

**Cost-effectiveness of brief intervention and referral for smoking cessation**

**Revised Draft**

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## 1. Introduction

The outline model for the project is given in Figure 1. The ability to use this model to estimate the cost-effectiveness of brief interventions and referrals for smoking cessation depends crucially on the availability of the evidence. Very limited evidence of effectiveness was found in the draft evidence synopsis. In particular there are no data from existing evidence to provide estimates of the number receiving brief interventions that may be referred to specialist services within the UK. For these preliminary estimates therefore no simulations have been performed for this element of the model in Figure 1.

Due to the limited nature of the project, it has also proved impossible to find reliable estimates of the year by year changes in smoking related mortality. This would be needed to construct a Markov model which generates year by year changes in quality adjusted life years related to the interventions being compared over the stated time period of the model simulation.

The model was therefore simplified to reflect the available research evidence. This model uses estimates of average quality adjusted life years gained summed over the simulation time period. The estimates are based on the estimated 12 month quit rates taken from the evidence synopsis, as described in the next section. The estimates are calculated for different ages and gender of the population cohort. Because of the limited nature of the evidence a wide range of sensitivity analyses have been performed.

For the estimates of incremental cost effectiveness ratios, two further elements are required. First, it is necessary to define and determine the resource costs of the simulated interventions being compared. The final element of the economic model is the simulated reduction in smoking related health care costs following changes in smoking behaviour. These three elements are then combined to give an incremental cost effectiveness ratio in terms of net costs per QALY using a NHS & PSS perspective following NICE guidance (NICE, 2004).

In the model presented in this report, a cohort of patients is given a brief intervention, which may or may not involve the recommendation to use further smoking cessation aids. The intervention will have a rate of effectiveness which is applied to the cohort. The costs of the intervention are derived by adding the cost of the health professional's time, plus any smoking cessation aids which are used and training costs for interventions requiring an initial training element.

Incremental cost-effectiveness of the intervention is assessed over and above the number of patients that would stop smoking with no intervention, which is derived from the natural or background quit rate.

The model runs for a cohort of smokers, and the mean age of the cohort and the gender of the cohort can be varied. The model is based upon ages of 30, 40, 50 and 60 years.

From the draft effectiveness synopsis, only a limited number of brief interventions could be reliably estimated. These are:

1. GP opportunistic advice
2. GP opportunistic advice plus advice to use NRT.

Further variants of brief interventions have been simulated. However, the evidence for these interventions is less reliable. In particular whether these two elements, the telephone advice and the self help material, are adjuncts or stand alone interventions is not clear cut. For these two interventions the costs have been calculated on the bases of these elements being delivered along with a 5 minute brief interventions and the evidence of effectiveness on the maximum likely impact of these elements as suggested in the evidence synopsis.

3. GP opportunistic advice plus referral to a telephone helpline.
4. GP opportunistic advice plus self help material.

There was insufficient evidence of effectiveness for other health care professionals. Also, the review stated that nurses and other health care professionals normally delivered brief interventions in stand alone sessions, as opposed to opportunistically. For illustrative purposes we have included two model simulations using different effectiveness rates to explore the potential cost-effectiveness of realistic interventions by nurses in different settings. There are:-

5. Nurse-led brief intervention of 30 minutes in a primary care setting.
6. Nurse-led brief intervention of 30 minutes in a hospital setting.

## 2. Effectiveness

### 2.1 Effectiveness rates

The effectiveness rates used in the following simulations are based on the effectiveness over and above a 'no intervention' scenario. For the economic model it is necessary to determine effectiveness in terms of the proportion of those receiving an intervention which will have an effect. This requires additional information. It is assumed that without any brief intervention there is a 1% background quit rate amongst smokers. This is a broad estimate, higher than the 0.48 suggested in the evidence synopsis for the likely rate of smokers who attempt to quit "cold turkey" but below the overall estimated 2.65% population quit rate estimated in this paper to be the result of all current interventions, including referrals to smoking cessation services and those currently receiving prescriptions for smoking cessation products such as NRT. As stated in the synopsis these estimates are subject to a wide margin of error.

The GP brief opportunistic advice intervention compared to no intervention uses the odds ratio of 1.74 from the evidence synopsis. The evidence and cost effectiveness reviews did not yield clear estimates of the average length of time of such interventions. Cost-effectiveness estimates are presented for brief advice of 5 minutes which is considered the longest practical period for a brief intervention in the UK setting.

For the incremental cost-effectiveness of NRT in addition to GP opportunistic advice, the draft synopsis suggests an odds-ratio of 1.81 which is used in this model. Data regarding the use and take up of NRT are difficult to model since they will be tied in with effectiveness rates. In the trials used in evidence reviews, generally all the participants in the NRT arm are offered the products and this is the basis on which the effectiveness rates are drawn. This model uses the same assumptions as in Godfrey et al (2005) for the English Smoking Cessation evaluation.

