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Economic Evaluation

The Economic Potential of Smoking Cessation Interventions at the Point of Diagnosis of Non–Small Cell Lung Cancer

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ABSTRACT

Objectives: Stopping smoking has proven benefits in nearly all illnesses but the impact and health economic benefits of stopping smoking after a diagnosis of lung cancer are less well defined. We assessed the cost-effectiveness of smoking cessation (SC) services for patients with newly diagnosed lung cancer against current usual care, where patients are unlikely to receive SC service referral.

Methods: A health economic model was constructed in Excel. The modelled population comprised of patients with a new diagnosis of non–small cell lung cancer (NSCLC). Data from the LungCast data set (Clinical Trials Identifier NCT01192256) were used to estimate model inputs. A structured search of published literature identified inputs not represented in LungCast, including healthcare resource use and costs. Costs were estimated from a 2020/2021 UK National Health Service and Personal Social Services perspective. The model estimated the incremental quality-adjusted life-year (QALY) gained in patients with newly diagnosed NSCLC receiving targeted SC intervention than those receiving no intervention. Extensive one-way sensitivity analyses explored input and data set uncertainty.

Results: In the 5-year base case, the model estimated an incremental cost of £14 904 per QALY gained through SC intervention. Sensitivity analysis estimated an outcome range of between £9935 and £32 246 per QALY gained. The model was most sensitive to the estimates of relative quit rates and expected healthcare resource use.

Conclusion: This exploratory analysis indicates that SC intervention for smokers with patients with newly diagnosed NSCLC should be a cost-effective use of UK National Health Service resources. Additional research with focused costing is needed to confirm this positioning.

Keywords: cost, economic model, non–small cell lung cancer, quality-adjusted life-year, smoking cessation.

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Introduction

Smoking and smoking-related diseases contribute to an increasingly challenging public health problem. A total of 7.69 million smoking-related deaths were reported for 2019, almost 90% of which occurred in current smokers.[1] The link between smoking and lung cancer (responsible for 1.8 million deaths worldwide) is irrefutable, and in high-income countries, lung cancer is consistently reported as the leading cause of smoking-attributable deaths.[2] Related healthcare expenditure is substantial. Diseases caused by smoking accounted for approximately 6% of the 2012 global health expenditure (US$422 billion), with total economic costs of smoking accounting for 1.8% of global gross domestic product.[3] The most recent figures for the United Kingdom (UK) estimate the total cost of smoking to society at £17.04 billion, £2.4 billion of which is a direct cost to the UK National Health Service (NHS).[4] The latest UK audit data indicate 21% of adult inpatients in the UK NHS are smokers.[5]

Lung cancer is a leading cause of morbidity and mortality in the UK, with smoking accounting for > 70% of diagnoses.[6] Stopping smoking before a diagnosis of cancer reduces the subsequent risks of many types of cancer. The focus on smoking cessation (SC) after a diagnosis of cancer is less clear. Up to 50% of patients with lung cancer are smoking at the time of diagnosis.[7] There is growing evidence that stopping smoking can improve survival and quality of life (QoL) in people with lung cancer. There are plausible mechanisms for this effect: by reducing lung cancer growth and spread, reducing the rate of new cancers developing, reducing the impact of smoking-related comorbidities, and improving response to and reducing complications from cancer treatments (especially surgery but also radiotherapy, chemotherapy, and probably immunotherapies).[7] Despite this, SC services in the UK remain underused with the latest figures indicating that only 1 in 7 smokers in acute care are referred to SC services.[5]

The LungCast study was a multicentre, "real-world" study conducted across 28 hospitals in the UK to assess whether

smoking status after a diagnosis of lung cancer independently influences survival.[8] Enrolled patients with newly diagnosed lung cancer were classified into 3 groups—current smoker, ex-smoker, or never smoker—and were followed up over a period of 2 years. Current smokers enrolled in the study were offered, or signposted toward, SC support in line with patient choice, local best practice, and availability of services. We wanted to explore the potential cost-effectiveness of standard SC interventions at the time of diagnosis, with initial focus on those patients diagnosed of non–small cell lung cancer (NSCLC). Such analysis could help inform commissioners if investment in a dedicated SC service for patients with newly diagnosed NSCLC would provide good value for money for the UK NHS.

