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A COST-EFFECTIVENESS ANALYSIS OF STOP SMOKING INTERVENTIONS IN SUBSTANCE USE DISORDER POPULATIONS

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ABSTRACT

Background

Tobacco smoking is highly prevalent among people attending treatment for a substance use disorder (SUD). In the UK, specialist support to stop smoking is largely delivered by a national network of Stop Smoking Services, and typically comprises of behavioural support delivered by trained practitioners on an individual (one-to-one) or group basis combined with a pharmacological smoking cessation aid. We evaluate the cost-effectiveness of these interventions, and compare cost-effectiveness for interventions using group- and individual-based support, in populations under treatment for SUD.

Methods

Economic modelling was used to evaluate the incremental cost-per-quality adjusted life years (QALYs) gained for smoking cessation interventions compared to alternative methods of quitting for the SUD treatment population. Allowance was made for potentially lower abstinence rates in the SUD population.

Results

The incremental cost per QALY gained from quit attempts supported through more frequently provided interventions in England ranged from around £4,700 to £12,200. These values are below the maximum cost-effectiveness threshold adopted by policy makers in England for judging whether health programmes are a cost-effective use of resources. The estimated cost-per QALY gained for Interventions using group-based behavioural support were estimated to be at least half the magnitude of those using individual support due to lower intervention costs and higher reported quit rates. Conclusions reached regarding the cost-effectiveness of group-based interventions were also found to be more robust to changes in modelling assumptions.

Conclusions

Smoking cessation interventions were found to be cost-effective when applied to the SUD population, particularly when grouped-based behavioural support is offered alongside pharmacological treatment.

IMPLICATIONS

This analysis has shown that smoking cessation interventions combining pharmacological treatment with behavioural support can offer a cost-effective method for increasing rates of smoking cessation in populations being treated for a substance use disorder. This is despite evidence of lower comparative success rates in terms of smoking abstinence in populations with SUD. Our evaluation suggests that medication combined with group-based behavioural support may offer better value for money in this population compared to interventions using individual support, though further evidence on the comparative effectiveness and cost of interventions delivered to SUD treatment populations would facilitate a more robust comparison.

BACKGROUND

Tobacco smoking is highly prevalent among people attending treatment for a substance use disorder (SUD).[1] In the UK, specialist support to stop smoking is largely delivered by a national network of Stop Smoking Services, and typically comprises of behavioural support delivered by trained practitioners on an individual (one-to-one) or group basis combined with a pharmacological smoking cessation aid. While these services are generally regarded as a cost-effective public health intervention when applied to the general population, [2,3] economic evaluations of smoking cessation interventions in more vulnerable groups have been less frequent. This paper reports an economic evaluation of the cost-effectiveness of smoking cessation interventions applied to SUD treatment populations.

METHODS

Analytical approach

We evaluated smoking cessations interventions within a cost-per quality-adjusted life year ("cost-utility") framework.[4] A key statistic in economic evaluation is the incremental cost-effectiveness ratio (ICER). In a cost-utility analysis this measures the additional cost per extra quality- adjusted life years that are gained from a health programme compared to its next best alternative. Quality-adjusted-life-years (QALYs) are a widely used metric of health outcome in economic analysis. They combine, in a single measure, the impact on life-expectancy and/or the quality of life years lived attributable to health interventions.

We adopted a cost-utility framework as it is one of a number of economic approaches currently recommended by NICE for evaluating whether public health interventions deliver value for money.[5] Evidence-based economic modelling to estimate ICERs applicable to smokers attending SUD treatment programmes for specialist smoking cessation interventions most frequently provided by stop smoking services across England. These

include: medication (single or combination NRT or varenicline) combined with either specialised group or individual (one-to-one) behavioural support. Our evaluation presents a broad assessment of average intervention cost-effectiveness within the population of interest, largely because some of the evidence inherent to our modelling of cost-effectiveness (e.g. mortality risks) relate to the SUD treatment population as a whole. Our findings are therefore more likely to be weighted towards more commonly presenting and prevalent substance use disorders within the population seeking treatment.