No odds-ratio is presented for the incremental effectiveness of brief advice plus self help material in the synopsis. This model uses 1% as an estimated additional quit rate over and above brief advice only. Similarly no odds-ratio is provided for the incremental effectiveness of telephone helpline. The following simulations use an estimated 2-3% additional quit rate.

There was insufficient evidence of effectiveness for other health care professionals delivering stand alone brief interventions. Brief interventions delivered by nurses are presented based on a range of effectiveness estimates, from 0.5% to 3% over and above the control scenario.

**Table 1: Effectiveness rates (12 months)**

	Quit rate	Incremental quit rate (over and above control)
Control (background quit rate)	0.01	-
Brief opportunistic advice (5 minutes)	0.01727 (CIs: 0.01473, 0.02029)	0.00727
Brief opportunistic advice + NRT	0.03083 (CIs: 0.02751, 0.03428)	0.02083
Brief opportunistic advice + telephone helpline	0.03727 – 0.04727	0.02727 – 0.03727
Brief opportunistic advice + self-help	0.02727	0.01727
Brief opportunistic advice + nurse-led interventions	0.015-0.04	0.005-0.03

The effectiveness evidence is based upon a 12 month quit rate. However, these rates should be adjusted to take into account the longer term relapse. This adjustment is made based on an eight year follow up study of abstinence following the use of nicotine patches (Yudkin et al, 2003).

## 2.2 Quality of Life

The EQ-5D scores for the quality of life used in this model are based on a survey of current and ex-smokers from an unpublished study of approximately 15,000 individuals in the UK in 2003. For example for a male smoker aged 50-59, the mean quality of life index was 0.805, compared with 0.858 for an ex-smoker. For a female in the same age group, the means were 0.755 and 0.837 respectively.

An individual who stops smoking will gain both quality and quantity of life. Most economic studies reviewed used life years saved but ignored quality of life gains. Those studies that have expressed results in terms of QALYs have used a general adjustment and the source and quality of this evidence is unclear.

For this model the evidence of life years gained was taken from Doll et al. (2004). This study is based on UK data for men over a 50 year period. While not ideal it is the most recent epidemiological evidence. The life years gained were calculated for ex-smokers in this cohort study and therefore it is important to ensure the gains are relevant to sustained quitters rather than using an adjusted quit rate from studies with limited follow-up periods.

The additional life years gained clearly varies by age of quitting. For this model the average ages of 30, 40, 50 and 60 were chosen and the life years gained from quitting smoking are 10 years, 9 years, 6 years and 3 years respectively, based upon the estimates by Doll et al (2004).

Therefore, an individual who stops smoking at the age of 30 will gain both quality and quantity of life. Between the ages of 30 and 39, the gain will be an annual quality increment which is derived from the difference in the quality of life of a smoker and an ex-smoker between these ages. For the next ten years, the gain is the difference in the quality of life between a smoker and an ex-smoker aged between 40 and 49, and so on, until the average age of death for a smoker is reached. In addition the individual will gain ten life years, the quality of which is based upon an average quality of life for ex-smokers throughout the lifetime. For a 40 year old smoker, the gain will be the increments in quality between ages 40 and 49, 50 and 59, and so on, plus nine additional life years. The same method is applied to 50 and 60 year old smokers, with gains getting smaller as the age at intervention increases. Summing these components will give the QALY gains from stopping smoking at the different ages in the model. A discount rate of 3.5%, as set out in the NICE Guide to the Methods of Technology Appraisal (NICE, 2004), is applied to each of these estimates to give a discounted QALY gain at each age, assuming that the gains are spread evenly across the ex-smokers remaining life years.

### 3. Resource use and costs

#### 3.1 Resource use

As noted in both the effectiveness and cost-effectiveness reviews, details of interventions delivered, in particular the intervention intensity, are very limited. A number of additional assumptions are required to calculate resource use for each of the simulations. These are based, as far as possible, on the reviewed research literature.

Table 2 shows the resources used by each of the interventions. GP opportunistic advice is simulated for 5 minutes of GP time. The addition of NRT to the brief intervention assumes 5 minutes of brief advice and advice to use NRT, following which 50% of patients will use a full NRT course and 50% will use NRT for one month (see Godfrey et al, 2005). Adding referral to a telephone helpline to brief advice assumes 5 minutes brief advice plus a mean of two calls by the smoker to a telephone helpline. Provision of self-help material assumes one unit of self help material is given to each smoker during the 5 minutes of advice.

A number of assumptions must be made to estimate the cost of a nurse-led brief intervention. In primary care, the intervention is delivered by a practice nurse for 30 minutes. The practice nurse attends a two hour training session before beginning the programme. An invitation is sent to smokers who are screened from the practice database, and 2% of smokers are assumed to attend the 30 minute session.