Methods

An exploratory health economic analysis was conducted based on an analysis of the complete NSCLC subset of the LungCast data (IRAS 30973). These data were combined with a candidate set of resource and cost data to create a framework health economic model. The core outcome of the economic model was an estimate of the expected incremental cost per quality-adjusted life-year (QALY) gained by smokers with newly diagnosed NSCLC receiving an SC intervention than those receiving no SC intervention. QALYs incorporate the quantity of life (additional life-years [LYs]) and QoL in one measure, with the incremental cost per QALY gained established as a generalizable measure of cost-effectiveness.[9]

The LungCast Data Set

LungCast (Clinical Trials Identifier NCT01192256) enrolled consecutive adult patients with a new clinical, radiological, or pathological diagnosis of lung cancer (all indications) across 28 UK hospitals between 2010 and 2020 and now consists of > 2400 adults, followed for up to 2 years (or death). Enrolled patients were classified into 3 groups—current smoker, ex-smoker, or never smoker, with current smokers offered, or signposted to, available SC services. Lung cancer treatments were offered according to local multidisciplinary team decisions, informed by local and national guidelines, with outcomes (including disease status and incidence of treatment-related complications) collected at each visit. Smoking status was validated with exhaled carbon monoxide at every visit. Healthcare resource use (HCRU) data were not collected in the study. Interim results from the LungCast trial indicated that quitting smoking at diagnosis and maintaining abstinence were associated with a 25% decrease in mortality at one year.[8] This did not reach statistical significance (P = .01) because of the lower-than-expected overall death rate (people were recruited from clinics rather than acute hospital beds). Nevertheless, this reduction in mortality is likely to be clinically important given the overall poor prognosis of the disease and additional analysis is underway with longer follow-up of more patients. This exploratory analysis focused on the subset of data relating to patients with newly diagnosed NSCLC who were classified as current smokers or who had a history of smoking (IRAS 30973).

Model Development

A structured literature search was conducted to inform model development. Only 1 decision analytic model was retrieved specific to SC interventions in a lung cancer population.[10] This analysis modeled the cost-effectiveness of SC in patients undergoing lung cancer surgery based on outputs of a US study comparing a computer-delivered SC intervention with a usual care program consisting of no targeted SC, before surgery for lung cancer. The US model used a simple framework with the cohort split into patients who quit smoking and patients who continued smoking. Three Markov health states were then defined as alive smoker, alive nonsmoker, or dead, with the probability of death higher in the smoker group. Our model followed a similar approach with an additional breakdown of the "alive" health states to reflect whether the patient was responding to disease management. A more complex approach to the lung cancer patient pathway was outside our current scope.

The health economic evaluation required relevant clinical evidence but also an estimate of the HCRU and costs associated with NSCLC management. Where possible, routinely collected, fully anonymized data from LungCast were used to provide data inputs, with structured literature searches undertaken to identify other required parameters (ie, relative quit rate without intervention, and health state and SC intervention costs) (see Supplemental Materials found at https://doi.org/10.1016/j.jval.2023.03.2429 for the scope and search terms). The mathematical integrity of the model was tested according to guidelines for the assessment of model credibility.[11]