Incremental costs and QALYs for each intervention are measured in comparison to the cost and QALY outcomes associated with other methods of quitting that might have been chosen to support a current quit attempt in the absence of an intervention. For this evaluation we assumed that these alternative "treatment as usual" methods include unsupported quit attempts or use of "over-the-counter" nicotine replacement products (OTC NRT). Both are reported to have broadly the same abstinence rate (around 4%),[6] which is significantly below rates of success reported for interventions delivered through stop smoking services. [7] Our evaluation also adjusted separately for the presence of a "background quit rate".[3,8] This refers to the possibility that, in the absence of a current quit attempt supported through whichever means, future attempts to quit smoking might still otherwise be undertaken. Failure to account for this will overstate the QALY benefits of current attempts to quit smoking.

For our evaluation we define the ICER for each type of smoking cessation intervention as:

$$(C_i - C_c)/(Q_i - Q_c)$$

C_i is the cost of delivering a smoking cessation intervention and C_c is the cost of the alternative method of quitting. For this evaluation we examined cost-effectiveness from the perspective of English local government authorities who currently commission and pay for smoking cessation interventions delivered through stop smoking services. The evaluation is therefore inclusive of the costs of providing medication and behavioural support that local

authorities will pay for directly, but excludes consideration of any out-of-pocket expenses for OTC NRT or other expenditures made by smokers through unsupported attempts to quit. Therefore, for the incremental analysis reported here, C_c is assumed to be zero.

Similarly Q_i and Q_c are, respectively, the gain in QALYs over time that would be expected from a current quit attempt (adjusting for the background quit rate) aided by a smoking cessation intervention and the alternative quit method. Both Q_i and Q_c can in turn be defined as:

$$Q_{\text{life-time cessation}} * p$$

$Q_{\text{life-time cessation}}$ is the gain in QALYs that a current smoker would enjoy if they were to quit smoking permanently at any given age, and p is the rate at which life-time cessation is achieved through use of smoking cessation interventions or their alternatives.

Our evaluation used simulation modelling of the QALY impacts of permanent cessation combined with reported evidence on the costs and effectiveness (in terms of abstinence rates) of smoking cessation interventions and alternative methods of quitting. The modelling adjusted for lower expected abstinence rates for smokers in SUD treatment compared to rates observed for non-SUD populations.[9,10] It also assumes that smokers with an SUD would stand to gain less from quitting smoking in terms of gains in quality-adjusted life expectancy due to the less favourable survival prognosis expected for SUD populations due to additional non-tobacco related risks to health associated with SUD (e.g. for opiate users accidental overdose and risks of intravenous drug use).[11]

To evaluate whether the estimated ICERs point to smoking cessation interventions being cost-effective when applied to the SUD treatment population, they were compared to the maximum cost per QALY threshold of £20,000 to £30,000 currently adopted in England by the National Institute for Health and Care Excellence (NICE) for assessing whether health care and public health interventions represent value for money in these terms[12].

We report a "base-case" evaluation of cost-effectiveness based on a specific set of evidence-based assumptions regarding the value of different modelling parameters. We also tested, through a sensitivity analysis, the extent to which cost-effectiveness conclusions from the base-case evaluation were sensitive to deviations from modelling assumptions.

All modelling for the economic evaluation was carried out in Microsoft Excel (2010 version).

Modelling and base-case assumptions

For the "base-case" analysis our approach to quantifying the QALYs that a smoker in treatment for SUD would gain if they quit smoking centred on using current evidence on the mortality and health effects of smoking to estimate the *proportional* gain in QALYs that would be expected from quitting in the wider population of smokers. We then separately modelled the total remaining QALYs expected for continuing smokers attending SUD treatment and, combining this with the estimated proportional QALY improvement expected from smoking cessation, estimated the *absolute* gain in QALYs that would result if a smoker with SUD were to quit. In taking this approach we implicitly adjust for the impact of a less favourable underlying survival (and therefore QALY) prognosis for smokers with SUD on the expected health-related benefits of quitting smoking in this population.