It is assumed that the hospital based brief intervention is undertaken by a staff nurse. Prior to the intervention, the nurse attends a two hour training session. A one minute screening of patients for smoking status is undertaken, and 10% of screened patients are assumed to receive the brief intervention of 30 minutes.

**Table 2: Resource use**

<b>Intervention</b>	<b>Resources</b>
Control (background quit rate)	No cost
Brief opportunistic advice from a GP (5 minutes)	5 minutes GP time
Brief opportunistic advice from a GP + advice to use NRT	5 minutes GP time + NRT, assuming 50% use full NRT course and 50% use one months supply
Brief opportunistic advice from a GP + telephone helpline	5 minutes GP time + 2 calls to a telephone helpline
Brief opportunistic advice from a GP + self-help material	5 minutes GP time + self help material @ £2.00/unit
Brief advice from a practice nurse in a primary care setting	Assumes a 2% response rate from a mailed out invitation. 30 minutes PN time (inc overheads).
Brief advice from a staff nurse in a hospital	Assumes a one minute screening of all patients

setting	of which 10% receive the intervention. 30 minutes advice by a staff nurse.
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### 3.2 Unit Costs

The initial time for the brief intervention is calculated by multiplying the time taken for the event by the unit cost for the relevant health care professional. Additional costs are added for recommendations to use NRT, which is the average cost of NRT multiplied by the take up rate for the NRT.

Costs for the GP, practice nurse and staff nurse are taken from Curtis and Netten (2005) and are based on the cost per minute in 2004/5. The GP cost of £2.00 per surgery minute is used in the following calculations, which includes the costs of overheads but excludes qualifications costs. The cost of a staff nurse is £0.32 per minute, and the cost of a practice nurse is £0.37 per minute. These costs include overhead costs.

A self help material cost of £2.00 per unit is taken, based on a mean cost from a range of studies from the review. The cost of NRT is based on a cost of £9.07 per pack of seven patches (BNF, March 2005). A course of 15 mg patches for eight weeks, followed by a 10mg patch for 2 weeks and a 5mg patch for 2 weeks is recommended, and we assume that 50% of patients complete the full course, and 50% of patients use just one months supply. This gives a mean cost of £72.56 per patient.

**Table 3: Unit costs**

Element	Cost
GP	£2.00/minute
Practice nurse	£0.37/minute
Staff nurse	£0.32/minute
Self help material	£2.00/unit
NRT	£9.07/7 patches, used for 12 weeks = £108.84 for 50% completing course, £36.28 for 50% not completing course. Mean cost=£72.56 (2004 BNF)
Telephone helpline	£4.82/call

### 3.3 Programme costs per smoker

Resource utilisation and costs can be combined to estimate the programme cost of each of the interventions listed in Section 1.

The GP brief interventions are based on GP time, including overhead costs for 5 minutes. Total cost per smoker is £10.00.

For the brief intervention plus NRT intervention we add the mean cost of NRT per smoker to the cost of 5 minutes brief advice, which gives a cost of £82.56 per smoker.

The telephone helpline cost per smoker is derived from the cost of 5 minutes brief advice plus the cost of two calls, which gives £19.46 per smoker.

The cost of the self-help programme is derived by adding the cost of self help material, which is estimated at £2.00 per unit, to the cost of 5 minutes GP advice, which gives a cost of £12.00 per smoker.

The hospital based nurse-led intervention assumes 2 hours of nurse training, costing £38.40 which we spread across a population of 1000 smokers. Assuming a screen of smoking status takes 1 minute, and for every ten screens, one smoker is exposed to the brief intervention, the cost of screening and training for one smoker is £3.24. We add the cost of 30 minutes nurse time for the brief advice is added to give a total cost of £12.84 per smoker.

In the primary care setting we assume a two hour training session per nurse, which is divided by 1000 smokers to give £0.04 per smoker. A letter is sent out to smokers, which takes an estimated 30 minutes of nurse time to write. The letter is mailed out to 1000 smokers, costing £0.30 in postage and materials. If we assume a 2% response rate, the cost per smoker attending the brief intervention is £17.50. We add £11.10 of nurse time to the recruitment and training cost to give a total of £28.60 per smoker attending the brief intervention.

The costs of the interventions used in the modelling are summarised in Table 4.

