Suspected acute pulmonary emboli: cost-effectiveness of chest helical computed tomography versus a standard diagnostic algorithm incorporating ventilation-perfusion scintigraphy

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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.

Health technology
The use of chest helical computed tomography (CT) alone, or combined with venous ultrasound (US) of the legs and pulmonary angiography (PA), for the diagnosis of suspected acute pulmonary emboli.

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population was a hypothetical cohort of 1,000 patients with suspected acute pulmonary emboli. The mean age of the patients referred for the diagnosis of pulmonary emboli was 57 years.

Setting
The setting was a hospital. The economic analysis was carried out in Australia.

Dates to which data relate
The effectiveness and resource use data were collected from studies published between 1960 and 1997. The cost data were obtained from the Commonwealth Medicare Benefits Schedule (see of Related Interest). The price year was 1996.

Source of effectiveness data
The effectiveness data were gathered from a literature review, from a retrospective review of the case data obtained at the authors' institution, and from authors' assumptions.

Modelling
A decision analytical model was used to model the costs and effectiveness of the three diagnostic strategies.

Outcomes assessed in the review
The review assessed the sensitivity and specificity of the diagnostic strategies, mortality, and prevalence of primary emboli.

Study designs and other criteria for inclusion in the review
Not stated.

**Sources searched to identify primary studies**
The effectiveness estimates were derived from published primary studies. The authors also conducted a retrospective review of the case data obtained at their institution over a period of 12 months. This was used to quantify the number of "non-diagnostic", i.e. inconclusive, V/Q scans.

**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**
Ten 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 probability of a V/Q scintigraphy being diagnostic was 62.3% (range: 50 - 75).

The sensitivity of venous US of the leg was 95% (range: 90 - 100), and the specificity was 99% (range: 98 - 100).

The sensitivity of PA was 98% (range: 96 - 100) and the specificity was 96% (range: 92 - 100).

The sensitivity a helical CT scan was 63% (range: 50 - 90) and the specificity was 89% (range: 80 - 98).

The prevalence of primary emboli was 34% (range: 20 - 50). Of these, 50% (range: 25 - 75) also had deep vein thrombosis.

The mortality rate was 26% (range: 13 - 30) in patients with untreated primary emboli, and 2% (range: 1 - 3) in those who were treated immediately.

Twenty per cent (range: 10 - 30) of patients with primary emboli were expected to die of other disorders over the next two years, irrespective of treatment.

The mortality rate was 0.25% (range: 0.123 - 0.375) in patients without primary emboli, who were treated erroneously with anticoagulants.

The mortality rate following PA was 0.2% (range: 0.1 - 0.3).

Bleeding complications that required further treatment were also reported. These occurred in 15% (range: 10 - 20) of the patients undergoing treatment for primary emboli, and 7% (range: 3 - 11) of the patients undergoing PA. The authors stated that the ranges shown came from the literature.
Methods used to derive estimates of effectiveness
The authors made assumptions about effectiveness.

Estimates of effectiveness and key assumptions
The authors assumed that patients surviving to two years post-primary emboli would have a remaining life expectancy of 25 years.

Measure of benefits used in the economic analysis
The measure of benefit was the number of life-years gained. The life-years gained were discounted at an annual rate of 3%.

Direct costs
The direct costs were not discounted given the short timeframe of the study (less than one year). The quantities and unit costs were only reported separately for the diagnostic tests. The direct costs were the costs of diagnosis, treatment, hospitalisation and readmission. The quantity/cost boundary adopted was that of the hospital. The costs of the diagnostic strategies were derived from the Commonwealth Medicare Benefits Schedule for diagnostic tests (see of Related Interest). The price year was 1996.

Statistical analysis of costs
The authors reported the total deterministic costs for each diagnostic strategy.

Indirect Costs
The indirect costs were not included.

Currency
Australian dollars (Aus$).

Sensitivity analysis
One-way sensitivity analyses were conducted to assess the robustness of the results. A series of best and worse case cost-estimates were estimated using the ranges for each parameter and the treatment costs for diagnostic composite (+/- 25%), initial primary emboli (Aus$990 - 2,965) and complications composite (+/- 50%).

