Comparative effectiveness and cost-effectiveness of computed tomography screening for coronary artery calcium in asymptomatic individuals

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 assessed the cost-effectiveness of screening for coronary artery calcium using computed tomography (CT) for asymptomatic men and women at intermediate risk of coronary heart disease. The authors concluded that CT screening was likely to be cost-effective for men, but not for women. The methods were robust and various areas of uncertainty were considered. The results strongly depended on some key model parameters, but the authors’ conclusions appear to be valid.

Type of economic evaluation
Cost-utility analysis

Study objective
This study assessed the cost-effectiveness of screening for coronary artery calcium using computed tomography (CT) for asymptomatic men and women at intermediate risk of coronary heart disease (CHD).

Interventions
The four strategies were usual care with no prevention, prevention according to guidelines, screening by CT to determine risk, and prevention for all (low-dose statin therapy).

The prevention guidelines recommended lifestyle advice for all, statin therapy when a patient’s baseline low-density lipoprotein (LDL) cholesterol was over 130mg per dL, and antihypertensive medication when their baseline systolic blood pressure exceeded 140mmHg.

CT screening determined the coronary calcium score. Patients at low risk received lifestyle advice and pharmacological treatment if their systolic blood pressure was above 140mmHg or their plasma LDL-cholesterol level was over 160mg per dL. Patients at intermediate risk received treatment according to the prevention guidelines. Patients at high risk received lifestyle advice, statin therapy, and antihypertensive medication, irrespective of their cholesterol and blood pressure levels (men also received low-dose aspirin).

Location/setting
USA/primary and secondary care.

Methods
Analytical approach:
The analysis was based on a Markov model, with a lifetime horizon. The authors stated that it was carried out from the perspective of society.

Effectiveness data:
The clinical data were from relevant studies. The patients’ characteristics and the ability of CT screening to determine low, intermediate, and high risk came from a cohort study (the Rotterdam study) of 2,028 people who underwent CT to determine their coronary calcium score and were followed-up for a median of 9.2 years. The 10-year risk of CHD was calculated using either the conventional Framingham risk model or the CT calcium prediction model and this was the key input for the model. Other inputs were from published meta-analyses, official life tables, or expert opinion.
Monetary benefit and utility valuations:
The utility values were from published sources, including an economic evaluation and a survey of the US population.

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 health care costs of diagnostic procedures, personnel, materials, equipment, medications, resources for long-term follow-up after a cardiovascular event (hospital stay, diagnostic workup, interventions, and rehabilitation), and overheads. Non-health care costs included travel and patient time. Most of the direct health care costs were from reimbursements and average wholesale prices. Some quantities of resources and long-term costs were from published literature, including a cost study conducted in the USA. All costs were in US dollars ($) and the price year was 2010. A 3% annual discount rate was applied.

Analysis of uncertainty:
One-way, two-way, and multi-way sensitivity analyses were performed focusing on the key inputs to the model. A probabilistic sensitivity analysis was carried out for various willingness-to-pay (WTP) thresholds.

Results
In asymptomatic men, the lifetime costs were $7,551 with usual care, $10,276 with statin therapy, $12,184 with guideline prevention, and $12,228 with CT screening. The QALYs were 10.03 with usual care, 10.12 with statin therapy, 10.14 with guideline prevention, and 10.16 with CT screening. Women had higher costs and lower QALYs.

Compared with the next-best strategy, for men, guideline prevention was extendedly dominated, as it was less effective and less cost-effective than another option. The incremental cost per QALY gained was $30,278 with statin therapy, over usual care, and $48,800 with CT screening, over statin therapy.

In women, CT screening was extendedly dominated and the incremental cost per QALY gained was $23,910 with statin therapy, over usual care, and $51,400 with guideline prevention, over statin therapy.

At a WTP threshold of $50,000, the best strategy depended on the model assumptions.

In men, statin therapy was the best strategy if there was a slight lack of synergy between drugs, if treatment adherence dropped below 58%, if the effect of aspirin therapy on CHD was reduced, if the cost of a CT scan was over $200, or if the risk of radiation-induced cancer increased more than 10-fold. In women, statin therapy was the best strategy if there was a slight lack of synergy between drugs.

In men, CT screening was cost-effective in most simulations at a WTP threshold of $50,000 per QALY. In women, CT screening was cost-effective in less than 20% of simulations even at higher WTP thresholds.

Authors’ conclusions
The authors concluded that CT screening for coronary artery calcium, in those at intermediate risk of CHD, was likely to be cost-effective for men, but not for women.

CRD commentary
Interventions:
The selection of the comparators was appropriate as various strategies were considered for patients with differing risks of CHD. The strategies were clearly described.

Effectiveness/benefits:
The clinical data were generally from valid sources, selected by the authors. For example, the patients’ characteristics and CT accuracy were from a large cohort study with a long-term follow-up. The treatment effect and safety data were from meta-analyses that should ensure the inclusion of all relevant studies, but the designs of these studies were not stated. The estimations of the clinical inputs were described in an online appendix. QALYs were an appropriate benefit
measure for these patients and they allow comparisons to be made with other economic evaluations. The utility weights were representative of the US population, but the instruments used to elicit them were not reported.

Costs:
A broad perspective was adopted. Most of the costs were presented as category totals and were not broken down into individual items. Official reimbursement rates were used for the medical costs, but the sources for the non-health care costs were not reported. The sources that were reported were relevant to the setting. The price year was explicitly stated, allowing reflection exercises. The cost estimates were varied in the sensitivity analyses. Few resource quantities were reported. The long-term costs were from a published study conducted in the USA, but the details were not given.

Analysis and results:
The results were extensively presented. An incremental approach was used to synthesise the costs and benefits of the strategies. Valid approaches were used to assess the uncertainty, and the methods and key results were presented. The authors stated that the patient population was old (average age 69 years) and their results might not be generalisable to younger patients. They also appear to be specific to the USA and their transferability to other settings was not discussed.

Concluding remarks:
The methods were robust and various areas of uncertainty were considered. The results strongly depended on some key model parameters, but the authors’ conclusions appear to be valid.

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