The Economic Model

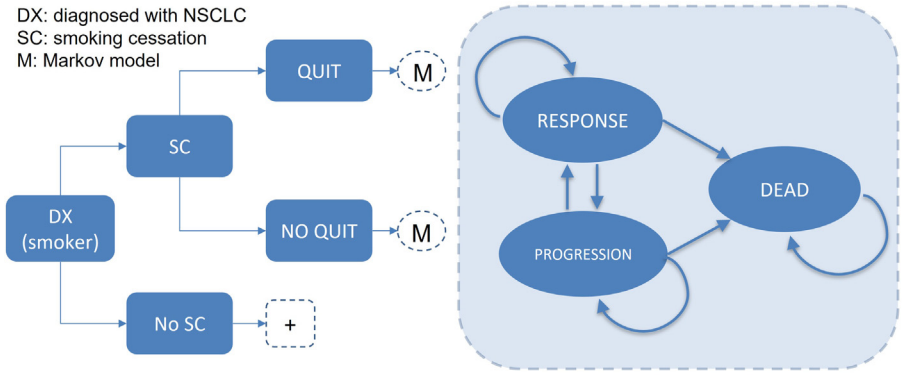
A simple 2-part model comprising a decision tree and add-on Markov was constructed in Excel (Fig. 1). The initial decision tree accounted for whether patients received an SC intervention. Following outcome at 1 month (quit or no quit), patients enter the Markov model. The time horizon was set to 5 years to capture expected health benefits and costs for the included patient group. This timeframe was chosen in preference to a lifetime time horizon to reflect the uncertainties in predicting longer-term behavioral choices.

A UK NHS and Personal Social Services perspective was adopted, in line with NICE recommendations.[12] The population was defined as active smokers receiving a diagnosis of NSCLC. The intervention was defined as a combined basket of available SC interventions (the exact type of SC intervention was not tracked in LungCast given that the available SC service varied in every hospital). The comparator was defined as no targeted SC intervention.

The population comprised smokers diagnosed of NSCLC. Cohort characteristics including age, gender, method of NSCLC management, and NSCLC staging are presented in Table 1.

Expected quit rates with and without SC intervention were estimated based on adjusted data from the LungCast trial (Table 2). Smoking status at month 1 (as reported in the LungCast data set) was used to estimate the quit rate for smokers undergoing SC intervention (the SC quit rate). In a "real-world" setting, it would be expected that some patients would quit without SC intervention (a non-SC quit rate, not tracked in LungCast). A structured literature search found limited data to estimate this parameter. Therefore, we estimated it according to the relative quit rates reported in the previously identified modeling study.[10] The SC quit rate reported in this study was related to a low-intensity SC intervention combined with nicotine replacement therapy (considered comparable with the generalized/unspecified SC intervention recorded in LungCast). We were also interested to model a scenario that might better reflect the benefits of a more intense SC intervention (eg, a face-to-face multi-follow-up intervention). An increased SC quit rate was estimated based on findings of a recent network meta-analysis assessing the component effect of different SC interventions.[13] In this we apply a weighting of 1.3 to the baseline SC quit rate to include a likely face-to-face component of a more intense intervention and estimate an associated increased SC baseline quit rate.

Figure 1. Model schematic.



DX indicates diagnosed of non–small cell lung cancer; M, Markov model; SC, smoking cessation.

Extensive analyses were conducted on the LungCast data to best categorize the data into meaningful health states allowing for appropriate capture and differentiation of NSCLC patient pathways, alongside the observed health-related QoL and complications data (where complications were limited to those categorized as related to NSCLC treatment). Three core health states were defined: response (including stable disease [no change to staging], partial response to treatment and cure), progression (a deterioration to a higher disease staging of NSCLC), and death. The model cycle length was set to 1 month. Initial patient distribution differed according to smoking status. At each cycle, patients were able to stay in their current health state or transition to one of the other health states based on time-dependent transition probabilities estimated from the LungCast data using established methods.[14] Response and progression health states were further differentiated based on the presence or absence of complications. Clinical inputs and model transition probabilities are presented in Table 3.[10,13]