Modelling the proportional gain in QALYs from smoking cessation

To estimate the proportional gain in QALYs afforded through smoking cessation we used evidence on the mortality and health-related quality of life impacts of smoking applicable to the wider population to quantify the QALYs expected for a hypothetical cohort of continuing smokers and a cohort of quitters (for both cohorts n=1000).

We have assumed that quitters stopped smoking between 35 and 44 years of age as this age group best matched the average age profile of clients attending SUD structured treatment programmes in England: for opiate-only clients and clients using non-opiates and alcohol combined the median age is 39 and 34 years respectively, though the median age

for clients attending treatment for non-opiate use only (29 years) is below the selected age band[13]. Life years survived for both cohorts were simulated over a 40 year time horizon, the period over which mortality data were available from the specific study we chose to inform assumptions regarding risk of death for continuing smokers and quitters across different age groups (see below).

We chose a widely cited British study by Doll et al[14] into the mortality impacts of smoking to inform our modelling of survival smokers and quitters. Evidence from this study has also been used to inform mortality risk assumptions in previous economic evaluations of smoking cessation activity[8,15]. A limitation is that the study was that it was restricted to examining the effects of smoking in a specific cohort of male doctors followed-up over a 50 year period between 1951 and 2001 and may therefore not be entirely representative of wider population mortality risks. The modelling described here used the mortality rates reported by Doll et al for continuing smokers from age 35 to 44 onwards and for former smokers across different ages who quit smoking within that age band. These rates were used to estimate the number of person years of survival at each age over the 40 year time horizon within each cohort.

For each cohort QALYs were estimated by weighting simulated year of survival by age-specific health state "utility" weights reported for current and former regular smokers [16].These were based on data from the 2006 Health Survey of England [17] which asked respondents sampled from the general population to report their health status using the EQ-5D instrument [18]. As well as being from drawn from a nationally representative survey, these data have the advantage that the EQ-5D instrument was designed specifically for yielding health state weights suitable for estimating QALYs. It characterises health across five dimensions (mobility, self-care, usual activity, pain/discomfort and anxiety/depression) and at three levels within each dimension. Each possible health state has a corresponding utility weight based on how a sample of respondents from the British general population rated a core sample of 243 unique health states when compared to "full health" (scored as 1) and death (scored as zero).[18] A disadvantage is that the data will potentially understate the

health state differential between continued smoking and extended periods of smoking cessation that began in the age group of interest as health state information by age of quitting is not presented.

To calculate remaining QALYs for continuing smokers and a quitters the weighted life years for each cohort were summed over the 40 year time horizon and divided by 1000 (the initial size of each simulation cohort) to estimate average remaining QALYs. Following convention, future QALYs acquired through smoking cessation were discounted to reflect the lower relative value placed on future quality-adjusted years of life lived: the recommended discount rate applicable to health programmes in England is 3.5% [19].

The proportional gain in (discounted) QALYs due to smoking cessation was then calculated as:

[Remaining QALYs for quitter – Remaining QALYs for continuing smoker] ÷ Remaining QALYs for continuing smoker)

Modelling QALYs for smokers in SUD treatment

To estimate remaining QALYs for a smoker attending SUD treatment we again modelled person years survived over a 40 year time period, in this case for a hypothetical SUD treatment cohort (n=1000). This required an estimate of the mortality rate at differing ages that reflects not only deaths associated with continued tobacco use but also the wider health risks linked to SUD.

To determine these rates we used published age-specific standardised mortality ratios (SMRs) estimated for n=10,927 SUD treatment cases identified from electronic patient records for a large NHS mental health service provider in England.[20] These SMRs measure the relative risk of death for identified cases compared to that for comparable age groups in the general population of England and Wales. To estimate absolute mortality rates for the

SUD treatment population the SMRs were multiplied by corresponding age-specific death rates reported in national death statistics for England and Wales.[21]

Given that the SMR data used were specific to a particular service-area locality they may not be wholly representative of mortality risks nationally for SUD treatment participants. They also relate to risk of mortality on a patient case register that will be inclusive of a non-smoking minority, where tobacco smoking prevalence could be variable depending on the type of SUD being treated.[22] As such these estimates are likely to be a conservative measure of morality risk for smokers attending treatment for SUD and will, by implication, over-estimate remaining life expectancy. This in turn will have a tendency to inflate our base-case estimate of the absolute gain in QALYs from smoking cessation for the SUD treatment population (using the estimated proportional gain in QALYs linked to smoking cessation).

