double to include patients' costs, the cost per success would be £1702 while the cost per life year gained would be between £681/LY - £851/LY

Change in the proportion of patients that stop smoking as a result of physician's advice

If 10% of patients stop smoking as a result of physician's advice, then the cost per success would be £1838 while the cost per life year saved would be between £735/LY - £919/LY

Sensitivity analysis (two-way):

Inclusion of patient and indirect costs and change in the proportion of patients that stop smoking as a result of physician's advice If the total cost of the programme was doubled to include patients' costs and 10% of patients are assumed to stop smoking as a result of physician's advice, then the cost per success would be £3540, and the cost per life year saved would range between £1416/LY and £1770/LY
Notes **Limitations identified by author:** • Patients' costs were not included in the analysis **Limitations identified by review team:** • Costs and benefits not discounted • ICERS were recorded as ranges • The type of model used is not clearly stated • Perspectives of the analysis were not clearly stated **Evidence gaps and/or recommendations for future research:** • NR **Source of funding:** • Llandough Hospital and Community NHS Trust

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Quist-Paulsen *et al.* **Year:** 2006 **Citation:** Quist-Paulsen, P., Lydersen, S., Bakke, P. S., & Gallefoss, F. (2006). Cost-effectiveness of a smoking cessation	**Source population/s:** Smokers with coronary heart disease in Norway. **Setting:** Hospital. **Data sources:** Smoking cessation rates: RCT (Quist-Paulsen & Gallefoss, 2000). Survival data: from a 20-year follow-	**Intervention/s description:** Smoking cessation programme: booklet that focused on fear arousal messages and positive feedback. Was delivered by cardiac nurses without special training in smoking cessation. Intervention was initiated in hospital and was followed up in the community via follow-up telephone calls for at least 5 months.	**Primary outcomes:** Incremental cost-effectiveness of the programme per life year gained: cost of the intervention x number needed to treat (NNT*)/gain in mean discounted life years per patient. **Secondary outcomes:** NR **Time horizon:** Intervention outcomes: 12-months;

program in patients admitted for coronary heart disease. *European Journal of Cardiovascular Prevention and Rehabilitation: Official Journal of the European Society of Cardiology, Working Groups on Epidemiology & Prevention and Cardiac Rehabilitation and Exercise Physiology*, *13*(2), 274–280. **Aim of study:** To determine the incremental cost-effectiveness of smoking cessation programmes in patients with low (i.e. stable coronary heart disease) and high cardiovascular risk (i.e. after myocardial infaraction). **Type of economic analysis:** cost-effectiveness. **Economic perspective:** NR. **Applicability:** [+]	up study on mortality rates after smoking cessation in patients following coronary artery bypass surgery for low risk group (Van Domburg *et al.,* 2000); or data from Daly *et al.* (1983) for high risk group. Intervention costs: sources unclear but included: *Nursing costs:* based on average salary of specialised nurses in Norway with > 10 years of seniority (190 NOK/h). *Printing costs*: 17 NOK per booklet (did not include costs for developing the booklet. *Office rental rate:* 1500 NOK per square meter per year (including overhead costs); only the average time devoted to each patient in the smoking cessation programme was included in the rental estimation. *Telephone costs:* prices from the telephone company, Telenor (0.89 NOK per call + 0.49 NOK per minute). **Sample characteristics:** N/A	**Comparator/control/s description:** Treatment as usual (TAU): usual care after admission for acute myocardial infarction, unstable angina or recent bypass surgery. **Sample sizes:** N/A **Total:** N/A **Intervention:** N/A **Control:** N/A	Survival analysis: 5 years and 25 years (“life-time”) for the high risk group; and 5 and 40 years for the low risk group. **Modelling method:** Costs: included intervention costs; indirect costs were not included. Costs calculated on the basis of Norwegian prices in 2000 and were converted to Euros at the 2000 exchange rate (€=8.1 NOK). Discount rates: discount rates for *intervention costs* at 12 months were not applied as the intervention only lasted one year. Discount rates for costs per life year gained was 5% in the baseline assumption; and 3.5% in sensitivity analysis. 12-month abstinence rates: self-report and biochemical verification at 12-months from Quist-Paulsen & Gallefoss (2000). TAU = 44/118 (37%); Treatment = 57/100 (57%); p=0.004. NNT = 5 (95%CI 3 to 16). Survival rates: *Low risk group:* average mortality rate was 1.7% at 10 years (Van Domburg *et al.,* 2000). Differences in mortality between persistent smokers and

Quality score: [+]			quitters increased throughout the follow-up period; at 20 years 46% had died among the quitters and 64% among the persistent smokers. *High risk group* (those suffering from myocardial infarction or unstable angina)*:* no recent studies with long follow-up. Average 10-year mortality rate was 4.5%. Mortality in those who continued to smoke was 82% and 37% in those who stopped smoking. Mortality rates among quitters were stable between 11 and 13 years. Estimations based on Daly *et al.* (1983). *NNT: the number of patients needed to treat to get one additional quitter from the smoking cessation programme.

Results:

Primary results:
Low risk group, 5% discount rate:
Mean discounted life years gained per patient (in quitters vs. sustained smokers): 0.06 at 5 years; 0.97 at 20 years; 0.16 from 20 to 40 years; 1.13 in the life-time (40 years).
Incremental cost-effectiveness of the programme per life year gained: EUR 5,230 at 5 years; EUR 280 in the lifetime (40 years).

High risk group, 5% discount rate:
Mean discounted life years gained per patient (in quitters vs. sustained smokers: 0.26 at 5 years; 0.95 at 11 years; 1.83 from 11 to 25 years; 2.77 in the life-time (25 years).
Incremental cost-effectiveness of the programme per life year gained: EUR 1,200 at 5 years; EUR 110 in the lifetime (25 years).

Secondary results:
Low risk group, 3.5% discount rate: Incremental cost-effectiveness of the programme per life year gained: EUR 230 in the lifetime.
High risk group, 3.5% discount rate: Incremental cost-effectiveness of the programme per life year gained: NR.

Notes
Limitations identified by author: Costs of the programme may have been overestimated by including the time to fill in questionnaires for the purpose of this trial; conservative data was used in the low-risk model; lifetime was shortened to 25 years in the high-risk group. **Limitations identified by review team:** No further limitations noted. **Evidence gaps and/or recommendations for future research:** NR. **Source of funding:** NR.