Resource and cost data were not collected in LungCast; therefore, a set of candidate inputs were defined based on a mixture of source data and applied as one-off costs (rather than as a combination of resource and unit costs) (Table 4). SC intervention costs were defined based on the expected costs associated with a baseline SC intervention (ie, a nonoptimized blend of SC interventions as experienced by the LungCast cohort) and the expected costs of a more intense SC intervention. A structured search of current literature found limited papers to identify locally relevant SC costs (see Supplemental Materials found at https://doi.org/10.1016/j.jval.2023.03.2429 for the scope and list of search terms that were used). A recent publication reported and costed usual care for patients with severe mental illness accessing generalized SC services.[15] Although not directly applicable to our cohort, the patients represent a similar high-risk, high complications group and these costs are used to estimate the cost of a baseline SC intervention (ie, the expected level of intervention in the LungCast cohort). The cost for an intense SC intervention was estimated based on the weighted average cost of locally provided pharmacy and hospital-based SC programs, following national SC recommendations for hospital attendees,[16,17] with the costings provided by the Hywel Dda University Health Board authors.

Health state costs included the cost implications of progression and/or response. A structured search of recent literature found limited publications reporting the observed cost of lung cancer management in a UK setting (see Supplemental Materials found at https://doi.org/10.1016/j.jval.2023.03.2429 for search terms). Several studies reported the overall cost of management but not in a way that readily mapped to the LungCast health states.[13] Therefore, UK costs reported for the LuCaBIS study, a retrospective observational study of patients with NSCLC conducted across France, Germany, and the UK (14 centers), were considered a reasonable placeholder for estimating the LungCast health state costs.[18] Reported costs included treatment, supportive treatment, hospitalizations, health professional visits, diagnostics, hospice/other care, and reimbursed transportation, with costs

Table 1. Cohort characteristics of the underlying data set.

Patient characteristics		Smoking categorization in the LungCast data set	
		Quitters	Current smokers
Age, years, n (SD)		69 (8.7)	64 (9.3)
Management after diagnosis of NSCLC	Chemotherapy	549 (69)	159 (77)
	Surgery	98 (12)	9 (4)
	Radiotherapy	239 (30)	60 (29)
Staging on diagnosis	Stage 1	143 (11)	28 (14)
	Stage 2	348 (27)	37 (18)
	Stage 3	275 (22)	42 (20)
	Stage 4	364 (29)	77 (37)

Note. All values are n (%) unless otherwise specified.
NSCLC indicates non–small cell lung cancer.

Table 2. Quit rate with and without SC intervention.

Model parameter	Input value	Source/comment
Baseline SC quit rate	0.18	LungCast trial data (calculated)
RR quit with no SC*	0.77	Slatore et al 2009[10] (average over time)
Alternate RR quit with no SC†	0.59	Hartmann-Boyce et al 2020[13]

NSCLC indicates non–small cell lung cancer; RR, relative rate; SC, smoking cessation.
*Relative quit rate over time for no intervention, equivalent to 14% quit rate for patients with NSCLC with no SC.
†Adjusted interventional effect equivalent to 10% quit rate in patients with no SC or an SC intervention quit rate of 23%.

differentiated by NCSLC health states. End of life (EOL) costs can be substantial in cancer but were not explicitly included in the health state costs. We looked at the impact of including these by adding a one-off cost to our DEATH state based on EOL costs described in a recently reported comparable NSCLC patient cohort.[19] These costs were not included in our base case analysis.

The LungCast data allowed us to estimate the rate of complications by health state and by smoking status but the complications were not fully described (so unit costs could not be directly assigned to estimate an expected cost). We wanted to explore the impact of complication rates in our modeling, so we needed to include a complication cost that was independent to the cost of the health state. We looked for UK studies in similar cohorts with sufficient detail on complication rates and costs to transparently estimate a UK-relevant one-off cost that we could use as a proxy cost in our analysis. Limited studies were identified. One recent cost-effectiveness analysis of chemotherapy in patients with previously treated NSCLC reported expected complication rates for standard-care chemotherapy alongside a list of associated unit costs.[20] This allowed us to identify an average cost of complications considered broadly applicable to our cohort, with the rationale that most LungCast patients underwent chemotherapy. This informed our base case cost of complications and was applied as an average cost for each complication event.