To estimate future QALYs for the cohort of smokers in treatment for SUD, person years of survived at different ages were again weighted by a health state utility score. An initial weighting of 0.65 (full health = 1; death =0) was applied to the simulated years survived for smokers attending SUD treatment aged 35 and 44 years. This weighting was taken from a national evaluation of drug treatment programmes in England [23,24] [25] and is the mean pre-treatment health state utility score reported by study participants using the short form 12 (SF12) health survey instrument.[23] The SF12 measure includes assessment of physical function, limitations in role due to physical or emotional problems, the effect of pain on normal work and activities, general health, vitality, impact of physical or emotional problems on social activities, and mental health. A primary motivation for using this evidence was that it provided health state information suitable for QALY estimation within the population of interest. The utility weights relate to a large SUD treatment sample (n=1762) drawn from all new treatment episodes presenting at 342 treatment sites across England[26]. A limitation was that consent to participation in the survey led to some reported differences in characteristics between the survey sample and the wider SUD treatment population.[25]

To account for declining health status with age, years of survival at older ages were given a lower health state weighting. In the absence of direct evidence on the rate of health depreciation among smokers with SUD, it was assumed that health status would depreciate with age at a similar rate to that observed for smokers in the general population albeit from a lower base-level. The initial 0.65 weighting for the 35 to 44 age group was therefore depreciated at a rate equivalent to the differences in health state utility scores reported for smokers sampled from the general population at different ages for the Health Survey of England. [16] This yielded health state utility weightings ranging from 0.62 for life years lived between ages 45 to 54 to 0.53 for ages 75 to 84. Expected remaining QALYs for a continuing smoker in treatment for SUD were then estimated as the (discounted) sum of the health state weighted years of survival.

The absolute gain in QALYs due to smoking cessation in the SUD treatment population was subsequently calculated by multiplying the proportional improvement in QALYs attributable to smoking cessation described earlier by the remaining discounted QALYs modelled for continuing smokers attending SUD treatment.

Life-time smoking cessation rates for interventions

To estimate life-time cessation rates for interventions we have used continuous abstinence rates over 52 weeks from the instigation of a quit attempt reported for interventions most frequently provided by English stop smoking services [6]. These rates were inferred from separately reported estimates of intervention effects,[7,27] including the results from a statistical analysis of clinically validated 4-week abstinence data obtained from over 125,000 treatment episodes during 2009-2010 across 24 stop smoking services.[7] While comprehensive, these average estimates do mask variability in success rates between different services[7] . Furthermore, as the data used to model 4-week abstinence rates were extracted from administrative data systems, it is unclear to what extent unmeasured confounding may have biased the estimated effects.

Our base-case analysis assumed that 52-week abstinence rates for the SUD treatment population would be half the magnitude of the estimates reported for the wider population attending smoking cessation services. This is based on evidence that quit rates in this population could be as low as 50% of those reported for populations without SUD [9,10]. While this amounts to a reasonable base-case assumption given the evidence, a draw-back neither of the two studies used to support the 50% assumption were based on data from populations in SUD treatment: one study examined the association between illicit drug use and smoking cessation in a population attending treatment services for tobacco addiction[9], the other compared cessation between users and non-users of illicit drugs using data from a national household survey.[10]

To estimate life-time smoking cessation rates for different interventions, 52-week abstinence rates were multiplied by an estimate of the rate of life-time continued abstinence beyond 52 weeks. This was based on a long-term smoking relapse rate of 0.35 reported in other smoking cessation studies [3]. This value was again halved to reflect lower expected life-time cessation rates in the SUD population.