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Ruger *et al.* **Year:** 2008 **Citation:** Ruger JP, Weinstein MC, Hammond SK, Kearney MH, Emmons KM. (2008). Cost-effectiveness of motivational interviewing for smoking cessation and relapse prevention among low-income pregnant women: a randomized controlled trial. *Value Health*. *11*(2):191-8 **Aim of study:** To examine the cost-	**Source population/s:** Low-income pregnant smokers in Boston metropolitan area, US **Setting:** Hospitals and health clinics. **Data sources:** Data collected as part of this study (RCT): • Cost of reproducing the intervention in a non-research setting (staff time related to intervention delivery, costs of analysing environmental nicotine, cost of training staff, and costs of producing self-help materials all calculated using the medical care component of the consumer price index from the Bureau of Labour Statistics) • Direct cost of patient's time	**Intervention/s description:** Motivational Interviewing: • Average of 3 home visits that specifically employed motivational interviewing to deliver smoking cessation • Sessions educated clients about the impact of smoking on mothers , foetuses, and newborns; helped clients evaluate their smoking behaviour; helped increase self-efficacy for smoking cessation and abstinence; provided information on reducing exposure to environmental tobacco smoke and set goals on changes in smoking; and	**Primary outcomes:** • Mean intervention cost per participant: Cost per participant for motivational interviewing and usual care; cost per quitter, and cost per relapse prevention (costs, 1997 US$) • Incremental cost-effectiveness: cost per QALY (costs, 1997 US$). • Incremental cost-effectiveness: cost per LY saved (costs, 1997 US$). **Secondary outcomes:** Infant health outcomes: • Birth weight • Low birth weight • Attended Neonatal Intensive Care Unit/special care unit

effectiveness motivational interviewing in low-income pregnant women. **Type of economic analysis:** cost-effectiveness analysis. **Economic perspective:** Societal **Applicability: +** **Overall quality score: +**	(productivity time and costs of setting up the program were excluded). • Smoking status (smoking cessation and relapse prevention) • Infant health outcomes (birth weight and post delivery status) • Effectiveness measures (quit and relapse prevention rates) **Sample characteristics:** **Age, mean (S.D)**: intervention 25.6 (24.5-26.5); control 25.7 (24.6-26.8) **Ethnicity**: White: intervention 109 (70.0%); control 94 (64.4%); Asian/Pacific Islander: intervention 1 (0.65%); control 0 (0.0%), Black: intervention 30 (19.4%), control 22 (15.1%); Hispanic: intervention 13 (8.3%); control 16 (11.0%). American Indian, Aleut or Eskimo: intervention 2 (1.3%); control 1 (0.7%), and Other: intervention 12 (7.7%); control 29 (19.9%)	provided feedback about the household nicotine levels • Sessions lasted 1 hour on the average • Clients also received self help smoking cessation manuals **Comparator/control/s description:** Usual care: An up to 5 minute intervention outlining the harmful effects of smoking during and after pregnancy. Clients also received self-help manuals. **Sample sizes:** **Total:** N=302 **Intervention:** N=156 **Control:** N=146	• Had respiratory problems at birth Sensitivity analyses (one-way): • Motivational interviewing's effectiveness for smoking cessation and relapse prevention • Life years gained and quality of life year weights • Intervention costs • Inclusion of maternal medical cost savings • Inclusion of cost savings for infant healthcare during the first year of life Sensitivity analyses (two-way): • Costs and effectiveness of motivational interviewing **Time horizon:** unclear; three assessment points - at baseline, 1 month and at 6 months postpartum; cost-effectiveness conducted at baseline and at 3 months post partum **Modelling method:** • No information provided on the modelling method. • One-way sensitivity analyses conducted for intervention's effectiveness for smoking cessation and relapse prevention,

			change life years gained and quality of life year weights, change in intervention costs, inclusion of maternal medical cost savings, and inclusion of cost savings for infant healthcare during the first year of life • Two-way sensitivity analyses conducted for cost and effectiveness of intervention

Results
Primary results:
Mean intervention cost per participant: (costs, 1997 US$)
Mean intervention cost per participant for motivational interviewing: $309.2
Mean intervention cost per participant for usual care: $4.85
Difference in cost per participant: $309.2-$4.85 = 304.4 (confidence interval: $289.2-$320.2); p-value: NR

At 6 months post-partum, 7/110 of the intervention group and 8/100 of the control group had quit smoking.
Cost per quitter: NR for intervention or control (motivational interviewing was dominated by usual care i.e. it was more costly but less effective).

There were fewer relapses in the intervention group, although this was of borderline statistical significance (9/21 for the intervention vs 5/28 for the controls, p=0.055).
Cost per relapse prevented: intervention $1217; control NR

Incremental cost-effectiveness: cost per LY saved (costs, 1997 US$).
ICER for current smokers: for intervention or control (motivational interviewing was dominated by usual care i.e. it was more costly but less effective)
ICER for recent quitters (the incremental cost per LY of preventing relapse among motivational interviewing ex-smokers compared to normal care ex smokers): intervention $851/LY saved; control NR

Incremental cost-effectiveness: cost per QALY (costs, 1997 US$).
ICER for current smokers: for intervention or control (motivational interviewing was dominated by usual care i.e. it was more costly but less effective)
ICER for recent quitters (the incremental cost per QALY of preventing relapse among motivational interviewing ex-smokers compared to normal care ex smokers): intervention $628; control NR

Secondary results:
Infant health outcomes (all differences at 6 months postpartum reported to be not statistically significant)
Birth weight: intervention 3241.2g (standard deviation 586.0g); control 3321.3g (standard deviation 612.1)
Low birth weight (<2500g): intervention n=16, 59.3%; control n=11, 40.7%
Attended Neonatal Intensive Care Unit/special care unit: intervention n=14, 10.1%; control n=23, 17.6%
Had respiratory problems at birth: intervention n=21, 15.1%; control 23, 17.8%

Sensitivity analyses (one-way):
Effectiveness of Motivational Interviewing for current smokers with baseline being 7 quitters per 110 smokers i.e.7/110 (cost per LY and cost per QALY)
If the effectiveness of motivational interviewing in current smokers changed to 10/110, or 9/110, the corresponding ICERs would be $19,500/LY, $117,100/LY and $14,400/QALY, $86,300/QALY respectively.
However, if the effectiveness of motivational interviewing in current smokers changed to 8/110, 5/110, or 1/110, usual care was dominant i.e. motivational interviewing is more costly and less effective than usual care in these instances.