Health state utilities were estimated for each time period and health state based on observed data from the LungCast study and considering the utility decrement associated with complications (Table 2[10,13]). Observed data did not show a consistent relationship between health state and reported utility (utility was trial-collected using the EQ-5D-3L), and values were tested extensively in sensitivity analysis (SA).

The base case analysis compared costs and outcomes over a 5-year time horizon with patient pathways based on observed LungCast data and SC intervention costs and relative intervention effect based on a generalized SC intervention and no application of EOL costs.

Incorporation of Uncertainty

Comprehensive deterministic one-way SAs were conducted. Analyses included alternate cost assumptions for SC and health states, application of an EOL cost, and exploration of time horizon. In addition, we looked at different approaches to data incorporation including smoothing of observed data and relaxation of time dependency. We also conducted a provisional probabilistic SA (PSA) with distributions defined according to best practice. Please note that the PSA outputs should be interpreted cautiously because this is an exploratory model based on a candidate set of HCRU and cost data.

Results

Total costs for the SC and no SC model cohorts were estimated at £9834 and £9718, respectively. Total LYs were estimated at 0.960 and 0.952, respectively, and total QALYs at 0.645 and 0.637, respectively. The incremental cost per QALY gained for patients who experienced targeted SC than those who did not was estimated at £14 904 in the base case.

Extensive SAs were conducted across a range of input parameters (Table 5[15,16,18–20]). Based on these,input and structural explorations, the model appeared most sensitive to the "no SC quit rate" assumption (SA 1), the SC intervention cost (SA 2), and the methods of premodel analysis (SAs 4-5). In addition, the model is sensitive to extreme testing of complication costs (SAs 8-9), the relative differences in utility across the 2 arms (SAs 10-11), the inclusion of an EOL cost (SA 12), and consideration of a shorter time horizon (SA 13). The model was least sensitive to a combined change in cost and effectiveness of the SC intervention (SA 3), costing of the health states (SAs 6-7), and extrapolation to a lifetime time horizon (SA 14). The implications of these findings are discussed below. The outputs of the provisional PSA are plotted as a scatterplot in Figure 2. Outputs from the PSA indicated a 74% probability of cost-effectiveness at a willingness-to-pay threshold of £20 000 per QALY.

Discussion

The economic analysis compared patients with newly diagnosed NSCLC receiving a generalized SC intervention with a hypothetical cohort of patients receiving no SC intervention. In the base case, we estimated a cost increase of £116 for patients in the SC intervention arm than those in the nonintervention arm, over a 5-year time horizon. Benefit equated to an LY gain of 0.008 years (equivalent to a 3-day improvement in survival) and a QALY gain of 0.008 QALYs. This resulted in an estimated incremental cost-effectiveness ratio (ICER) of £14 904 per QALY gained through intervention, suggesting that SC intervention at the time of NSCLC diagnosis would be a cost-effective use of UK NHS limited resources. The outputs of the provisional PSA indicated that these findings were robust to plausible variations in input parameters and suggested a high likelihood that targeted SC would be considered cost-effective at a willingness-to-pay threshold of £20 000 per QALY (> 70%).

There are several caveats to this statement. Although the ICER can be considered cost-effective at a standard willingness-to-pay threshold of between £20 000 and £30 000 per QALY gained, it is important to note that the survival benefits found in the base case of this analysis are unlikely to be considered clinically meaningful. This is not an unusual finding in often frail populations with severe illness, where the capacity to benefit is limited. In addition, PSA outputs from this exploratory model should be interpreted with caution given that robust quantification of uncertainty is challenging at this stage of model and data development.

There were a number of provisional inputs used in this exploratory analysis that were not reported directly in the

Table 3. Clinical inputs and utility weightings.