Abstinence rates for unsupported quit attempts and over-the-counter NRT

For the base-case analysis it was assumed that, in the absence of receiving a stop smoking intervention, a quit attempt would either be made unsupported or through use of over the counter NRT. Evidence suggests that, for smokers in the general population, these methods are associated with a 52-week quit rate of 4%.[6] This was translated into a life-time cessation rate using the same assumptions regarding long-term relapse described above.

Life-time cessation rates for specific smoking cessation interventions and for the alternative quit methods are summarised in table 1. These are shown for the general population of smokers attending smoking cessation services (based directly on the published evidence) and the adjusted estimates applicable to smokers attending SUD treatment, which formed

the base-case assumptions regarding intervention abstinence rates for the economic evaluation.

Adjusting for the "background quit rate"

To adjust for the background quit rate in tobacco using population we deflated the estimated QALYs associated with smoking cessation using the same adjustment factors adopted in a previous cost-effectiveness analysis of smoking cessation activity applied to the general population [3]. This used: 1. an estimate of age-specific future cessation rates (2.5% of smokers per annum[14]) which was halved (in line with evidence cited earlier) to reflect the expectation of lower quit rates in the SUD population; and 2. an estimate of the proportion of the life-extending benefits from current successful quit attempts (0.24)[3] that could be reasonably attributed to cessation achieved in future years, adjusting for evidence that quitting at future (older) ages will afford less life-extending impact.

Intervention costs

The costs per quit attempt supported through each smoking cessation intervention were taken from published indicative estimates of the average cost per treatment episode for each type of intervention, where one treatment episode corresponds to one attempt to quit. [6]. The costs relate resources used to deliver intensive multi-session behavioural support (with prescribed NRT or varenicline) provided by specialist clinics operating through the national stop smoking services network. They exclude National Health Service (NHS) non-specialist clinics that provide less intensive behavioural support for smoking cessation either in primary care or hospital-based settings. All costs were inflated using a hospital and community health services inflation index for England[28] and are reported in UK pounds at 2015/2016 prices (see table 1).

Sensitivity analysis

We tested the sensitivity of cost-effectiveness conclusions reached to changes in base-case assumptions regarding the following: 52-week abstinence rates for the wider population accessing stop smoking services; the magnitude of the proportional downward adjustment made to 52-week abstinence rates for the wider population in order to estimate a base-case abstinence rate for the SUD treatment population; QALY gains from smoking cessation in the SUD treatment population; and the cost of each smoking cessation intervention.

The sensitivity analysis was carried out by comparing base-case assumptions against the "tipping point" values for the parameters listed. The tipping points identify the value specific parameters must take for ICERs to equate to the lower end of the maximum acceptable cost per QALY threshold used by NICE to gauge health programme cost-effectiveness (£20,000). The greater the deviation of tipping point values from the base-case assumptions the greater the confidence that can be placed in the cost-effectiveness conclusions given modelling uncertainty.

A recent report into the suitability of the threshold set by NICE has argued for the adoption of a lower maximum threshold closer to £13,000 per QALY gained (effectively a more stringent test of whether health programmes should be recommended for funding on cost-effectiveness grounds).[29] We therefore also tested the extent to which the adoption of this alternative threshold affected cost-effectiveness conclusions, as well as the gap between the new implied tipping point values linked to the lower threshold and the base-case modelling assumptions.

RESULTS

QALY gains from smoking cessation

Table 2 reports the estimated discounted QALYs over a 40 year time horizon for continuing smokers and smokers who quit between ages 35 and 44 years and the implied QALY gains

from smoking cessation. These estimates are presented separately for the general population (used to estimate the proportional increase in QALYs associated with quitting smoking) and SUD treatment population.

Quitting smoking at age 35 to 45 in the general population was estimated to generate a 16% increase in discounted QALYs lived (c.11.3 QALYs for permanent quitters vs. c.9.8 QALYs for continuing smokers). If this proportional increase also applies to the SUD treatment population, continuing smokers would see their remaining QALYs increase from 6.4 to 7.4 – a gain of 1 QALY through permanent smoking cessation. The final column of table 2 presents estimated QALY gains from smoking cessation after adjusting for the background quit rate (used to estimate ICERs).