Effectiveness of Motivational Interviewing for recent quitters with baseline being 9 relapses prevented per 21 ex-smokers i.e. 9/21 (cost per LY and cost per QALY)
If the effectiveness of motivational interviewing in recent quitters changed to 12/21, 10/21, 8/21, 6/21, 5/21, the corresponding ICERs would be $540/LY, $720/LY, $1,050/LY, $2,000/LY, $3,600/LY and $400/QALY, $530/QALY, $780/QALY, $1,500/QALY, $2,600/QALY respectively.
However, if the effectiveness of motivational interviewing in recent quitters changed to 3/21, usual care was dominant

Discounted LYs and QALYs saved with baseline being 1.43 and 1.94 respectively (cost per LY or cost per QALY)
If the discounted life years and quality of life year weights were 2. 1. 0.5, 0.1, 0.05 and 0.025, usual care was dominant for current smokers
ICERS for discounted utilities were $610/LY, $1,200/LY, $2,400/LY, $12,200/LY, $24,400/LY, $48,700/LY for recent quitters $610/QALY, $1,200/QALY, $2,400/QALY, $12,200/QALY, $24,400/QALY, $48,700/QALY respectively

Cost of motivational interviewing with baseline being $309 (cost per LY or cost per QALY)
If the intervention costs either $250, $500, $1,000, or $2,000, usual care was dominant for current smokers
ICERs for motivational interviewing were $690/LY, $1,400/LY, $2,800/LY, $5,600/LY and $510/QALY, $1,020/QALY, $2,100/QALY, $4,100/QALY for recent quitters respectively

Cost of motivational interviewing with baseline being $309 (cost per LY or cost per QALY)
If the intervention costs either $250, $500, $1,000, or $2,000, usual care was dominant for current smokers
ICERs for motivational interviewing were $690/LY, $1,400/LY, $2,800/LY, $5,600/LY and $510/QALY, $1,020/QALY, $2,100/QALY, $4,100/QALY respectively

Maternal medical care cost savings with baseline being $0 (cost per LY or cost per QALY)
If maternal medical care cost savings in first year of life was either $6,000 or $12,000, usual care was dominant for current smokers and motivational interviewing was cost saving *(values not reported)* for recent quitters in both cost per LY and cost per QALY

Cost savings for healthcare of newborns at birth and during first year of life with baseline being $0 (cost per LY or cost per QALY)
If cost savings in first year of life was either $1000 or $5000, usual care was dominant for current smokers and motivational interviewing was cost saving *(values not reported)* for recent quitters in both cost per LY and cost per QALY

Sensitivity analyses (two-way):
Costs and effectiveness of motivational interviewing
If the cost of motivational interviewing was $2,000 per participant for recent quitters and the effectiveness of the intervention was 5 relapses prevented per 21 ex-smokers, the corresponding ICERs were $23,400/LY and $17,300/QALY.
If the cost of motivational interviewing was $400 per participant for current smokers and the effectiveness of the intervention was 9 quitters per 110 smokers, the corresponding ICERs was $112,000/QALY; cost per LY not reported.

Notes
Limitations identified by author:

- Findings cannot be generalised to high income women and geographic groups
- It was difficult to know how income and pregnancy might affect health related quality of life and life expectancy measures
- Authors did not measure some non-smoking related costs and benefits of motivational interviewing like the effect of instruction on general health and social services
- The study may not have enough power to detect differences between groups on a number of study variable due to a small sample size
- The study may have underestimated the importance of relapse prevention during pregnancy because it does not consider the impact of reducing maternal smoking during pregnancy on the risk of nicotine dependence among offspring

Limitations identified by review team:

- The study was conducted in the USA which may limit the generalisability of the study to the UK context.
- Discount rate unknown
- Time horizon was unclear

Evidence gaps and/or recommendations for future research:

- There were no long term morbidity and mortality data for children related to smoking-related disease

Source of funding:

• National Cancer Institute and National Institute on Drug Abuse

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:
Authors: Slatore *et al.* **Year:** 2009 **Citation:** Slatore CG, Au DH, Hollingworth W. 2009. Cost-effectiveness of a smoking cessation program implemented at the time of surgery for lung cancer.J *Thorac Oncol. 4*(4):499-504. **Aim of study:** To evaluate the cost-effectiveness of a smoking cessation intervention initiated preoperatively for patients with non-small cell lung cancer (NSCLC). **Type of economic analysis: Cost-effective**ness analysis. **Economic**	**Source population/s:** Patients with NSCLC at stage IIIB or less. **Setting:** Patients going for lung cancer resection. **Data sources:**: • Effectiveness of smoking cessation program (estimates from a setting similar to the current study as preoperative smoking cessation programs had only been studied in heterogeneous settings). • Cost of smoking cessation program (from Centres for Medicare and Medicaid Services – CMS) • Perioperative pulmonary complications probabilities (existing literature) • Cost of Perioperative pulmonary complications (from Centres for Medicare and Medicaid Services – CMS). • Mortality (existing literature)	**Intervention/s description:** Counselling program and nicotine replacement therapy: (Counselling intervention not described). **Comparator/control/s description:** Usual care: (Usual care not described). **Sample sizes:** **Total:** NR, **Intervention:** NR **Control:** NR	**Primary outcomes:** • Incremental cost-effectiveness ratio (Cost/QALY) • Incremental cost-effectiveness ratio (Cost/LY) **Secondary outcomes:** Sensitivity analysis: • Postoperative complication rate • Cost of the intervention: Includes counselling – two short sessions and two long sessions, and nicotine replacement therapy • Effectiveness of the intervention • Mortality difference between current smokers and recent quitters • Difference in utility scores: Differences between QALYs and Life Years (LY) **Time horizon:** 5 years (analysis at 1 year and 5 years) **Modelling method:**

perspective: Health care providers **Applicability: +** **Overall quality score: +** **Intensity: Unclear**	• Health-Related Quality of Life – HRQoL (existing literature) **Sample characteristics:** **Age, mean (S.D)**: NR **Female:** N/A **Ethnicity**: N/A		Decision analytic Markov model: • Annual transition states were from smoker to non smoker to dead • Half cycle corrections were done • Discount rate of 3% was used for outcomes after the first year • One way sensitivity analyses were conducted at 1 year and 5 years on postoperative complication rate, cost of the intervention, effectiveness of the intervention, mortality difference between current smokers and recent quitters, and difference in utility scores • Threshold value for incremental cost-effectiveness is $50,000/QALY Assumptions: • Deaths during a year occurred on average half-way through the year • There is no difference in the proportion of both control and intervention group that will suffer perioperative complications • The smoking cessation program leads to an increase of 7% of the subjects achieving abstinence at 3 months post-surgery • Smokers have a 12% higher proportion who are deceased at 1

			year compared with quitters • Quitters have a utility score of 0.15 higher than smokers

Results
By the time of surgery, 78% of the intervention group and 65% of usual care patients had quit smoking. After 3 months, 19% of the intervention group and 12% of the control group were still abstinent.
The mean cost of the intervention was $199.96 ($50 to $450 for different pharmacological treatments)

Primary results:
Incremental cost-effectiveness ratio (Cost/QALY and Cost/LY across 5 years):

Year 1	$16,415/QALY	Year 1: $45,629/LY
Year 2	$7,441/QALY	Year 2: $12,455/LY
Year 3	$4,649/QALY	Year 3: $6,120/LY
Year 4	$3,344/QALY	Year 4: $3,813/LY
Year 5	$2,609/QALY	Year 5: $2,703/LY

Secondary results:
Sensitivity analysis
Postoperative complication rate: (if recent quitters rate is 24% higher than for smokers)
Year 1 post surgery ICERs: $49,985/QALY and $138,835/LY
Year 5 post surgery ICERs: $7938/QALY and $8224/LY

Cost of the intervention: If the smoking cessation intervention costs $450
Year 1 post surgery ICERs: NR
Year 5 post surgery ICERs: $5871/QALY and $6083/LY

Effectiveness of the intervention: If the chances of achieving abstinence at 3 months with the program increases by 5% among smokers compared with recent quitters, then
Year 1 post surgery ICERs: $22,981/QALY and $63,881/LY
Year 5 post surgery ICERs: $3652/QALY and $3784/LY

Mortality difference between current smokers and recent quitters: An increase in mortality to 10.1% for smokers compared with 5.1% for recent quitters results in
Year 1 post surgery ICERs: $18,368/QALY and $114,263/LY

Year 5 post surgery ICERs: $3560/QALY and $6182/LY

Difference in utility scores: A utility estimate of 0.02 in recent quitters less than smokers will result in
Year 1 post surgery ICERs: $252,567
Year 5 post surgery ICERs: $6467/QALY

Cost-effectiveness occurred 1 year post surgery if the utility of recent quitters was 0.03 higher than for smokers (value not given) and it did not occur for any estimate of utility at 5 years post surgery.