**Table 4: Intervention costs**

<b>Intervention</b>	<b>Staff</b>	<b>Resources</b>	<b>Cost per smoker</b>
Control (background quit rate)		Nil	-
Brief opportunistic advice (5 mins)	GP	5 minutes GP time	£10.00
Brief opportunistic advice + NRT	GP	5 minutes GP time Course of NRT (50% smokers using full, 50% using half)	£82.56
Brief opportunistic advice plus telephone helpline	GP	5 minutes GP time 2 calls to telephone helpline	£19.64
Brief opportunistic advice plus self-help	GP	5 minutes GP time One unit/self help material	£12.00
Brief nurse advice in primary care setting (30 mins)	Practice nurse	Two hours training (assumed per 1000 smokers) Writing letter (30 minutes) (assumed per 1000 smokers) Postage and materials (£0.30) 30 minutes brief advice from practice nurse	£28.60
Brief nurse advice in hospital setting (30 mins)	Staff nurse	Two hours training (assumed per 1000 smokers) One minute screen 30 minutes brief advice from staff nurse	£12.84

## 4. Results

### 4.1 GP led brief interventions

The following tables show the cost per QALY for a range of interventions presented by patient age and gender. All QALY gains are discounted at a rate of 3.5% per annum. We assume that the gains are distributed evenly across the patients remaining life.

Table 5 shows the incremental cost per QALY for GP brief intervention only, based on an intervention length of 5 and 10 minutes. For five minutes brief advice, cost per QALY ranges from £633 to £1510 for males and £577 to £1677 for females.

**Table 5: Brief Intervention only: Incremental cost per QALY over and above control (discounted at 3.5%)**

	5 minutes BI	
	Male	Female
Age 30	£636	£577
Age 40	£633	£611
Age 50	£829	£845
Age 60	£1510	£1677

Table 6 shows the incremental cost-effectiveness of 5 minutes brief advice plus NRT over and above the control. An intervention of 5 minutes brief advice plus advice to use NRT would generate one QALY at a cost of between £1831 and £4352 for male smokers aged 30 to 60, compared to £1664 to £4833 for female smokers aged 30 to 60.

**Table 6: Brief Intervention (5 minutes) + NRT: Incremental cost per QALY over and above control (discounted at 3.5%)**

	Male	Female
Age 30	£1831	£1664
Age 40	£1825	£1761
Age 50	£2390	£2435
Age 60	£4352	£4833

Table 7 shows the incremental cost-effectiveness of *adding NRT to the brief intervention*. In this example the brief intervention is taken as the baseline and the incremental costs and effects are combined to give the incremental cost-effectiveness ratio. This suggests that adding advice to use NRT over and above brief advice will generate an *additional* QALY at a cost of between £2463 and £5876 for males and £2246 and £6524 for females.

**Table 7: Brief Intervention (5 minutes) + NRT: Incremental cost per QALY over and above brief advice only (discounted at 3.5%)**

	Male	Female
Age 30	£2473	£2246
Age 40	£2463	£2378
Age 50	£3226	£3288
Age 60	£5876	£6524

Table 8 presents the cost-effectiveness of a telephone helpline, based on effectiveness rates of 2% and 3% over and above the control. At an incremental effectiveness rate of 2%, cost-effectiveness ranges from £332 to £791 per QALY for males and from £302 to £878 per QALY for females. At an incremental effectiveness rate of 3%, cost-effectiveness ranges from £243 to £579 per QALY for males and from £221 to £643 per QALY for females.

**Table 8: Brief Intervention (5 minutes) + Telephone Helpline: Incremental cost per QALY over and above control (discounted at 3.5%)**

	Effectiveness of 2% over and above control		Effectiveness of 3% over and above control	
	Male	Female	Male	Female
Age 30	£333	£302	£243	£221
Age 40	£332	£320	£243	£234
Age 50	£434	£443	£318	£324
Age 60	£791	£878	£579	£643

Table 9 presents the cost-effectiveness of 10 minutes brief advice plus self help material, based on effectiveness rates of 2.7% over and above the control. Using this estimated additional effect of 1% over and above brief advice only, cost-effectiveness ranges from £320 to £763 per QALY for males and from £292 to £847 per QALY for females.

**Table 9: Brief Intervention (5 minutes) + Self Help: Incremental cost per QALY over and above control (discounted at 3.5%)**

	Male	Female
Age 30	£321	£292
Age 40	£320	£309
Age 50	£419	£727
Age 60	£763	£847

### 4.1.1 Sensitivity analysis

The estimates presented above were subjected to a sensitivity analysis based on a number of variables.

#### 4.1.1.1 Variations in effectiveness

Table 10 uses the 5 minutes brief advice and applies the 95% confidence intervals to the effectiveness rate. It is evident that results are not particularly sensitive to these variations in effectiveness. The analysis is repeated for brief advice plus NRT in table 10.