Intervention cost-effectiveness

Table 3 reports the expected incremental QALY gains for the SUD treatment population for each smoking cessation intervention over use of either unsupported quit attempts or OTC NRT to support a current quit attempt. Combining these values with intervention costs, figure 1 presents the resulting ICERs.

All ICERs are below the current cost threshold adopted by NICE. They range from £4,700 (combination NRT with group support) to £12,200 (single NRT with individualised support) per QALY gained. All Interventions using group support combined with medication were estimated to cost less per QALY gained compared with those using individual support on account of the former being less costly and having higher reported abstinence rates at 52 weeks.

Sensitivity analysis

Base-case and tipping point values for identified parameters, assuming a maximum threshold of £20,000 to £30,000 per QALY gain, are shown in table 4. In parentheses we

also present the corresponding tipping points when a cost-effectiveness threshold of £13,000 is applied.

The difference between tipping point and base-case parameter values were larger for interventions combining medication with grouped-based compared to those using individual-focussed behavioural support. This would imply that, relatively speaking, cost-effectiveness conclusions for the former are likely to less sensitive and more robust to any deviation from our main modelling assumptions. While all ICERs were below the lower alternative £13,000 cost-per QALY threshold, only small to modest changes in base-case assumptions would be needed for ICERs relating to interventions that use individual behavioural support to equal or exceed this threshold. In contrast, the corresponding tipping point values relating to interventions involving group-based support suggest that relatively larger deviations from base-case values would be required to change conclusions regarding cost-effectiveness by increasing the cost-per QALY estimates above this lower threshold.

DISCUSSION

An economic evaluation of smoking cessation support applied to smokers undergoing treatment for a substance use disorder has shown that, compared to unsupported quit attempts or use of over-the-counter products, the incremental cost per QALY gained for interventions commonly provided by stop smoking services across England were below a maximum cost-effectiveness threshold used to determine whether health programmes offer value for money.

Interventions using group-based support combined with medication were estimated to cost less per QALY gained compared to those using individual behavioural support. Moreover, a sensitivity analysis suggested that more confidence can be placed in the cost-effectiveness conclusions regarding the former given modelling uncertainty.

Study limitations

Our evaluation of intervention cost-effectiveness did not consider sub-group variability in intervention cost-effectiveness. For example, smokers presenting for treatment could differ in terms of life-expectancy and health state prognosis depending on their primary substance of use (e.g. cannabis versus opiate use). There may also be variation in the extent to which different treatment sub-groups engage and respond to interventions and achieve abstinence. Both these factors imply that the health impacts of interventions, and therefore their cost-effectiveness, could also be variable.

Our conclusions suggest that interventions that use medication combined group-based support may be more cost-effectiveness and less sensitive to modelling uncertainty, compared to those that use individual support. The caveat to add to this is that, in our base-case modelling, we applied evidence regarding the effectiveness and costs of interventions applicable to the wider population of smokers seeking help to quit. It may be that people with SUD respond differently to these alternative modes of behavioural support, as revealed through smoking abstinence rates, which will impact on the incremental QALY benefits of the interventions. Further evidence on the comparative effectiveness of medication combined with alternative approaches to delivering behavioural support in the SUD and other vulnerable populations would add further insight to this.

The sensitivity analysis we conducted was deterministic and did not, through a more sophisticated probabilistic analysis, gauge the impact of sampling error in relation to important parameter values extracted from the literature. This means that we were unable to evaluate in more detail the probability of intervention cost-effectiveness given this type of uncertainty, and the extent to cost-effectiveness probabilities varied depending on the value of the maximum cost-effectiveness threshold adopted.