Notes

Limitations identified by author:

- Costs of treating recurrent or metastatic disease were not included
- Costs and effects of treating other smoking-related diseases which would have decreased the cost/QALY were not included
- Results overestimate the QALYs and cost-effectiveness for patients who survive a short period of time after surgery
- Results are not applicable to lung cancer patients with inoperable disease
- No data available on postoperative rates of relapse to guide its inclusion plus the effectiveness of a combination of chemotherapy in the model

Limitations identified by review team:

- The study was conducted in the USA which may limit the generalisability of the study to the UK context.
- Discount rate used was 3%

Evidence gaps and/or recommendations for future research:

- Only one study has evaluated the association of short term preoperative smoking cessation on subsequent mortality and the study did not evaluate stage specific survival
- No data to guide estimates of utility of perioperative complications of lobectomy
- There is no evidence of increase in mortality for recent quitters

Source of funding:

- Department of Veterans Affairs, USA

Study Details	Population and setting	Intervention/ comparator	Outcomes and methods of analysis:

Authors: Windsor *et al.* **Year:** 1993 **Citation:** Windsor RA, Lowe JB, Perkins LL, Smith-Yoder D, Artz L, Crawford M, Amburgy K, Boyd NR Jr. (1993) Health education for pregnant smokers: its behavioral impact and cost benefit. *Am J Public Health.* *83*(2):201-6 **Aim of study:** To evaluate the behavioural impact and cost benefit of a health education program for pregnant smokers in public health maternity clinics. **Type of economic analysis: C**ost-benefit analysis. **Economic perspective:** Agency perspective **Applicability: +** **Overall quality score: ++**	**Source population/s:** Pregnant smokers attending antenatal care in public health maternity clinics in Alabama, USA **Setting:** Maternity clinics **Data sources:** (Data collected as part of the study) • Self report smoking status (with the aid of self administered questionnaires) • Salivary cotinine levels (cut-off of ≤30 ng/ml to validate self reports) • Compliance with the use of patient use of all health education methods (report of use of materials for 4 or more days as well as use of five or more cessation methods to be compliant) • Cost to deliver the intervention (personnel time and materials) • Net incremental healthcare costs of a low birth weight infant (1990 US$) **Sample characteristics:** **Age, mean**: intervention 24.1 years; control 24.7 years **Female:** 100%	**Intervention/s description:** <u>Health education intervention</u> • Initial visit, where a trained female health counsellor provided the participants with a standardised cessation skills and risk counselling session lasting approximately 15 minutes. Patients were taught how to use a 7-day self-directed cessation guide. There was also a 30 minute group prenatal education class, where the nurse discussed smoking risks and the importance of quitting • During follow-up visits, the information provided to the participant was reinforced and a chart reminder was put in the medical record and a medical letter was sent to the patient within 7 days • Social support was provided in the form of a buddy letter, a buddy contract, and a buddy tip sheet. Each patient also sent a quarterly, one-page "newsletter" with testimonials from successful quitters, additional risk information and cessation tips. • Participants were also given two	**Primary outcomes:** • Quit rates by ethnicity and study group • Quit rates by level of baseline cotinine • Rates of reduction of smoking by ethnicity • Estimated impact of statewide dissemination of intervention • Estimated cost benefit of statewide dissemination of intervention (1990 US$) **Secondary outcomes:** <u>Sensitivity analysis:</u> • Intervention cost • Estimated economic benefit **Time horizon:** Unclear; From first visit to > 32 weeks gestation **Modelling method:** • No information provided on the modelling method • Costs were discounted based using a range of inflation rates – 5.8% in 1987, 6.9% in 1988, 8.5% in 1989, and 9.6% in 1990 • One- and two-way sensitivity analyses conducted on change in intervention costs and estimated economic benefits

Intensity: 4	**Ethnicity**: Black total 424/814 (52%); intervention 200/400 (50%); control 224/414 (54%) **Salivary cotinine levels ng/ml, mean (S.D.)**: total 114 (96); intervention 117 (100); control 109 (91)	pamphlets – *"Smoking and the Two of You"* and *"Where to Find Help if You Want to Stop Smoking"*. ***Comparator/control/s description:*** <u>Control</u> • Two minutes with the health counsellor at first visit, plus brief contacts at follow-up visits, totalling 5 minutes, spent discussing and reinforcing risk information. There was also a 30 minute group prenatal education class at the initial visit • Participants were also given two pamphlets – *"Smoking and the Two of You"* and *"Where to Find Help if You Want to Stop Smoking"*. **Sample sizes:** **Total:** 814 **Intervention:** 400 **Control:** 414	
Results The intervention led to significantly higher quit rates than the control. However, relapse rates were significantly higher in the intervention group (18%) than the control group (8%, p=0.001). **Primary results:** <u>*Quit rates by ethnicity and study group*</u>			

Black: Intervention, n=210: 18.1%; control, n=242: 10.7%; 95% CI: 0.8-13.9; p-value: 0.03
White: Intervention, n=190: 10.0%; control, n=172: 5.2%; 95% CI: -0.6-10.2; p-value: 0.08
Total: Intervention, n=400: 14.3%; control, n=414: 8.5%; 95% CI: 1.4-10.1; p-value: 0.01

Quit rates by level of baseline cotinine
Low (≤99 ng/ml): Intervention, n=57: 89%; control, n=35: 83%
Moderate (100-199 ng/ml): Intervention, n=57: 9%; control, n=35: 14%
High (≥200 ng/ml): Intervention, n=57: 2%; control, n=35: 3%

Rates of reduction of smoking by ethnicity
Black: Intervention, n=210: 12.9%; control, n=242: 11.6%; 95% CI: -4.8-7.3; p-value: 0.68
White: Intervention, n=190: 21.1%; control, n=172: 13.4%; 95% CI: 0.0-15.4; p-value: 0.05
Total: Intervention, n=400: 16.8%; control, n=414: 12.3%; 95% CI: -0.4-9.3; p-value: 0.07

Estimated impact of statewide dissemination of intervention
There might have been 32 fewer infants born with low birth weight with the implementation of the intervention at a state level.