**Table 10: Using 95% confidences intervals for 5 minutes Brief Intervention: Incremental cost per QALY over and above control (discounted at 3.5%)**

	Lower CI		Upper CI	
	Male	Female	Male	Female
Age 30	£977	£887	£449	£408
Age 40	£973	£939	£447	£432
Age 50	£1275	£1299	£586	£597
Age 60	£2321	£2578	£1067	£1185

**Table 11: Using 95% confidences intervals for 5 minutes Brief Intervention plus NRT: Incremental cost per QALY over and above control (discounted at 3.5%)**

	Lower CI		Upper CI	
	Male	Female	Male	Female
Age 30	2179	1979	1571	1427
Age 40	2171	2095	1565	1511
Age 50	2843	2897	2050	2089
Age 60	5177	5749	3734	4146

#### 4.1.1.2 Background quit rates

Background quit rates of 0.5% and 2% were used to assess the variability of the cost-effectiveness of brief advice and brief advice plus NRT. Table 12 shows the revised effectiveness rates, and Tables 13 and 14 show the cost-effectiveness ratios for 5 minutes brief advice and 5 minutes brief advice plus NRT. At 0.5% background quit rate, for brief advice only, the cost-effectiveness ratio ranges from £1254 to £2992 for males and £1144 to £3322 for females. For brief advice plus NRT, the ratio ranges from £3592 to £8569 for males and £9515 to £2359 for females. At 2.0% background quit rate, for brief advice only, the cost-effectiveness ratio ranges from £322 to £768 for

males and £294 to £853 for females. For brief advice plus NRT, the ratio ranges from £941 to £2244 for males and £858 to £2492 for females.

**Table 12: Effectiveness rates (12 months) based on 0.5% and 2% background quit rate**

	0.5% background quit rate		2.0% background quit rate	
	Quit rate	Incremental quit rate (over and above control)	Quit rate	Incremental quit rate (over and above control)
Control (background quit rate)	0.005	-	0.02	-
Brief opportunistic advice (5-10 minutes)	0.00867	0.00367	0.03429	0.01429
Brief opportunistic advice + NRT	0.01558	0.01058	0.06039	0.04039

**Table 13: Brief Intervention only based on 0.5% and 2% control: Incremental cost per QALY over and above control (discounted at 3.5%)**

	0.5% background quit rate		2.0% background quit rate	
	Male	Female	Male	Female
Age 30	£1259	£1144	£323	£294
Age 40	£1254	£1211	£322	£311
Age 50	£1643	£1674	£422	£430
Age 60	£2992	£3322	£768	£853

**Table 14: Brief Intervention plus NRT based on based on 0.5% and 2% control: Incremental cost per QALY over and above control (discounted at 3.5%)**

	0.5% background quit rate		2.0% background quit rate	
	Male	Female	Male	Female
Age 30	£3606	£3275	£945	£858
Age 40	£3592	£3468	£941	£908
Age 50	£4705	£4795	£1232	£1256
Age 60	£8569	£9515	£2244	£2492

#### 4.1.1.3 Length of intervention

Evidence was not available to determine the relationship between the duration of brief advice and the effectiveness rate. Table 15 summarises how the cost-effectiveness ratio varies based upon a range of durations for brief advice from one to four minutes, using the effectiveness estimate presented in Table 1.

**Table 15: Brief advice (1 to 5 and 10 minutes) cost per QALY over and above control (discounted at 3.5%)**

Age	1 minute		2 minutes		3 minutes	
	Male	Female	Male	Female	Male	Female
30	£127	£115	£254	£231	£381	£346
40	£127	£122	£253	£244	£380	£367
50	£166	£169	£332	£338	£498	£507
60	£322	£335	£604	£671	£906	£1006

Age	4 minutes		5 minutes		10 minutes	
	Male	Female	Male	Female	Male	Female
30	£508	£462	£636	£577	£1271	£1155
40	£507	£489	£633	£611	£1266	£1222
50	£663	£676	£829	£845	£1659	£1690
60	£1208	£1342	£1510	£1677	£3021	£3354

#### 4.1.1.4 Threshold analysis by age and treatment

The following section examines the potential variations in costs and effect sizes which could be tolerated if the cost-effectiveness ratio was to remain below £20,000 per QALY. The analysis is based upon brief advice and brief advice plus NRT and is presented by age group.

#### Effect size

Table 16 shows that the cost-effectiveness ratio will remain below £20,000 per QALY provided that the total effectiveness rate is above 0.01055 for males and 0.01062 for females for brief advice only. That is for every 100 interventions, it would be below the threshold if at least 0.06 smokers had quit after 12 months over and above the 1% who would have quit without this intervention. For the brief advice plus NRT treatment (Table 17), the cost-effectiveness ratio remains below £20,000 provided the total effectiveness rate is greater than 0.01454 for males and 0.01504 for females. The relationship between age and effectiveness is shown below.

