Estimating the benefit and cost of radiotherapy for lung cancer
Barbera L, Walker H, Foroudi F, Tyldesley S, Mackillop W

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 use of radiotherapy (RT) for the initial treatment of lung cancer.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients with lung cancer. A hypothetical cohort of 5,000 patients was used to estimate the health benefits. No further inclusion or exclusion criteria were reported.

Setting
The setting was not explicitly stated. The economic study was carried out in Canada.

Dates to which data relate
The effectiveness evidence was derived from studies published between 1980 and 2002. The cost data were derived from a study published in 1999. All data were adjusted to 2002 levels.

Source of effectiveness data
The effectiveness data were derived from a review or synthesis of completed studies and from official published sources (National Cancer Institute), augmented by guesses made by the authors.

Modelling
An extended version of a published model was used to estimate the costs and benefits of using RT in the initial treatment of lung cancer patients. Further information on the model used was provided elsewhere (Tyldesley et al. 2001, see ‘Other Publications of Related Interest’ below for bibliographic details). Assumptions about the dose or fractionation of irradiations used for each indication were made in the model:

for small-cell lung cancer (SCLC), the irradiation used was assumed to comprise 15 fractions for curative thoracic RT, 10 fractions for prophylactic cranial irradiation and 5 fractions for palliative indications;

for non-small-cell lung cancer (NSCLC), the irradiation referred to 30 fractions in the case of curative indications, 25 fractions for curative indications, 25 fractions for adjuvant indications, 15 fractions for high-dose palliative chest RT and 5 fractions for all other palliative indications; and

local control was considered equivalent to symptom control.
Outcomes assessed in the review

The following input parameters were used in the model:

- Survival gain (in months) when using thoracic RT for limited-stage (LS) SCLC, prophylactic cranial irradiation for LS SCLC, prophylactic cranial irradiation for extensive-stage (ES) SCLC, Stage I, II and curative RT for NSCLC, Stage III and IV palliative RT;

- The percentage of complete response and duration of the response when using palliative whole brain RT for ES-SCLC;

- Gain in local symptom control (in months) when using Stage I and II surgery positive margin and adjuvant RT, Stage II surgery without mediastinal lymph node dissection and adjuvant RT, pT1-4 N2-3 negative margin and adjuvant RT, pT1-4 N2-3 positive type and adjuvant RT, pT3 N0-1 positive margin and adjuvant RT.

Study designs and other criteria for inclusion in the review

The study designs included in the review were clinical guidelines, large randomised trials, case series studies, epidemiological observations, meta-analyses and retrospective institutional series.

Sources searched to identify primary studies

Not reported.

Criteria used to ensure the validity of primary studies

Not reported.

Methods used to judge relevance and validity, and for extracting data

Not reported.

Number of primary studies included

Overall, 9 primary studies were reported to have provided effectiveness evidence.

Methods of combining primary studies

A narrative method was used to combine the studies.

Investigation of differences between primary studies

The authors do not seem to have investigated differences between the primary studies.

Results of the review

The complete response for palliative whole brain RT for ES SCLC was 39%, lasting 10 months.

With Stage IV palliative RT for NSCLC, there was a 56% improvement in the chest, lasting 91 days, and the brain response rate was 68%, lasting 10 weeks.

The full results are too numerous to report here but were reported in the paper (table 1).

Methods used to derive estimates of effectiveness

The authors relied on their "best guess" to derive some estimates of effectiveness, owing to the lack of data published in
the literature.

**Estimates of effectiveness and key assumptions**
The authors made a guess about survival improvement in patients with locally advanced NSCLC. They also made a guess about the median survival of untreated locally advanced Stage III lung cancer patients with good performance status and no weight loss.

**Measure of benefits used in the economic analysis**
The outcome measures used in the economic analysis were months of survival gained when using curative RT and months of symptom control gained when using palliative RT. Survival gains were estimated as an improvement in median survival. Gains in symptom control were estimated as the proportion of patients who responded to treatment, counting also their average duration of response. These estimates were derived from the review of the literature.

**Direct costs**
The health service costs included in the analysis were for labour, all materials used for the service provided, general administration, overheads for the treatment machine, office and fixed overheads, and maintenance or quality control overheads. The costs of treatment delivery and continuing care were also included. Central administrative costs (e.g. finance, human resources) were omitted. The costs and the quantities were not analysed separately and the unit costs were not reported. The quantities and unit costs were derived from a published study and were adjusted to 2002 levels, using the health consumer price index. Discounting was not carried out as all the costs were incurred during less than 2 years.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
The indirect costs were not included in the study.

