Cost-effectiveness of computed tomography screening for lung cancer in the United States
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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

CRD summary
The objectives were to assess the cost-effectiveness of computed tomography (CT) screening for lung cancer in smokers in the USA, and to identify the characteristics of a lung cancer screening programme that most influence its cost-effectiveness. The authors concluded that the cost-effectiveness of CT screening depended on the associated smoking cessation rates. The methods and results were not fully presented, but the authors’ conclusions reflect their objective and should be considered in this context.

Type of economic evaluation
Cost-utility analysis

Study objective
The objectives were to assess the cost-effectiveness of computed tomography (CT) screening for lung cancer in smokers in the USA, and to identify the characteristics of a lung cancer screening programme that most influence its cost-effectiveness.

Interventions
Screening once at ages 50, 60, or 70 years and annual screening from the ages of 50, 60, or 70 years were compared with no screening. People were eligible for screening if they had a history of 20 pack-years of smoking or more. Smoking cessation programmes with or without screening were also considered.

Location/setting
USA/primary care.

Methods
Analytical approach:
The published Lung Cancer Policy Model (LCPM), a patient-level micro-simulation (McMahon, et al. 2008, see 'Other Publications of Related Interest' below for bibliographic details), was used to predict the long-term cost-effectiveness of screening, in male or female cohorts of 50,000 smokers. The authors reported that a societal perspective was adopted.

Effectiveness data:
The clinical and effectiveness data were mainly from the LCPM model. Smoking histories were from six US cohorts (men or women, aged 50, 60, or 70 years). The main estimates of effectiveness were the sensitivity and specificity of CT screening in detecting asymptomatic prevalent lung cancers and benign pulmonary nodules. These estimates were from the LCPM model. Other parameters included the proportion of patients who quit smoking after screening, the screening eligibility and participation rates, the risks of secondary lung cancer due to radiation from the CT scans, and the survival after diagnosis.

Monetary benefit and utility valuations:
The utility estimates for people without lung cancer were from a survey that used the European Quality of life (EQ-5D) questionnaire. The estimates for people with lung cancer were from published studies that used various methods.

Measure of benefit:
Quality-adjusted life-years (QALYs) were the summary benefit measure and they were discounted at an annual rate of 3%.
Cost data:
The direct costs included those of diagnosis, staging, cancer treatment, pharmaceuticals, and smoking cessation interventions. The diagnosis, staging, and treatment costs were from US Medicare reimbursements. The pharmaceutical costs were their average wholesale prices. The indirect costs included the time spent by patients and their caregivers for diagnostic tests and treatments. This was valued using mean wages by age. The price year was 2006 and all costs were reported in US dollars ($). Future costs were discounted at an annual rate of 3%.

Analysis of uncertainty:
One-way sensitivity analyses were undertaken by varying the proportion of patients who quit smoking after screening, the eligibility for screening determined by pack-years, the adherence to screening, the CT sensitivity, the diagnostic test costs, and other parameters.

Results
The incremental cost per patient, who was screened once, compared with no screening, ranged from $1,778 to $3,637. The incremental QALYs ranged from 0.009 to 0.022. Screening once was weakly dominated by annual screening, as screening once had a higher incremental cost-effectiveness ratio and was less effective.

The incremental cost per QALY gained ranged from $126,000 to $169,000 for annual screening of smokers aged 50 to 70 years, compared with no screening.

Compared with no screening, annual screening of 50- to 70-year-olds was associated with an incremental cost-utility ratio of $149,000 per QALY gained for men and $137,000 per QALY gained for women.

The sensitivity analysis showed that if participation in screening was 100% and screening doubled the cessation rate to 6%, the incremental cost-utility ratios for annual screening of 50- to 70-year-olds were below $100,000 per QALY gained, for men ($73,000) and women ($40,000).

Authors’ conclusions
The authors concluded that the cost-effectiveness of CT screening depended on the associated smoking cessation rates. Unless participation increased smoking cessation, screening cost more than $100,000 per QALY, compared with no screening.

CRD commentary
Interventions:
The screening strategies were not clearly reported, but were listed in the results section. The main comparator (no screening) was not explicitly justified, but appears to have been relevant to the authors' setting; it was unclear if this was the usual care. Screening using other imaging techniques, was not considered. These options might be applicable to other settings.

Effectiveness/benefits:
The clinical and effectiveness estimates were, in general, those reported in the LCPM model. This model was described, with the data sources and base-case values, in online supplementary files. QALYs were an appropriate benefit measure, because of the impact of the disease on survival and quality of life. The utility weights and their sources were presented in a supplementary file. These sources should be reviewed to assess the quality of evidence.

Costs:
The authors reported that a societal perspective was adopted and they included some indirect costs, such as patient and caregiver time, but other relevant costs, such as those of early death or absence from work due to illness, were not included. The sources for the costs were reported, and supplementary information was provided. The time horizon of the study was unclear, but a long-term analysis was conducted and discounting was appropriately performed. Most cost items were reported, but the quantities of resources were not, which reduces the transparency of the analysis. The price year and currency were provided.

Analysis and results:
The clinical and cost data were synthesised, using a published model and an incremental analysis. Additional details of
the model methods, structure, and parameter assumptions were provided in the supplementary files. In general, only the aggregated results were presented. The parameter uncertainty was investigated in one-way sensitivity analyses, but a probabilistic sensitivity analysis could have more comprehensively assessed the overall impact of parameter uncertainty on the results. The authors acknowledged some limitations of their study, such as the assumption that all patients took up screening and treatment, which could have overestimated the QALYs gained with screening.

Concluding remarks:
The methods and results were not fully presented, but generally the methods were appropriate. The authors’ conclusions reflect their objective and should be considered in this context.

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