**Table 16: Total effect size which takes the cost-effectiveness ratio to £20,000/QALY for brief advice (control = 0.01)**

	5 minutes brief advice	
	Male	Female
Age 30	0.01024	0.01022
Age 40	0.01022	0.01023
Age 50	0.01031	0.01031
Age 60	0.01055	0.01062

**Table 17: Total effect size which takes the cost-effectiveness ratio to £20,000/QALY for brief advice plus NRT (control = 0.01)**

	5 minutes brief advice plus NRT	
	Male	Female
Age 30	0.01191	0.01174
Age 40	0.01191	0.01184
Age 50	0.01249	0.01254
Age 60	0.01454	0.01504

### Cost

Brief advice remains cost-effective provided that costs remain below £132 for males and £119 for females. This is the equivalent of 66 minutes advice for males and 60 minutes advice for females. Again this is based upon the highest age group in the analysis. For brief advice plus NRT the cost-effectiveness ratio remains below £20,000 provided that the cost is below £379 for males and £341 for females. Again this is based on the highest age group in the analysis.

**Table 18: Cost which takes the cost-effectiveness ratio to £20,000/QALY for brief advice**

	brief advice	
	Male	Female
Age 30	£314	£346
Age 40	£315	£327
Age 50	£241	£236
Age 60	£132	£119

**Table 19: Cost which takes the cost-effectiveness ratio to £20,000/QALY for brief advice plus NRT**

	brief advice plus NRT	
	Male	Female
Age 30	£901	£992
Age 40	£904	£937
Age 50	£690	£677
Age 60	£379	£341

#### **4.1.1.5 Previous failures**

Data are not available on the relationship between making an unsuccessful quit attempt and the effectiveness of a second exposure to brief advice. Assuming 3.5 GP consultations per year by the average individual (Office for National Statistics, 2004), the total cost of these sessions of brief advice would be £34.57 if we assume only the first consultation is effective. This is estimated by giving all smokers brief advice at the first visit, of which 0.9827 will still be smokers at the second visit and will be given 2.5 further sessions

of brief advice which have no effect upon those who do not stop smoking after the first session.

The question surrounding the cost-effectiveness of follow up brief advice is a marginal issue, and we can refer to the threshold analysis in Table 21 to determine the minimum effect size required for follow up advice to be cost-effective. Provided the total effectiveness of a follow up session is at least 0.015 amongst female smokers aged 60, the cost-effectiveness of the advice will fall below £20,000/QALY. That is providing at least 0.5 out of every 100 smokers of these type quit, over an above the 1 person who would have quit without the intervention, the follow-up session would be below the cost-effectiveness threshold. For female smokers aged 30, the total effectiveness rate should be at least 0.01174.

#### **4.1.1.6 Level of Dependence**

Data regarding the relationship between dependency and effectiveness were not available. The following presents an incremental cost-effectiveness analysis of treating dependent smokers over and above less dependent smokers. Assuming two types of smokers, dependent smokers (50% of all smokers) and less dependent smokers (50% of all smokers) which feed into the quit rate of brief advice only, we know that the total effectiveness impact should be 0.00727 over and above the no intervention scenario. Therefore assuming 'low' effectiveness rates amongst dependent smokers to be 0.001, 0.002 and 0.004 we can then estimate the effectiveness amongst less dependent smokers.

Tables 20 and 21 show different scenarios based upon assumptions regarding high and low dependence smokers. If we assume only 0.001 effectiveness rate amongst dependent smokers, the incremental cost-effectiveness ratio for treating this group ranges from £4604 to £10981 per QALY for males and £4197 to £12193 for females. If we assume 0.004 effectiveness rate amongst dependent smokers, the incremental cost-effectiveness ratio for treating this group ranges from £1151 to £2745 per QALY for males and £1049 to £3048 for females.

For less dependent smokers, the effectiveness rates are calculated corresponding to the effectiveness rates for the more dependent groups, which are 0.01354, 0.01254 and 0.01054 respectively. Using the highest quit rate, cost-effectiveness ranges from £340 to £811 for males and £310 to £901 for females. Using the lowest quit rate, cost-effectiveness ranges from £437 to £1042 for males and £398 to £1157 for females.

However, effectiveness rates amongst dependent smokers should be subject to further research before reliable conclusions can be drawn.

**Table 20: Cost-effectiveness of 5 minutes brief advice by high dependence**

	Effectiveness rate for dependent smokers					
	0.001		0.002		0.004	
	Male	Female	Male	Female	Male	Female
Age 30	£4621	£4197	£2310	£2099	£1155	£1049
Age 40	£4604	£4444	£2302	£2222	£1151	£1111
Age 50	£6030	£6144	£3015	£3072	£1507	£1536
Age 60	£10981	£12193	£5490	£6096	£2745	£3048

**Table 21: Cost-effectiveness of 5 minutes brief advice by low dependence**

	Effectiveness rate for dependent smokers					
	0.01354		0.01254		0.01054	
	Male	Female	Male	Female	Male	Female
Age 30	£341	£310	£368	£335	£438	£398
Age 40	£340	£328	£367	£354	£437	£422
Age 50	£445	£454	£481	£490	£572	£583
Age 60	£811	£901	£876	£972	£1042	£1157

#### 4.1.1.7 Variations in cost-effectiveness by socio-economic group

No data were available to explore variations in cost-effectiveness by different socio-economic group. However, the results in section 4.1.1.6 illustrate variations in effectiveness across two groups of the population. If effectiveness rates were lower in some socio-economic groups similar variations in cost-effectiveness would be found. However, the figures even for the lowest effectiveness rates are below the £20,000 per QALY estimates and would be even lower in health care cost savings were included, see section 4.3 below.