Time	Transition	Smoking classification		HR*
		Quit	No quit	
Initial distribution (at 1 month)	Response	0.728	0.728	-
	Progression	0.121	0.096	-
	Dead	0.151	0.176	-
1-3 months	Response to progression	0.051	0.051	1.00
	Response to dead	0.036	0.073	2.04†
	Progression to response	0.151	0.051	0.34†
	Progression to dead	0.265	0.368	1.39†
3-6 months	Response to progression	0.045	0.064	1.41†
	Response to dead	0.056	0.031	0.55
	Progression to response	0.072	0.049	0.68†
	Progression to dead	0.228	0.289	1.27†
6-12 months	Response to progression	0.051	0.043	0.83
	Response to dead	0.041	0.056	1.37†
	Progression to response	0.021	0.019	0.91†
	Progression to dead	0.201	0.135	0.67
12-24 months	Response to progression	0.009	0.012	1.28†
	Response to dead	0.033	0.039	1.18†
	Progression to response	0.005	0.000	0.00
	Progression to dead	0.112	0.162	1.44†
Time	**Health state**	**Probability of complications**		**HR***
		Quit	**No quit**	
1 month	Response	0.26	0.19	0.73
	Progression	0.67	0.77	1.15†
1-3 months	Response	0.28	0.21	0.75
	Progression	0.59	0.59	0.99
3-6 months	Response	0.25	0.29	1.17†
	Progression	0.54	0.41	0.76
6-12 months	Response	0.11	0.24	2.16†
	Progression	0.44	0.57	1.29†
12-24 months	Response	0.15	0.32	2.06†
	Progression	0.53	0.14	0.27
Time	**Health state**	**Mean utility**		**HR***
		Quit	**No quit**	
1-3 months	Response (no cc)	0.713	0.685	0.96†
	Progression (no cc)	0.640	0.550	0.86†
	Response (cc)	0.718	0.564	0.79†
	Progression (cc)	0.615	0.553	0.90†
3-6 months	Response (no cc)	0.749	0.691	0.92†
	Progression (no cc)	0.627	0.588	0.94†
	Response (cc)	0.647	0.435	0.67†
	Progression (cc)	0.430	0.509	1.18
6-12 months	Response (no cc)	0.747	0.652	0.87†
	Progression (no cc)	0.643	0.641	1.00

continued on next page

Table 3. Continued

Time	Health state	Mean utility		HR*
		Quit	No quit	
	Response (cc)	0.627	0.567	0.90†
	Progression (cc)	0.594	0.525	0.88†
12-24 months	Response (no cc)	0.790	0.793	1.00
	Progression (no cc)	0.625	0.651	1.04
	Response (cc)	0.651	0.558	0.86†
	Progression (cc)	0.516	0.848	1.64

cc indicates complications; HR, hazard ratio.
*The range of HR values indicate the lack of clear direction in the observed data.
†HRs that indicate a benefit in quit versus no quit.

LungCast data set and a robust assessment of cost-effectiveness is challenging. Nevertheless, multiple scenario analyses were conducted to explore the model's sensitivity. Across the range of plausible scenarios explored, we found ICER estimates between £9935 per QALY gained (increased quit rate for the intervention relative to the no intervention quit rate) and £32 246 per QALY gained (high-cost intervention with no change in relative quit rates). In the scenario where we increased the expected SC quit rate and applied the local Hywel Dda University Health Board cost of a focused SC intervention (a weighted average cost of £224 per patient), the ICER was estimated at £15 985. This might come closest to an expected "real-world" application of an intense SC intervention; nevertheless, the lack of patient-specific resource and cost inputs limits the potential generalizability of these findings.

The outcomes of our analysis are not directly comparable with other research. Recently, the CURE study reported a cost per QALY of £487 for a tobacco dependency treatment service for smokers admitted to hospital.[21] This service was based on gains for all patients attending hospitals and not focused solely on people with newly diagnosed NSLC. Moreover, their study assumed that patients without intervention would not quit smoking and those who quit remained quitters. In our analysis, we assume that, given the nature of the diagnosis, a reasonably high proportion of patients would quit without formalized intervention (following previously published studies). In addition, our findings of limited LY gains cannot be directly mapped to the 25% survival benefit found in the longitudinal study.[9] The analysis here is comparing the composite impact of an "SC intervention" with "no SC intervention," rather than focusing on a direct comparison of survival in patients who quit versus those who do not (the emphasis of the LungCast longitudinal study).