Estimated benefits used in the economic analysis
There would be 138.7 deaths without diagnosis and treatment.

Compared with a 'do nothing' strategy, the number of lives saved was:

61 with the combined strategy of V/Q, venous US and PA;
40.9 with helical CT; and
63.6 with the combined strategy of helical CT, venous US and PA.

Compared with a 'do nothing' strategy, the number of life-years gained was:

1,017 with the combined strategy of V/Q, venous US and PA;
682 with helical CT; and
1,058 with the combined strategy of helical CT, venous US and PA.

**Cost results**

Compared with the 'do nothing' strategy, the total costs amounted to:

- Aus$1,739,820 for the combined strategy of V/Q, venous US and PA;
- Aus$1,424,040 with helical CT; and
- Aus$2,718,905 for the combined strategy of helical CT, venous US and PA.

**Synthesis of costs and benefits**

The incremental cost per life-year gained of V/Q with venous US and PA was Aus$940, compared with helical CT alone. The incremental cost per life-year gained of the helical CT, venous US and PA strategy was Aus$23,905, compared with the V/Q, venous US and PA strategy. The cost-effectiveness of the V/Q strategy was robust with respect to most of the assumptions, except for the discount rate.

**Authors' conclusions**

The conventional algorithm using ventilation-perfusion (V/Q) scintigraphy for the diagnosis of primary emboli cost slightly more than helical computed tomography (CT) alone, but was more cost-effective. The cost per life-year gained of the V/Q-based approach compared favourably with other accepted health programmes in the Australian community. Chest helical CT should not be routinely used in patients with suspected primary emboli.

**CRD COMMENTARY - Selection of comparators**

The comparator was justified on the basis that it represented a commonly used and evidenced strategy in the diagnosis of primary emboli. You should decide if these health technologies are relevant to your setting.

**Validity of estimate of measure of effectiveness**

The authors did not state that a systematic review of the literature had been undertaken. No details of the methods used to select and assess the studies were provided. There was insufficient information on the design of the review and the methods used to pool primary effectiveness estimates. In addition, there was no comment on how the uncertainty in the estimates was accounted for; although a one-way sensitivity analysis was conducted, the origin of the ranges was not given.

**Validity of estimate of measure of benefit**

The benefits were estimated by weighting the outcomes of each possible health state by the probabilities derived from the decision tree. The measure of the number of life-years gained enabled comparisons with similar technologies, where issues of quality of life were not so important.

**Validity of estimate of costs**

The cost analysis appears to have included all the relevant direct cost categories from the perspective of the health care provider. In addition, the price year was reported, which would make reflation exercises in other settings possible. However, the charges used to estimate the unit costs and the resource quantities were not generally given separately, thus reducing the generalisability to other settings. Also, the indirect costs relating to lost productivity or death were not considered, although these would need to be accounted for from a societal perspective.

**Other issues**
The authors made appropriate comparisons of their findings with those from other studies. The issue of generalisability to other settings was partly addressed by the sensitivity analysis. The authors do not seem to have presented their results selectively. The study considered patients with suspected acute pulmonary emboli. This was reflected in the authors’ conclusions, although the patients’ baseline characteristics in the various studies were not reported or compared. The authors acknowledged that they did not consider the value of using helical CT as a second-line investigation in patients with non-diagnostic V/Q scans.

**Implications of the study**
The cost per life-year gained of the V/Q-based approach compared favourably with other accepted health programmes in Australia. Chest helical CT should not be routinely used in patients with suspected primary emboli. The combined strategy of helical CT, venous US and PA might be cost-effective in the UK, given that the recent acceptance of these technologies by NICE has occurred at a similar rate. The resource mix, the unit costs for the UK, and the prevalence of local primary emboli would need to be applied to aid this judgement.

**Source of funding**
None stated.

**Bibliographic details**

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10833110

**Other publications of related interest**


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Subject indexing assigned by NLM

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