Estimated cost benefit of statewide dissemination of intervention, 1990 US$
The inflation adjusted estimates of the statewide healthcare costs attributable to the 32 infants if they had been born as low birth weight infants: $387328 - $989920 (health care cost per low birth weight infant X number of low birth weight infants = $12104 - $30935 X 32). This is the net benefit minus cost difference in favour of the intervention. The cost benefit ratio estimates for these values will range between $1:$17.83 and $1:$45.85 respectively.

Secondary results:
Sensitivity analysis
One-way sensitivity analysis
If the intervention costs were moderately increased by 50% (from $4.50 to $6.75), the cost benefit ratio ranges between $1:$11.95 and $1:$30.55.

If the costs of the intervention were doubled to $9.00, the cost benefit ratio ranges between $1:$8.97 and $1:$22.91 with an equivalent net difference between benefit and cost of $344,128 to $946,720 respectively in favour of the intervention.

Two-way sensitivity analysis
If the intervention cost was increased to 100% and the benefit was decreased by 25%, the cost benefit ratio would range between $1:$6.72 and $1:$17.18. This will result in a $7 - $17 saved in medical costs for each $1 spent on smoking cessation intervention. This has an equivalent economic benefit of $247,296 to $699,240 saved in favour of the intervention.

Notes

Limitations identified by author:

- None identified by the authors

Limitations identified by review team:

- The study was conducted in the USA which may limit generalisability to the UK context
- The methods of modelling were not discussed
- A standard value was not used for discounting the costs and benefits (5.8% in 1987, 6.9% in 1988, 8.5% in 1989, and 9.6% in 1990)

Evidence gaps and/or recommendations for future research:

- There is no evidence on the degree to which health education methods are adopted in public and private health maternity care settings and to measure their behavioural and clinical impact

Source of funding:

- The National Cancer Institute

11.0 Appendix D. Studies excluded at full text stage

Table D1. Studies excluded after full text screening (N=14)

For exclusion codes see Appendix B.

Reference details	Abstract	Exclusion Code
Akehurst RL., Piercy J. Cost-effectiveness of the use of transdermal Nicorette patches relative to GP counselling and nicotine gum in the prevention of smoking related diseases. *Br J Med Economics* 1994; 7: 115-122.	Successful smoking cessation programmes would reduce both the incidence of and mortality from smoking-related diseases such as lung cancer and coronary heart disease. This study analyses the cost-effectiveness of using Nicorette patches in smoking cessation relative to GP counselling alone. It is shown that the use of Nicorette patch is relatively cost-effective in terms of cost per life year saved; and, in addition to GP counselling, represents good value for money in comparison with other accepted health care interventions.	6_EX.SETTING
Bolin K, Wilson K, Benhaddi H, de Nigris E, Marbaix S, Mork AC, Aubin HJ. (2009). Cost-effectiveness of varenicline compared with nicotine patches for smoking cessation - results from four European countries. Eur J Public Health. 2009 Dec;19(6):650-4. Epub 2009 Jun 2.	The aim of this study was to evaluate and compare the cost-effectiveness of varenicline with nicotine replacement therapy (NRT) for smoking cessation in four European countries (Belgium, France, Sweden and the UK). Markov simulations, using the Benefits of Smoking Cessation on Outcomes (BENESCO) model, were performed. We simulated the incidence of four smoking-related morbidities: lung cancer, chronic obstructive pulmonary disease, coronary heart disease and stroke. The model computes quality-adjusted life-years gained and incremental cost-effectiveness ratios. Incremental cost-utility ratios were calculated, adopting a lifetime perspective. Efficacy data were obtained from a randomized open-label trial: Week 52 continuous abstinence rates were 26.1% for varenicline and 20.3% for NRT. The analyses imply that for countries analysed, smoking cessation using varenicline versus NRT was associated with reduced smoking-related morbidity and mortality. The number of morbidities avoided, per 1000 smokers attempting to quit, ranged from 9.7 in Belgium to 6.5 in the UK. The number of quality-adjusted life-years gained, per 1000 smokers, was 23 (Belgium); 19.5	6_EX.SETTING

	(France); 29.9 (Sweden); and 23.7 (UK). In all base-case simulations (except France), varenicline dominated (more effective and cost saving) NRT regarding costs per quality-adjusted life-year gained; for France the incremental cost-effectiveness ratio was 2803. This cost-effectiveness analysis demonstrated that since varenicline treatment was more effective, the result was increased healthcare cost savings in Belgium, Sweden and the UK. Our results suggest that funding varenicline as a smoking cessation aid is justifiable from a healthcare resource allocation perspective.	
Bradford WD. (2003). Pregnancy and the Demand for Cigarettes. American Economic Review, 2003, vol. 93, issue 5, pages 1752-1763.	No abstract available	5_EX.INT
Cromwell J, Bartosch WJ, Fiore MC, Hasselblad V, Baker T. (1997). Cost-effectiveness of the clinical practice recommendations in the AHCPR guideline for smoking cessation. JAMA. 1997 Dec 3;278(21):1759-66.	The Agency for Health Care Policy and Research (AHCPR) published the Smoking Cessation: Clinical Practice Guideline in 1996. Based on the results of meta-analyses and expert opinion, the guideline identifies efficacious interventions for primary care clinicians and smoking cessation specialty providers. To determine the cost-effectiveness of clinical recommendations in AHCPR's guideline. The guideline's 15 recommended smoking cessation interventions were analyzed to determine their relative cost-effectiveness. Then, using decision probabilities, the interventions were combined into a global model of the guideline's overall cost-effectiveness. The analysis assumes that primary care clinicians screen all presenting adults for smoking status and advise and motivate all smokers to quit during the course of a routine office visit or hospitalization. Smoking cessation interventions are provided to 75% of US smokers 18 years and older who are assumed to be willing to make a quit attempt during a year's time. Three counseling interventions for primary care clinicians and 2 counseling interventions for smoking cessation specialists were modeled with and without transdermal nicotine and nicotine gum. MAIN OUTCOME MEASURE: Cost (1995 dollars) per life-year or quality-adjusted life-year (QALY) saved, at a discount of 3%.	6_EX.SETTING