Inclusion of EOL costs for all patients who died led to lower costs in the SC intervention arm and higher QALY gains; in this scenario, the SC intervention dominated "no SC intervention." The inclusion of an EOL cost is defendable but the approach here is necessarily simplistic (all patients incur EOL costs at the point of death) and so should be interpreted cautiously. A final set of SAs (SA 12-13) explored "ideal scenarios" for complication rates and utility estimates where we assumed a clear relationship between the quit and no quit data (ie, more complications and higher impact on QoL in the no quit patients than the quit patients). This resulted in calculated ICERs of £10 086 (complication adjustment) and £9299 (utility adjustment) suggesting that if a clear relationship could be observed in the data, the impact on the expected ICER could be high (> 30%).

SAs are a useful way of determining the key drivers of the model result. A review of the model outputs and scenario analyses indicates that the model was most sensitive to those factors that were not controlled for or included in the LungCast data set—for example, quit rates without an SC intervention, complication rates with a clear mapping to HCRU, and quit rates with SC intervention clearly mapped to a specific SC intervention (along with attendant HCRU and cost). It is challenging to conduct large-scale

Table 4. Unit costs.

Model parameter	Input,* £	Source/comment
SC intervention (base case)	89	Li et al 2020[15] Composite of basic SC provision primary care and nicotine replacement therapy (NRT) costs
SC intervention (high intensity)	224	HDUHB 2018/2019[16] Weighted average pharmacy level 3 and hospital-based smoke-free program costs
Cost of NSCLC	2343	Andreas et al 2018[18] Cost of adjuvant therapy as a proxy for cost of NSCLC, applied to all patients included in model
Response (per month)	346	Andreas et al 2018[18] Costs of the disease-free cohort
Progression (per month)	797	Andreas et al 2018[18] Costs for locoregional recurrence
Complication (one off)	1247	Rothwell et al 2021[20] Weighted average of reported complications, combined with reported unit costs
EOL adjuster (SA, one off)	2675	Verleger et al 2020[19] Estimated cost for EOL costs

EOL indicates end of life; HDUHB, Hywel Dda University Health Board; NHSCII, NHS cost inflation index; NSCLC, non–small cell lung cancer; SA, sensitivity analysis; SC, smoking cessation.
*All unit costs are inflated to 2020/2021 values using HSC inflation indices.

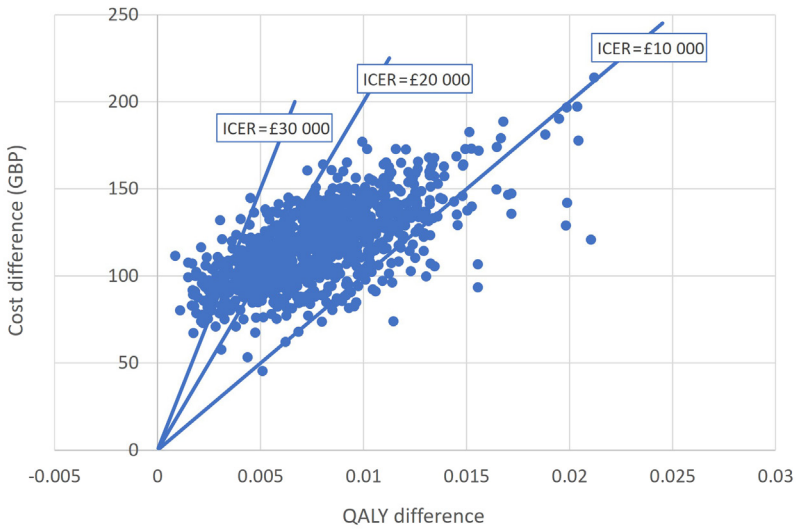
Table 5. Model outputs.