## 4.2 Further models of brief interventions

Two brief interventions by nurses are simulated based on a primary care and a hospital setting.

Table 22 presents the incremental cost-effectiveness results based on effectiveness rates from 0.5% to 3% over and above the control.

The cost-effectiveness of brief advice in primary care ranges from £575 to £3448/QALY for 50 year old males and £586 to £3514/QALY for 50 year old females, based on effectiveness rates of 1% to 3%. Even under the most conservative assumptions, these estimates are well below the cost-effectiveness ratios set out in NICE guidance (NICE, 2004).

**Table 22: Brief Intervention by practice nurse (30 minutes) in primary care: Incremental cost per QALY over and above control (discounted at 3.5%)**

	Effectiveness (over and above control)							
	0.5%		1%		2%		3%	
	Male	Female	Male	Female	Male	Female	Male	Female
Age 30	£2,644	£2,400	£1322	£1200	£661	£600	£441	£400
Age 40	£2,634	£2,542	£1317	£1271	£658	£635	£439	£424
Age 50	£3,448	£3,514	£1724	£1757	£862	£879	£575	£586
Age 60	£6,280	£6,974	£3140	£3487	£1570	£1744	£1047	£1162

Table 23 presents the incremental cost-effectiveness results based on effectiveness rates from 0.5% to 3% over and above the control.

The cost-effectiveness of brief advice in a hospital care setting ranges from £258 to £1548/QALY for 50 year old males and £263 - £1578/QALY for 50 year old females, based on effectiveness rates of 0.5% to 3%. Again, these estimates are below the cost-effectiveness ratios set out in NICE guidance (NICE, 2004).

**Table 23: Brief Intervention by staff nurse (30 minutes) in hospital setting: Incremental cost per QALY over and above control (discounted at 3.5%)**

	Effectiveness (over and above control)							
	0.5%		1%		2%		3%	
	Male	Female	Male	Female	Male	Female	Male	Female
Age 30	£1,186	£1,078	£593	£539	£297	£269	£198	£180
Age 40	£1,182	£1,142	£591	£571	£296	£285	£197	£190
Age 50	£1,548	£1,578	£774	£789	£387	£394	£258	£263
Age 60	£2,820	£3,132	£1410	£1566	£705	£783	£470	£522

### 4.3 Health care cost savings

We would expect that as the number of smokers is reduced, as smokers switch into the ex-smokers group and therefore experience less smoking-related morbidity, the average health care costs of will fall. The simulations for each age cohort are summarised in the tables below.

The estimated change in health care costs used in this model are adapted from the data used in Godfrey et al (2005) based on changes in health care costs from the evaluation of the national English smoking cessation programme. A mean cost saving of £448 per ex-smoker was estimated when adjusting for a 3.5% discount rate and inflating to 2004/5 prices.

The results presented in Tables 24-27 show how the cost per QALY is reduced as some of the savings in health care costs which are realised as smokers quit smoking offset the cost of providing the brief intervention.

**Table 24: Brief interventions: Cost per QALY using all health care costs, based on 30 year old cohort**

Intervention	Incremental cost/QALY over and above control	
	Male	Female
Brief opportunistic advice from a GP (5 minutes)	£540	£491
Brief opportunistic advice from a GP + advice to use NRT	£1736	£1577
Brief opportunistic advice from a GP + telephone helpline (2% - 3% above control)	£148 - £238	£135 - £216
Brief opportunistic advice from a GP + self-help material	£226	£205
Brief advice from a practice nurse in a primary care setting (0.5% - 3% above control)	£345 - £2452	£314 - £2228
Brief advice from a staff nurse in a hospital setting (0.5% - 3% above control)	£103 - £996	£93 - £904

**Table 25: Brief interventions: Cost per QALY using all health care costs, based on 40 year old cohort**

Intervention	Incremental cost/QALY over and above control	
	Male	Female
Brief opportunistic advice from a GP (5 minutes)	£538	£520
Brief opportunistic advice from a GP + advice to use NRT	£1299	£1254
Brief opportunistic advice from a GP + telephone helpline (2% - 3% above control)	£148 - £237	£143 - £228
Brief opportunistic advice from a GP + self-help material	£225	£217
Brief advice from a practice nurse in a primary care setting (0.5% - 3% above control)	£344 - £2444	£322 - £2358
Brief advice from a staff nurse in a hospital setting (0.5% - 3% above control)	£102 - £996	£99 - £958

