Cost effectiveness of chest computed tomography after lung cancer resection: a decision analysis model


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.

Health technology
The study evaluated postoperative surveillance with chest computed tomography (CT) in patients who had undergone resection of non-small-cell lung cancer (NSCLC). This was compared with no surveillance with CT.

Type of intervention
Diagnosis.

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of patients who had undergone annual chest CT after resection of a Stage IA NSCLC. The target population was the same as the study population.

Setting
The setting was secondary care. The economic study was carried out in New York, USA.

Dates to which data relate
The effectiveness data were derived from literature dating from 1974 to 2005. The resource use and cost data were derived from Medicare fee schedules for the year 2004. The price year was 2004.

Source of effectiveness data
The effectiveness evidence was derived from a synthesis of published studies.

Modelling
A decision tree, based on a Markov model, was used to predict the cost-effectiveness of surveillance CT. All patients were followed up until death. The health states included in the model were: dead from other causes; disease free from lung cancer; CT-detected second primary lung cancer (SPLC); recurrence; interval SPLC; death from lung cancer; resected Stage IA; resected Stage IIB-IIA; unresectable advanced disease; unresectable pulmonary insufficiency; unresectable small-cell lung cancer or other.

Outcomes assessed in the review
The outcomes assessed in the review and the variables used in the model included:

the age at entry,
the specificity and sensitivity of surveillance CT,
the annual incidence of SPLC,
lead time bias, and
anticipated survival after the resection of initial primary and second primary lung cancer.

**Study designs and other criteria for inclusion in the review**
The authors stated that data on the probability of transitioning from one health state to another, the distribution of patients among groups, and the survival of patients after treatment were derived from the literature and US census data. However, no information about the review was reported.

**Sources searched to identify primary studies**
Not stated.

**Criteria used to ensure the validity of primary studies**
Not stated.

**Methods used to judge relevance and validity, and for extracting data**
Not stated.

**Number of primary studies included**
Twenty-seven primary studies were included in the review.

**Methods of combining primary studies**
Not stated.

**Investigation of differences between primary studies**
Not stated.

**Results of the review**
The age at entry was 60.

The specificity of surveillance CT was 90.5% and the sensitivity was 85%.

The annual incidence of SPLC was 2%.

The lead time bias was 1 year.

The 5-year survival rates were:

- 67% for initial Stage IA NSCLC (resection);
- 40% for SPLC, Stage IA (resection);
- 18% for SPLC, Stage IB or higher (resection); and
Measure of benefits used in the economic analysis
The measure of benefits used was the quality-adjusted life-years (QALYs) gained in the surveillance group compared with the control group. The authors adopted the quality of life values from a published paper (Mahadevia et al. 2003, see Other Publications of Related Interest- below for bibliographic details).

Direct costs
The direct costs included costs associated with surveillance, such as the cost of CT scans, surgery and diagnostic procedures. The data were derived from Medicare fee schedules for the year 2004 in the State of New York. These costs included the associated surgeon, anaesthesia, pathology and facility fees, and represented Medicare reimbursement rates. Data on the excess cost associated with CT surveillance were taken from a retrospective review of postoperative CT scans performed at the authors’ institution. The costs were discounted at a rate of 3% per annum. The price year was 2004.

Statistical analysis of costs
No statistical analysis of the costs was reported.

Indirect Costs
The indirect costs were not reported.

Currency
US dollars ($).

Sensitivity analysis
A one-way sensitivity analysis was carried out to determine the impact on cost-effectiveness of every single variable.

Estimated benefits used in the economic analysis
Five-year survival was 29% among the surveillance patients in whom an SPLC developed, compared with 19% in the control cohort.

Surveillance increased overall survival by 0.16 QALYs.

Cost results
The base-case estimate for the cost of a full-dose, chest CT scan procedure was $454.

The incremental cost for surveillance patients over the control cohort was $7,716.

Synthesis of costs and benefits
The costs and benefits were combined by calculating the cost-effectiveness ratio.

Annual CT scans were determined to be a cost-effective intervention at an overall cost of $47,676 per QALY gained.

The sensitivity analysis showed that the factors that rendered surveillance CT cost ineffective were:

an age at entry into the surveillance programme of older than 65 years;
a cost of CT that was greater than $700;
an incidence of SPLC of less than 1.6% per patient per year of follow-up; and
a false-positive rate of surveillance CT that was greater than 14%.

**Authors' conclusions**

Surveillance with postoperative computed tomography (CT) may be a cost-effective intervention to detect second primary lung cancer (SPLC) in selected patients with previously resected Stage IA non-small-cell lung cancer (NSCLC).

**CRD COMMENTARY - Selection of comparators**

The rationale for the choice of the comparator (i.e. no surveillance) was clear. It represented current practice. You should decide if this is a widely used health technology in your own setting.

**Validity of estimate of measure of effectiveness**

The effectiveness evidence came from published studies. However, the methods and conduct of the review were not reported. No information on the design and characteristics of the primary studies was provided, thus it was not possible to assess the validity of the primary estimates. The authors stated that few, if any, randomised controlled trials were available.

**Validity of estimate of measure of benefit**

The authors used QALYs as the outcome measure. This will permit comparison of the results with other treatments and across other disease areas. The estimation of health benefits was modelled. The instrument used to derive a measure of health benefit, a Markov model, was appropriate.

**Validity of estimate of costs**

The perspective adopted in the study appears to have been that of the Medicare system. The direct costs were included. The authors stated that the costs included did not represent the actual, realised cost of the procedures that the patient and the health care facility incurred for these workups. Extensive information on the unit costs and sources of data was provided, which enhances the possibility of replicating the cost analysis in other settings. The cost estimates were treated deterministically. The price year was reported, which will facilitate reflation exercises in other time periods.

**Other issues**

The authors justified the assumptions used in the decision analysis model. The generalisability of the study was addressed. The authors stated that their choice of the cost-effectiveness threshold of $60,000 per QALY was intended more as a guideline than as a distinct cut-off value. The authors reported the limitations of their study, for example, the fact that the decision analysis model did not consider the psychological impact of surveillance.

**Implications of the study**

The decision to enrol patients in a surveillance CT programme must be made on an individual basis. Older patients, or those with life expectancy limited by other diseases, may not benefit from a programme of surveillance CT. Conversely, younger patients, including former smokers and (especially) current smokers, may derive the most benefit from surveillance CT. Prospective data collection is necessary to confirm these findings, as well as to address additional variables such as the use of adjuvant therapy and the utility of early detection of metastatic disease using surveillance CT.

**Source of funding**
Bibliographic details

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Other publications of related interest

Indexing Status
Subject indexing assigned by NLM

MeSH
Adult; Age Factors; Aged; Carcinoma, Non-Small-Cell Lung /radiography /surgery; Cohort Studies; Cost-Benefit Analysis; Decision Support Techniques; False Positive Reactions; Health Care Costs; Humans; Lung Neoplasms /radiography /surgery; Middle Aged; Neoplasms, Second Primary /radiography; Risk Assessment; Survival Analysis; Tomography, X-Ray Computed /economics

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