Cost-effectiveness of lower extremity compression ultrasound in emergency department patients with a high risk of hemodynamically stable pulmonary embolism

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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
This study examined the cost-effectiveness of a strategy of selective computed tomography (CT) angiogram based on compression ultrasonography, compared with universal CT angiogram for patients with suspected pulmonary embolism in the emergency department. The selective strategy was less expensive and more beneficial than universal CT, for patients with a high pre-test probability of pulmonary embolism. The cost-effectiveness framework was conventional, but the sources of clinical evidence were not extensively described. The authors' conclusions seem robust.

Type of economic evaluation
Cost-utility analysis

Study objective
This study examined the cost-effectiveness of a strategy of selective computed tomography (CT) angiogram, with compression ultrasonography, compared with universal CT angiogram, for patients with suspected pulmonary embolism in the emergency department.

Interventions
The selective CT strategy started with a screening compression ultrasonography. Negative results were followed-up with a CT angiogram, while positive results, identifying a deep vein thrombosis (DVT), were treated with anticoagulation of heparin for six days, followed by six months of out-patient anticoagulation of 5mg of warfarin daily. The universal CT strategy used CT angiogram without ultrasonography, with anticoagulation based on the CT results.

Location/setting
USA/emergency department.

Methods
Analytical approach:
The analysis was based on a decision-tree model, of a hypothetical 59-year-old haemodynamically stable woman, followed by a Markov node to model radiation-induced carcinogenesis. A lifetime horizon was considered. The authors stated that a societal perspective was adopted.

Effectiveness data:
The clinical data were from a selection of relevant studies. The authors selected the most appropriate estimate from the available evidence. The key input was the sensitivity and specificity of both CT angiogram for pulmonary embolism and compression ultrasonography for DVT.

Monetary benefit and utility valuations:
The utility values were from published sources.

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 economic analysis included the costs of hospital stay, professional services, imaging studies, anticoagulation therapy, and out-patient follow-up (physician office visits, anticoagulation clinic visits for fingerprick international normalised ratio checks, and warfarin). The long-term costs of complications, treatment of cancer, and death were considered. The resource quantities were based on published reports and authors’ opinions. The costs were from Medicare and the National Physician Fee Schedule for out-patient treatment. They were in US dollars ($) and the price year was 2009.

Analysis of uncertainty:
All the model inputs were varied in a one-way sensitivity analysis, using plausible ranges of values from published studies.

Results
The projected costs were $9,051.94 with universal CT and $7,594.24 with selective CT. The QALYs were 16.8091 with universal CT and 16.8304 with selective CT. In the base case, selective CT was dominant, as it was more effective and less expensive than universal CT.

The most influential inputs were the probabilities of: pulmonary embolism, death from pulmonary embolism following anticoagulation, major bleeding following anticoagulation, cancer, and death from cancer. Other influential parameters were the costs of both pulmonary embolism and death from cancer as well as the disutilities associated with the short-term morbidity of pulmonary embolism and untreated pulmonary embolism.

A key finding was that selective CT was dominant above a pre-test probability of pulmonary embolism of 8.3% (37% in the base case) or above a specificity of compression ultrasonography of 0.874 (0.99 in the base case). In general, the selective approach was cost-effective at the conventional threshold of $50,000 per QALY.

Authors’ conclusions
The authors concluded that selective CT, using compression ultrasonography to select patients, was less expensive and more beneficial than universal CT, for patients with a high pre-test probability of pulmonary embolism.

CRD commentary
Interventions:
The rationale for the selection of the comparators was clear as compression ultrasonography was proposed as a strategy to overcome the risks of CT-related radiation for patients with suspected pulmonary embolism.

Effectiveness/benefits:
The clinical analysis was limited by a lack of detail, both on the approach used to identify the data sources (no literature review was reported) and the methods of these sources. This information would have allowed the validation of the clinical inputs to be objectively assessed. The authors pointed out a key drawback of the small sample size for a few studies. For some inputs wide ranges of values were found in the literature and these were used as plausible ranges in the sensitivity analyses. The derivation of the utility values was not described; neither whose values nor the instrument used were given. QALYs were a valid benefit measure and they were particularly appropriate for patients with suspected pulmonary embolism given the impact of the disease on their survival and quality of life.

Costs:
The authors stated that a societal perspective was adopted, including both the direct and indirect costs, but only medical costs appear to have been analysed. The data source (Medicare) suggests a third-party payer perspective. The unit costs and resource quantities were reported separately for some items, while others were presented as category totals. The price year was reported, which will allow reflation exercises for other time periods. The economic inputs were treated deterministically, but the costs were varied in the sensitivity analyses. It was unclear whether a discount rate was applied to future costs and this would have been necessary for the lifetime horizon.

Analysis and results:
The results were extensively presented and the costs and QALYs were appropriately synthesised in an incremental analysis, which allowed the identification of the dominant strategy. Various decision thresholds were considered when...
the cost-utility ratios were calculated. The uncertainty was assessed by varying all the inputs individually, but a multivariate analysis would have been useful. The analysis was for the US setting and might be transferable to other settings with similar cost structures.

Concluding remarks:
The cost-effectiveness framework was conventional, but the sources of clinical evidence were not extensively described. The authors’ conclusions seem robust.

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