Finally, we did not consider the wider health care resource implications of increasing smoking cessation in the SUD treatment population. Partly this was because our evaluation

was carried from a local authority payer perspective, and therefore did not to set out to consider resource impacts affecting health care providers. However, we would also note the difficulty in establishing whether smoking cessation increases or reduces overall health care resource use over time. This will depend on the comparative magnitude of cost savings arising from avoidance of smoking-related illness and the cost increasing effects of extending life-expectancy for smokers who quit, given a likely increased utilisation of medical care with age.[30]

CONCLUSION

Interventions that combine specialist behavioural support with medication are a cost-effective means of promoting smoking cessation in the SUD treatment populations, though based on the this evaluation the economic case appears stronger for interventions that use specialised group- rather than individual-based behavioural support.

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Declaration of interests

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Table 1

Base-case assumptions: intervention abstinence rates and costs

	General population attending smoking cessation services		SUD treatment population		Cost of interventions[6]
	52 week continuous abstinence rate[6]	Life-time abstinence rate	52 week continuous abstinence rate	Life-time abstinence rate	
Single NRT with individual support	0.15	0.01	0.08	0.02	£192
Single NRT with group support	0.20	0.13	0.10	0.03	£124
Combination NRT with individual support	0.20	0.13	0.10	0.03	£215
Combination NRT with group support	0.26	0.17	0.13	0.04	£146
Varenicline with individual support	0.24	0.16	0.12	0.04	£311
Varenicline NRT with group support	0.31	0.20	0.16	0.05	£242
Unsupported quit attempt/OTC NRT	0.04	0.03	0.02	0.007	£0

Table 2

Base-case assumptions: remaining QALYs (discounted) for continuing smokers and quitters and QALY gain from life-time smoking cessation

	Remaining QALYs		QALY gain from life-time cessation	QALY gain from life-time cessation (adjusted for "background quit rate")
	Continuing smoker	Quitter		
Wider population (age 35 to 44)	9.760	11.295	1.535	1.132
SUD treatment population (age 35 to 44)	6.412	7.421	1.009	0.876

Table 3

Base-case assumptions: incremental QALY gains for interventions (compared to unsupported quit attempts/OTC NRT)

	Incremental QALY gain
Single NRT with individual support	0.0157
Single NRT with group support	0.0228
Combination NRT with individual support	0.0228
Combination NRT with group support	0.0313
Varenicline with individual support	0.0285
Varenicline NRT with group support	0.0384

Table 4

Sensitivity analysis: tipping point values assuming maximum cost-effectiveness threshold of £20,000 to £30,000 per QALY gained (tipping point values assuming maximum threshold of £13,000 per QALY gained shown in parenthesis)

	52 week abstinence rate for interventions (for wider population using stop smoking service)		52 week abstinence rate for unsupported quit attempt/OTC NRT (counterfactual)		Proportional reduction in abstinence rates to adjust for presence of SUD		QALY gain from permanent smoking cessation (SUD treatment population)		Intervention cost	
	Base case assumption	Tipping point	Base case assumption	Tipping point	Base case assumption	Tipping point	Base case assumption	Tipping point	Base case assumption	Tipping point
Single NRT with individual support	0.15	0.11 (0.14)	0.04	0.08 (0.05)	0.50	0.39 (0.48)	0.88	0.54 (0.83)	£192	£315 (£204)
Single NRT with group support	0.20	0.08 (0.11)	0.04	0.16 (0.13)	0.50	0.26 (0.32)	0.88	0.24 (0.37)	£124	£458 (£297)
Combination NRT with individual support	0.20	0.12 (0.16)	0.04	0.12 (0.08)	0.50	0.34 (0.43)	0.88	0.41 (0.64)	£215	£458 (£297)
Combination NRT with group support	0.26	0.09 (0.12)	0.04	0.21 (0.18)	0.50	0.24 (0.30)	0.88	0.20 (0.31)	£146	£629 (£409)
Varenicline with individual support	0.24	0.15 (0.21)	0.04	0.13 (0.07)	0.50	0.37 (0.46)	0.88	0.48 (0.74)	£311	£572 (£372)
Varenicline NRT with group support	0.31	0.12 (0.17)	0.04	0.23 (0.18)	0.50	0.28 (0.35)	0.88	0.28 (0.42)	£242	£772 (£502)