	The guideline would cost $6.3 billion to implement in its first year. As a result, society could expect to gain 1.7 million new quitters at an average cost of $3779 per quitter, $2587 per life-year saved, and $1915 for every QALY saved. Costs per QALY saved ranged from $1108 to $4542, with more intensive interventions being more cost-effective. Group intensive cessation counseling exhibited the lowest cost per QALY saved, but only 5% of smokers appear willing to undertake this type of intervention. Compared with other preventive interventions, smoking cessation is extremely cost-effective. The more intensive the intervention, the lower the cost per QALY saved, which suggests that greater spending on interventions yields more net benefit. While all these clinically delivered interventions seem a reasonable societal investment, those involving more intensive counseling and the nicotine patch as adjuvant therapy are particularly meritorious.	
Godfrey C, Parrott S, Coleman T, Pound E. (2005). The cost-effectiveness of the English smoking treatment services: evidence from practice. Addiction. 2005 Apr;100 Suppl 2:70-83.	To investigate the cost-effectiveness of English specialist smoking cessation services. Combination of observational cost and outcome data from English smoking cessation services to calculate cost-effectiveness ratios. Multivariate analysis of factors influencing variation in services' cost-effectiveness. Fifty-eight of the 92 specialist smoking cessation services in England in 2000/01. Services' costs were estimated using survey data which described services' configurations, staffing, interventions delivered and development. Information on services' throughput and outcomes (as biochemically validated 4-week smoking cessation rates) were obtained from routine sources. With reference to relevant literature and assumptions about relapse and background cessation rates, 4-week cessation rates were converted first to 1-year rates. One-year cessation rates were adjusted to reflect the likely permanent smoking cessation rate attributable to service intervention and finally attributable life-years gained were calculated. A wide variety of sensitivity analyses was performed to test the robustness of the average cost-effectiveness ratio, calculated by combining the cost and life-year gained estimates, for all services. With additional data on deprivation levels in services' areas, ordinary least-squares regression techniques were used to investigate variations in individual services' costs per client and cost-effectiveness ratios. Using an up-to-date estimate for health	6_EX.SETTING

	gain accrued by stopping smoking, the average cost per life gained was pound 684 (95% CI 557811), falling to pound 438 when savings in future health-care costs were counted. With the worst case assumptions, the estimate of cost-effectiveness rose to pound 2693 per life-year saved (pound 2293 including future health-care costs) and fell to pound 227 (pound 102) under the most favourable assumptions. Findings are comparable to previous published studies. The regression results suggest that different factors influence cost per client and the net cost per life-year saved, indicating that decision makers should be careful in setting performance targets for these services. In 2000/01, English smoking cessation services provided cost-effective services operating well below the benchmark of pound 20,000 per quality-adjusted life-year saved (QALY) that is used by the National Institute for Clinical Excellence in the United Kingdom.	
Haile MJ, Wiggers JH, D Spigelman A, Knight J, Considine RJ, Moore K. (2002). Novel strategy to stop cigarette smoking by surgical patients: pilot study in a preadmission clinic. ANZ J Surg. 2002 Sep;72(9):618-22.	Evidence-based guidelines suggest that all services, wards and clinics within hospitals consider smoking status a vital sign and routinely provide cessation care. Despite this, such opportunities are currently under-utilized. The aim of the present pilot study was to determine the potential effectiveness, feasibility and acceptability of computer delivery of smoking cessation advice to surgical preadmission patients. All smokers attending a non-cardiac surgical preadmission clinic at the John Hunter Hospital, New South Wales, completed a brief computerized smoking cessation intervention programme. Nine months following completion of the programme, patients completed a follow-up telephone interview that assessed their smoking status and the acceptability of the programme. At follow up, 22 of the 37 participants (60.0%) reported that they had stopped smoking prior to their surgery 9 months previously. Of the 37 participants at follow up, five reported that they were no longer smokers at that time, a cessation rate of 13.5%. Among those patients still smoking, a trend toward smoking fewer cigarettes was evident. Of the 56 smokers at baseline, all completed the computerized smoking cessation programme, with an average completion time of 21 min. A large majority of the smokers (80%) and non-smokers (88%) found that the provision of smoking cessation advice by the	12_IN.COST

	computer was appropriate and acceptable. Extrapolation of the results to a full year suggests a cost per quitter of $443. An interactive computerized smoking cessation programme is an acceptable and feasible method of routinely encouraging surgical preadmission clinic patients to stop or reduce their smoking. Further development and testing of the efficacy of this approach is required.	
Hurley SF. (2005). Short-term impact of smoking cessation on myocardial infarction and stroke hospitalisations and costs in Australia. Med J Aust. 2005 Jul 4;183(1):13-7.	To estimate the short-term benefits of a reduction in smoking on acute myocardial infarction (AMI) and stroke hospitalisations and costs. Epidemiological study which applied functions describing reductions over time in risk of AMI and stroke in people quitting smoking to hospitalisation rates and costs for Australia. The numbers of AMI and stroke hospitalisations in 35-64-year-olds and the associated costs that could have been avoided over a 7-year period from 2001-02 if smoking prevalence had decreased by 1% in the first year (Scenario 1) or by 1% per annum for 5 consecutive years (Scenario 2). Under Scenario 1, almost 1000 hospitalisations for AMI and about 350 hospitalisations for stroke would have been avoided over 7 years, saving about $20.4 million in health care costs. Under Scenario 2, over 3000 AMI hospitalisations and over 1000 stroke hospitalisations would be avoided, and health care costs could be reduced by $61.6 million (2.75% of costs for AMI and stroke over the period). This study provides further support for the proposition that modest and achievable reductions in smoking rates can substantially improve health outcomes and reduce health care costs, even in the short term.	5_EX.INT
Jones TE., Crocker H., Ruffin RE. (2008). Smoking habits and cessation programme in an Australian teaching hospital. Aust N Z J Med. 1998 Aug;28(4):446-52.	Data on prevalence of cigarette smoking by hospital employees are limited in Australia, but anecdotal evidence suggests that many health sector employees continue to smoke despite abundant evidence regarding the harmful effects of this habit. Nicotine is an addictive drug and arguably this should be known better in the health industry than in any other industry. Despite having this knowledge at their disposal, health sector employers rarely provide assistance to employees, relying instead on restrictive policies to reduce smoking in the	10_IN.EFFECT

	workplace. To assist employees to quit smoking, we instituted a medium intensity Stop Smoking Programme, run by a clinical pharmacist offering nicotine patches and support on a weekly basis. A principal aim of the service was to redress the imbalance between the availability of cigarettes and the most effective nicotine replacement therapy, the trandermal nicotine patch. Following 18 months operation of this service, we surveyed hospital employees to ascertain smoking rates and views on smoking cessation in this South Australian teaching hospital. In the first 18 months of operation, 111 staff members availed themselves of the service. At the first follow up period (three months), 21 were not contactable, 29 were successful in not smoking and 61 were still smoking. Six of the 29 who were not smoking at three months resumed smoking by six months, and a further four resumed smoking by 12 months. At the time of this report, 12 of the remaining 19 non smokers had completed two years since quitting and a further three of these had resumed regular smoking by this time. The cost of providing the service was modest at approximately $180.00 per known successful quitter. Results from the survey showed that 12.4% of hospital employees were regular smokers. Smoking prevalence was not equally distributed with female employees being twice as likely to smoke as their male counterparts and employees in the catering department having the highest smoking prevalence (23.8%). Although the prevalence of cigarette smoking by employees of this teaching hospital is lower than for the general community, health sector employers can reduce smoking prevalence further by providing assistance to their employees to quit smoking. The Stop Smoking Programme we describe is effective and could be replicated by other hospitals and similar organisations.	
Lakehurst R., Piercy J. (1994). Cost-effectiveness of the use of transdermal Nicorette patches relative to GP counselling and nicotine gum in the prevention of smoking related diseases. British Journal of Medical	Successful smoking cessation programmes would reduce both the incidence of and mortality from smoking-related diseases such as lung cancer and coronary heart disease. This study analyses the cost-effectiveness of using Nicorette patches in smoking cessation relative to GP counselling alone. It is shown that the use of Nicorette patch is relatively cost-effective in terms of cost per life year saved; and, in addition to GP counselling, represents good value for money in comparison with other accepted health care interventions.	6_EX.SETTING