**Currency**
Canadian dollars (Can$).

**Sensitivity analysis**
A one-way sensitivity analysis was carried out on all effectiveness and cost estimates used in the model, to test variability in the data. Some ranges were derived from the literature, while the costs were arbitrarily changed by +/-20%.

**Estimated benefits used in the economic analysis**
For SCLC, the average survival gain was 1.7 months per incident case and 4.1 months per treated case. The average gain in symptom control was 0.2 months per incident case and 3.9 months per treated case.

For NSCLC, the average survival gain was 2.1 months per incident case and 7.6 months per treated case. The average gain in symptom control was 0.5 months per incident case and 2.9 months per treated case.

For all lung cancers, the average survival gain was 2.0 months per incident case and 7.1 months per case of lung cancer treated with curative RT. The average gain in symptom control was 0.5 months per incident case and 3 months per case treated with palliative RT.
Cost results
The total intervention costs were not reported. However, average costs were reported.

The average cost per patient was $5,207 for Stage I NSCLC, $4,937 for Stage II NSCLC and $5,041 for Stage III NSCLC.

Synthesis of costs and benefits
For SCLC, the cost per life-year gained was $19,826 and the cost per year of symptom control gained was $9,506. For NSCLC, the cost per life-year gained was $8,126 and the cost per year of symptom control gained was $14,720. Overall (for all lung cancers) the cost per life-year gained was $9,881 and the cost per year of symptom control gained was $13,938.

The sensitivity analysis indicated that the results were most sensitive to large systematic variations in the estimates of benefits. The authors reported that the results of the model were fairly robust to variations in other input parameters.

Authors' conclusions
The use of radiotherapy (RT) in the treatment of lung cancer has the potential to provide significant benefits at a population level, at a relatively inexpensive cost.

CRD COMMENTARY - Selection of comparators
The selection of the health technology used was justified on the grounds that it is an important treatment option. However, the authors did not discuss the existence of alternative therapies. If there are any, which is likely, it makes this study only a partial analysis.

Validity of estimate of measure of effectiveness
The authors did not report that a systematic review had been undertaken. They appear to have used data from the available studies selectively. Although this is common practice with models, it does not always ensure that the best data available are actually used. Since the methods used to find and select the primary studies and to extract the data were unclear, it was difficult to assess the validity of the estimates. In addition, the authors did not consider the impact of differences between the studies identified. This, together with the absence of details on the methods or results associated with the relevance, validity and data extraction of the studies, potentially limits the reliability of the findings.

Validity of estimate of measure of benefit
The measures of benefit used were months of survival gained and months of symptom control gained. These were derived from the literature (see comments above).

Validity of estimate of costs
It appears that all costs relevant to the perspective adopted have been included in the analysis. Although some costs were omitted from the analysis, their omission is unlikely to have affected the authors' conclusions. The costs and the quantities were not reported separately, and the unit costs were also not reported. This would not enable the analysis to be easily reworked for other settings. The costs were treated deterministically, but a one-way sensitivity analysis was conducted to test variability in the data used. Discounting was not relevant, as the costs were incurred during less than 2 years, but the costs were appropriately inflated to 2002 levels.

Other issues
The authors compared their findings with those of published studies, reporting consistency in their results. Differences found in one published study were attributed to the different methodologies employed. The issue of generalisability of the results to other settings was addressed. The authors commented that their model could be used as a basis, and only...
the effectiveness and cost parameters should be changed according to epidemiological and cost data of the population. The authors do not appear to have presented their results selectively. The study enrolled patients with lung cancer and this was reflected in the authors' conclusions.

The authors reported a number of limitations to their study. First, they had employed a rather basic measure of benefit. Second, they had measured the benefit of RT for each indication only once and underestimated improvements in symptom control which were not estimated when using curative RT. Third, the study did not take repeat RT or RT delivered later in the course into consideration, thus underestimating the costs and benefits of RT treatment.

**Implications of the study**
The authors specifically recommended that their model analysis should be considered a useful source of information for the planning of resources and as a tool to facilitate prioritisation. They recommended that future research should extend the use of RT to other cancer sites, in order to make robust decisions about the effectiveness of RT for other forms of cancer.

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**Bibliographic details**

**Other publications of related interest**

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Cost-Benefit Analysis; Humans; Lung Neoplasms /economics /mortality /radiotherapy; Meta-Analysis; Quality of Life; Radiotherapy /economics; Randomized Controlled Trials as Topic

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