#	Scenario description	Incremental costs (£)	Incremental QALYs	ICER (£)	Impact, %
BC	Base case (SC £89, observed data, no SC quit rate 14%)	116	0.008	14 904	-
1	Relative quit rate for no SC reduced (no SC quit 10%)	137	0.014	9935	−33
2	HDUHB SC costs (£224 per patient)*	251	0.008	32 246	+116
3	HDUHB SC costs (£224) and increased SC quit rate†	286	0.018	15 985	+7
4	Pooled transition probabilities after 12 months‡	100	0.008	12 433	−17
5	Pooled transition and cc rates (no time dependency)§	155	0.006	24 929	+67
6	Cost of response and progression −30%	113	0.008	14541	−2
7	Cost of response and progression +30%	125	0.008	16 111	+8
8	Complication cost in "response" set to zero	142	0.008	18 180	+22
9	Complication cost in "progression" set to zero	95	0.008	12 181	−18
10	Same utility for quit and no quit disease states	116	0.006	18 313	+23
11	Same utility for quit and no quit health states	116	0.006	19 342	+30
12	Best case‖ complication rates (+20% rate in no quit compared with quit)	125	0.012	10 086	−32
13	Best case‖ utility (−20% HS utility, +20% cc disutility for no quit)	116	0.013	9229	−38
14	EOL weighting applied (£2675 one-off cost applied)	−8	0.008	Domain	-
15	Two-year time horizon (ie, study period only)	99	0.005	21 141	+42
16	Lifetime time horizon (extrapolating observed data)	124	0.009	13 892	−7

# indicates number; BC, Base case; cc, complications; EOL, end of life; HDUHB, Hywel Dda University Health Board; HS, health state; ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life-year; SA, sensitivity analysis; SC, smoking cessation.
*SA 2 applies intense SC intervention cost but no increase in effectiveness.
†SA 3 assumes intense SC cost and an increase in effectiveness based on Hartmann-Boyce et al 2018[13] (SC quit rate of 23%).
‡In SA 4, we apply pooled 1- to 24-month data after 12 months to iron out the more intense outcomes seen in 12- to 24-month data (patient numbers were very low).
§In SA 5 we apply pooled rates across all time horizon.
‖In the "best case" SAs (12-13), we explored scenarios that assumed consistent benefits in the quit patient cohorts.

randomized controlled trials (RCTs) in patients with limited survival but focused research on a targeted intervention conducted either as an RCT or matched cohort study could move toward a better definition of expected benefit. LungCast initially opened as an RCT but this was abandoned due to poor recruitment. Patients who smoked who consented to the observational arm were

Figure 2. PSA scatterplot.



ICER: Incremental cost-effectiveness ratio. ICER values reflect different bounds of willingness to pay.

GBP indicates Great Britain Pounds; ICER, incremental cost-effectiveness ratio; PSA, probabilistic sensitivity analysis; QALY, quality-adjusted life-year.

unwilling to sign up to an RCT because some did not want the risk of being allocated to a group with no tailored SC intervention (ie, physician basic advice only) when a tailored SC intervention was available, whereas others did not want to enroll because they wished to try and quit without additional support. Therefore, we sought an ethics amendment to turn the RCT into an open-label prospective observational study, where all subjects were offered support based on the best available services.

This exploratory analysis is based on an interim data set that has no direct mapping to HCRU or costs. The constructed model provides a flexible platform for exploratory analyses but additional analysis is recommended to increase the robustness of model inputs. Specific focus could usefully be applied to defining the type, the costs, and the quit rate of a focused SC intervention.

Based on this exploratory analysis, SC intervention in patients with NSCLC at the time of diagnosis could be a cost-effective use of UK NHS resources. Additional research with focused costings and specific outcomes according to different types of treatments (radical vs palliative, surgery vs radiotherapy vs chemotherapy), different stages of lung cancers, and different types of lung cancer is needed to confirm this promising positioning and help tailor resources most effectively.

Supplemental Materials

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.jval.2023.03.2429.

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