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Ong MK, Glantz SA. (2005). Free nicotine replacement therapy programs vs implementing smoke-free workplaces: a cost-effectiveness comparison. Am J Public Health. 2005 Jun;95(6):969-75.	We compared the cost-effectiveness of a free nicotine replacement therapy (NRT) program with a statewide smoke-free workplace policy in Minnesota. We conducted 1-year simulations of costs and benefits. The number of individuals who quit smoking and the quality-adjusted life years (QALYs) were the measures of benefits. After 1 year, a NRT program generated 18,500 quitters at a cost of 7020 dollars per quitter (4440 dollars per QALY), and a smoke-free workplace policy generated 10,400 quitters at a cost of 799 dollars per quitter (506 dollars per QALY). Smoke-free work-place policies are about 9 times more cost-effective per new nonsmoker than free NRT programs are. Smoke-free workplace policies should be a public health funding priority, even when the primary goal is to promote individual smoking cessation.	6_EX.SETTING
Ruger JP, Emmons KM, Kearney MH, Weinstein MC. (2009). Measuring the costs of outreach motivational interviewing for smoking cessation and relapse prevention among low-income pregnant women. BMC Pregnancy Childbirth. 2009 Sep 23;9:46.	Background: Economic theory provides the philosophical foundation for valuing costs in judging medical and public health interventions. When evaluating smoking cessation interventions, accurate data on costs are essential for understanding resource consumption. Smoking cessation interventions, for which prior data on resource costs are typically not available, present special challenges. We develop a micro-costing methodology for estimating the real resource costs of outreach motivational interviewing (MI) for smoking cessation and relapse prevention among low-income pregnant women and report results from a randomized controlled trial (RCT) employing the methodology. Methodological standards in cost analysis are necessary for comparison and uniformity in analysis across interventions. Estimating the costs of outreach programs is critical for understanding the economics of reaching underserved and hard-to-reach populations. Methods: Randomized controlled trial (1997-2000) collecting primary cost data for intervention. A sample of 302 low-income pregnant women was recruited from multiple obstetrical sites in the Boston metropolitan area. MI delivered by outreach health nurses vs. usual care (UC), with economic costs as the main outcome measures. Results: The total cost of the MI intervention for 156 participants was $48,672 or $312 per participant. The total cost of $311.8 per participant for the MI intervention compared with a cost of $4.82 per participant for usual care, a difference of $307 ([CI], $289.2 to	12_IN.COST

	$322.8). The total fixed costs of the MI were $3,930 and the total variable costs of the MI were $44,710. The total expected program costs for delivering MI to 500 participants would be 147,430, assuming no economies of scale in program delivery. The main cost components of outreach MI were intervention delivery, travel time, scheduling, and training. Conclusion: Grounded in economic theory, this methodology systematically identifies and measures resource utilization, using a process tracking system and calculates both component-specific and total costs of outreach MI. The methodology could help improve collection of accurate data on costs and estimates of the real resource costs of interventions alongside clinical trials and improve the validity and reliability of estimates of resource costs for interventions targeted at underserved and hard-to-reach populations.	
Severson HH, Andrews JA, Lichtenstein E, Wall M, Akers L. (1997) .Reducing maternal smoking and relapse: long-term evaluation of a pediatric intervention. Prev Med. 1997 Jan-Feb;26(1):120-30.	Background: Pediatric well-care visits provide a clinical opportunity to counsel new mothers about their smoking and the deleterious effects of environmental tobacco smoke (ETS) on infant health. Methods: Forty-nine Oregon pediatric offices enrolled 2,901 women who were currently smoking or had quit for pregnancy, using a brief survey at the newborn's first office visit. Randomly assigned offices provided advice and materials to mothers at each well-care visit during the first 6 months postpartum to promote quitting or relapse prevention. Results: The intervention reduced smoking (5.9% vs 2.7%) and relapse (55% vs 45%) at 6 month follow up but logistic regression analysis at 12 months revealed no significant treatment effect. The intervention had a positive effect on secondary outcome variables, such as readiness to quite and attitude toward and knowledge of ETS. Multiple logistic regression analysis indicated that husband/partner smoking was the strongest predictor of maternal quitting or relapse. Conclusions: A pediatric office based intervention can significantly affect smoking and relapse prevention for mothers of newborns but the effect decreases with time. Consistent prompting of the provider to give brief advice and materials at well care visits could provide a low cost intervention to reduce infant ETS exposure. Reproduced by kind permission of the Academic Press Inc.	10_IN.EFFECT
Stapleton J. (2001). Cost-	Calculations based on the reported performance of the NHS specialist	6_EX.SETTING

effectiveness of NHS smoking cessation services. *w.ash.org.uk/files/documents/ASH_427.pdf*	smoking cessation services suggests they are highly cost-effective – a cost of less than £800 per life-year saved.	
Xenakis JG, Kinter ET, Ishak KJ, Ward AJ, Marton JP, Willke RJ, Davies S, Caro JJ. (2011). A discrete-event simulation of smoking-cessation strategies based on Varenicline Pivotal Trial data. Pharmacoeconomics. 2011 Jun;29(6):497-510. doi: 10.2165/11589230-000000000-00000.	Smoking is the leading cause of preventable death in the US. While one in five individuals smoke, and 70% of these indicate a desire to quit, <5% of unaided quit attempts succeed. Cessation aids can double or triple the odds of successfully quitting. Models of smoking-cessation behaviour can elucidate the implications of individual abstinence patterns to allow better tailoring of quit attempts to an individual's characteristics. The objectives of this study were to develop and validate a discrete-event simulation (DES) to evaluate the benefits of smoking abstinence using data from the pooled pivotal clinical trials of varenicline versus bupropion or placebo for smoking cessation and to provide a foundation for the development of a lifetime smoking-cessation model. The DES model simulated the outcome of a single smoking-cessation attempt over 1 year, in accordance with the clinical trial timeframes. Pharmaceutical costs were assessed from the perspective of a healthcare payer. The model randomly sampled patient profiles from the pooled varenicline clinical trials. All patients were physically and mentally healthy adult smokers who were motivated to quit abruptly. The model allowed for comparisons of up to five distinct treatment approaches for smoking cessation. In the current analyses, three interventions corresponding to the clinical trials were evaluated, which included brief counselling plus varenicline 1.0 mg twice daily (bid) or bupropion SR 150 mg bid versus placebo (i.e. brief counselling only). The treatment periods in the clinical trials were 12 weeks (target quit date: day 8), with a 40-week non-treatment follow-up, and counselling continuing over the entire 52-week period in all treatment groups. The main outcome modelled was the continuous abstinence rate (CAR; defined as complete abstinence from smoking and confirmed by exhaled carbon monoxide ≤ 10 ppm) at end of treatment (weeks 9-12) and long-term follow-up (weeks 9-52), and total time abstinent from smoking over the course of 52 weeks. The model also evaluated costs and cost-effectiveness outcomes. For the varenicline,	6_EX.SETTING