**Table 26: Brief interventions: Cost per QALY using all health care costs, based on 50 year old cohort**

Intervention	Incremental cost/QALY over and above control	
	Male	Female
Brief opportunistic advice from a GP (5 minutes)	£705	£719
Brief opportunistic advice from a GP + advice to use NRT	£2266	£2309
Brief opportunistic advice from a GP + telephone helpline (2% - 3% above control)	£193 - £310	£197 - £316
Brief opportunistic advice from a GP + self-help material	£295	£300
Brief advice from a practice nurse in a primary care setting (0.5% - 3% above control)	£451 - £3200	£459 - £3262
Brief advice from a staff nurse in a hospital setting (0.5% - 3% above control)	£134 - £1300	£136 - £1324

**Table 27: Brief interventions: Cost per QALY using all health care costs, based on 60 year old cohort**

Intervention	Incremental cost/QALY over and above control	
	Male	Female
Brief opportunistic advice from a GP (5 minutes)	£1284	£1426
Brief opportunistic advice from a GP + advice to use NRT	£4126	£4581
Brief opportunistic advice from a GP + telephone helpline (2% - 3% above control)	£352 - £565	£391 - £627
Brief opportunistic advice from a GP + self-help material	£537	£596
Brief advice from a practice nurse in a primary care setting (0.5% - 3% above control)	£821 – £5828	£911 – £6472
Brief advice from a staff nurse in a hospital setting (0.5% - 3% above control)	£244 - £2368	£271 - £2628

## 5. Discussion

The model shows that the cost-effectiveness of brief interventions conducted by GPs and nurses, in all settings, to all age groups included in the model, and with all adjuncts (NRT, self help, telephone helpline) can generate QALY gains at a low cost. The cost per QALY tends to increase as patient age increases, but brief interventions delivered to a 60 year old cohort are still cost-effective.

The results for the cohort of 50 year old males and females are summarised in Table 27. It can be seen that in all cases, the incremental cost-effectiveness ratios over and above the control are well below the lower £20,000 per QALY benchmark set out in the NICE Guide to the Methods of Technology Appraisal (NICE, 2004). Threshold analysis suggests the incremental effectiveness of brief interventions compared to a control are only required to have very small effectiveness rates to remain below the NICE threshold.

**Table 27: Summary of cost-effectiveness of brief interventions: Cost per QALY based on 50 year old cohort (treatment cost perspective)**

Intervention	Incremental cost/QALY over and above control	
	Male	Female
Brief opportunistic advice from a GP (5 minutes)	£829	£745
Brief opportunistic advice from a GP (10 minutes)	£1659	£1690
Brief opportunistic advice from a GP + advice to use NRT	£2390	£2435
Brief opportunistic advice from a GP + telephone helpline (2% - 3% above control)	£318 - £434	£324 - £443
Brief opportunistic advice from a GP + self-help material	£419	£727
Brief advice from a practice nurse in a primary care setting (0.5% - 3% above control)	£575-£3448	£586-£3514
Brief advice from a staff nurse in a hospital setting (0.5% - 3% above control)	£258-£1548	£263-£1578

Cost-effectiveness ratios are slightly less favourable for older smokers compared to younger smokers. Brief interventions on their own are slightly more cost effective than with adjunct therapy. However, all the results are based on a number of assumptions and margins of error suggest that such results should not be over interpreted. Overall the results confirm previous economic studies as detailed in the draft review document.

There are a number of specific areas that merit further study. In particular, the research evidence suggests that NRT significantly increases effectiveness rates. In the available trials these NRT products are generally distributed to all of the intervention group. This practice is reflected in the resource estimates where for this simulation all are assumed to have had one prescription of NRT issued and dispensed. In practice advice to take-up NRT would result in a lower take-up of the product and therefore lower costs but effectiveness rates would also be reduced by the lower consumption of these products.

The results in this study compare favourably with the cost effectiveness of smoking cessation services in practice. The figures from Godfrey et al (2005) adjusted to 2004/05 prices would yield an estimate of £497 per life year gained. In this study no adjustment was made for quality of life years gained.

The results in the preceding analysis were subjected to sensitivity analysis based upon assumptions regarding background quit rates, length of intervention, age and level of dependency. Even in the most pessimistic scenarios cost-effectiveness did not reach the NICE £20,000 benchmark. In the age group demonstrating the lowest cost-effectiveness outcomes, it was estimated that for brief advice alone, cost-effectiveness would not reach the threshold value until the time spent exceeded one hour.

Therefore, the results appear robust regardless of variability of the parameters in the model, and brief advice has the potential to be cost-effective even with effectiveness rates which are a small fraction of those observed in practice.

## 5. References

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Appendix 1:  
Figure 1: Cost Effectiveness of Brief Intervention and Brief Intervention and Referral