	bupropion and placebo cohorts, respectively, the model predicted CARs for weeks 9-12 of 44.3%, 30.4% and 18.6% compared with observed rates of 44.0%, 29.7% and 17.7%; over weeks 9-52, predicted CARs in the model compared with observed rates in the pooled clinical studies were 22.9%, 16.4% and 9.4% versus 22.4%, 15.4% and 9.3%, respectively. Total mean abstinence times accrued in the model varenicline, bupropion and placebo groups, respectively, were 3.6, 2.6 and 1.5 months and total pharmaceutical treatment costs were $US261, $US442 and $US0 (year 2008 values) over the 1-year model period. Using cost per abstinent-month achieved as a measure of cost-effectiveness, varenicline dominated bupropion and yielded an incremental cost-effectiveness ratio of $US124 compared with placebo. The model accurately replicated abstinence patterns observed in the clinical trial data using individualized predictions and indicated that varenicline was more effective and may be less costly than bupropion. This simulation incorporated individual predictions of abstinence and relapse, and provides a framework for lifetime modelling that considers multiple quit attempts over time in diverse patient populations using a variety of quit attempt strategies.	

12.0 Appendix E. Example quality assessment forms

12.1 Economic evaluation

1. Is the study population appropriate for the topic being evaluated?	**Comments**
2. Are the interventions appropriate for the topic being evaluated?	**Comments**
3. Is the system in which the study was conducted sufficiently similar to the UK context?	**Comments**
4. Were the perspectives clearly stated?	**Comments**
5. Are all direct health effects on individuals included, and are all other effects included where they are material?	**Comments**
6. Are all future costs and outcomes	**Comments**

discounted appropriately?	
7. Is the value of health effects expressed in terms of quality adjusted life years (QALYs)?	**Comments**
8. Are costs and outcomes from other sectors fully and appropriately measured and valued?	**Comments**
9. Overall judgement (no need to continue if not applicable)	**Comments**
10. Does the model structure adequately reflect the nature of the topic under evaluation?	**Comments**
11. Is the time horizon sufficiently long to reflect all important differences in costs and outcomes?	**Comments**
12. Are all important and relevant outcomes included?	**Comments**
13. Are the estimates of baseline	**Comments**

outcomes from the best available source?	
14. Are the estimates of relative 'treatment' effects from the best available source?	**Comments**
15. Are all important and relevant costs included?	**Comments**
16. Are the estimates of resource use from the best available source?	**Comments**
17. Are the unit costs of resources from the best available source?	**Comments**
18. Is an appropriate incremental analysis presented or can it be calculated from the data?	**Comments**
19. Are all important parameters whose values are uncertain subjected to appropriate sensitivity analysis?	**Comments**
20. Is there any potential conflict of	**Comments**

interest?	
21. Overall assessment	**Comments**

13.0 Appendix F. Costs redenominated in 2011£

Study ID	Country	Denomination/ Year of value	Type of study	Results	Results in £/2011*
Barnett 2008	USA	$/2003	CEA	ICER per quit $6,204 (cost of intervention only) ICER per quit $11,496 (cost of intervention + additional service costs)	ICER per quit £5052.39 (cost of intervention only) ICER per quit £9362.08 (cost of intervention + additional service costs)
Dornelas 2006	USA	$/ 2002	CEA	Incremental cost/quit: $298.76	Incremental cost/quit: £248.54
Hejblum 2009	France	€/2008	CBA	Positive net monetary benefit of €117 vs control	Positive net monetary benefit of £90.33 vs control
Krumholz 1993	USA	$/1991	CEA	Cost per quit $380 Incremental cost-effectiveness ratio $220	Cost per quit £389.52 Incremental cost-effectiveness ratio £225.51
Ladapo 2011	USA	$/2008	CUA	Cost per QALY $5,050 Cost per life-year gained $4,350	Cost per QALY £3562.91 Cost per life-year gained £3069.04
Mani 2011	Sweden	€/2009	CEA/CUA	ICER per life-year gained €674 ICER per QALY €924	ICER per life-year gained £50.84 ICER per QALY £69.69
Marks 1990	USA	$/1986	CEA/CBA	Cost per life-year saved $2,943 Cost-saving of $3.31 for every $1 spent in avoiding NICU plus $3.26 for every $1 spent for avoiding disability in babies	Cost per life-year saved £3583.47 Cost-saving of £4.03 for every £1.22 spent in avoiding NICU plus £3.97 for every £1.22 spent for avoiding disability in babies
Meenan 1998	USA	$/1994	CEA	Incremental cost per quit $3,697 Incremental cost per life-year saved $3,680	Incremental cost per quit £3547.11 Incremental cost per life-year saved £3530.80
Olsen 2006	Denmark	€/2001	CEA	Mean ICER €1,058	Mean ICER £104.30
Parker 2007	USA	$/NR	CEA	Cost per quit $28 for control vs $61 to $94 with intervention	Not accessible
Pollack 2001	USA	$/1998	CEA	Cost per sudden infant death averted $210,500	Cost per sudden infant death averted £188,649.18
Prathiba 1998	UK	£/NR	CEA	Cost per quit £851 Cost/life-year saved £340 - £426	Not accessible
Quist-Paulsen	Norway	€/2000	CEA	ICER per life-year gained €230 to € 280 in low-	ICER per life-year gained £23.49 to £28.60

2006				risk ICER per life-year gained €110 (25 years) in high risk	in low-risk ICER per life-year gained £11.24 (25 years) in high risk
Ruger 2008	USA	$/1997	CEA	Cost per relapse prevented $1,217 Cost per QALY for relapse prevented $628	Cost per relapse prevented £1102.99 Cost per QALY for relapse prevented £569.17
Slatore 2009	USA	$/NR	CEA	ICER per QALY $16,415 at 1 yr, $2,609 at 5 yr ICER per life-year gained $45,629 1 yr, $2,703 5 yr	Not accessible
Windsor 1993	USA	$/1990	CEA	Cost benefit ratio between $1:$11.95 and $1:$30.55	Cost benefit ratio between £1.06:£12.68 and £1.06:£32.43

*Converted using the *CCEMG - EPPI-Centre Cost Converter* - http://eppi.ioe.ac.uk/costconversion/default.aspx