Cost-effectiveness of cardiovascular magnetic resonance in the diagnosis of coronary heart disease: an economic evaluation using data from the CE-MARC study  
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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
The objective was to assess the cost-effectiveness of eight diagnostic strategies to identify patients with significant coronary artery stenosis who required revascularisation. The authors concluded that cardiovascular magnetic resonance should be considered as part of a diagnostic strategy for identification of patients suitable for revascularisation. Study methods and reporting were good. The authors' conclusion appears to be appropriate.

Type of economic evaluation
Cost-utility analysis

Study objective
The objective was to assess the cost-effectiveness of eight diagnostic strategies to identify patients with significant coronary artery stenosis who required revascularisation. The population comprised patients referred to cardiologists with suspected angina.

Interventions
Eight diagnostic strategies were assessed. These comprised different combinations of four diagnostic tools: exercise treadmill testing (ETT), single-photon emission computed tomography (SPECT), cardiovascular magnetic resonance (CMR) and coronary angiography.

Location/setting
UK/secondary care.

Methods
Analytical approach:
A decision analytic model was developed to conduct the economic evaluation. For initial diagnosis a decision tree allocated patients to the appropriate diagnostic group; prognostic implications of being in one of these groups were then quantified using three distinct Markov models. The analysis used a lifetime horizon. The authors stated that the analysis was conducted from an NHS and Personal Social Services (PSS) perspective.

Effectiveness data:
The key effectiveness estimates were sensitivities and specificities of the diagnostic tools. Coronary angiography was assumed to have 100% sensitivity and specificity. All other diagnostic accuracy values were derived from the CE-MARC study. In the CE-MARC study all patients underwent ETT if physically able and were randomly scheduled for SPECT and CMR followed by coronary angiography irrespective of clinical intention. Other clinical inputs, such as mortality, severe stenosis and without stenosis but with angina were derived from the CE-MARC study, UK life tables, the EUROPA study, published literature and expert opinion.

Monetary benefit and utility valuations:
Utility estimates were based on the combination of several sources augmented by authors' assumptions to derive HRQoL weights by age, gender, baseline Canadian Cardiovascular Society classification and treatment status (whether the patient had received a revascularisation procedure or medical management). It was assumed that health-related quality of life (HRQoL) reductions for patients who experienced angina were a fixed proportion of the HRQoL of the general population by age.
Measure of benefit:  
The health benefit was measured in quality-adjusted life-years (QALYs). Future benefits were discounted at an annual rate of 3.5%.

Cost data:  
Direct costs to the NHS and PSS were included in the analysis. Cost categories included testing costs, revascularisation procedure costs, general treatment costs, fatal and non-fatal cardiovascular events and fatal non-cardiovascular events. Costs were derived from NHS Reference costs (2010-2011), a NICE document, Personal Social Services Research Unit costs and the EUROPA trial. For patients without significant stenosis or angina only the initial testing costs were included. Costs were expressed in 2010-2011 UK pounds sterling (£). Future costs were discounted at an annual rate of 3.5%.

Analysis of uncertainty:  
Probabilistic sensitivity analysis was conducted to assess the impact of joint parameter uncertainty on the model results. The probability that each strategy was cost-effective across a range of willingness to pay thresholds (for an additional QALY) was calculated. A range of alternative scenarios for age, gender, Canadian Cardiovascular Society grade, prior likelihood of disease, quality of life decrements and costs of the diagnostic tests were considered.

Results  
Extensive results were presented (summary presented here).

For the base case analysis (60-year-old male with grade 2 Canadian Cardiovascular Society score) four non-dominated strategies were identified. Assuming a cost-effectiveness threshold of £20,000, a strategy of ETT, followed by CMR where ETT was positive, followed by coronary angiography where CMR was positive or inconclusive appeared to be the optimal strategy. This had an incremental cost-effectiveness ratio (ICER) of £7,779 per QALY and a 55.34% probability of being the most cost-effective alternative when compared to the next best strategy.

At a threshold of £30,000 per QALY threshold the strategy of CMR followed by coronary angiography for CMR positive or inconclusive appeared to be the optimal strategy. This had an ICER of £26,858.45 per QALY and a 50.82% probability of being the most cost-effective alternative.

Sensitivity analysis showed that the results were most sensitive to prior likelihood of coronary heart disease requiring revascularisation and the rate at which false negative patients were eventually appropriately identified. For most of the scenarios either of the strategies outlined above remained the most cost-effective alternative for the £20,000 to £30,000 threshold range.

Authors’ conclusions  
The authors concluded that cardiovascular magnetic resonance should be considered as part of a diagnostic strategy for the identification of patients suitable for revascularisation.

CRD commentary  
Interventions:  
The diagnostic strategies were stated clearly. The authors highlighted that other diagnostic tools were available (such as CT coronary angiography) but not considered in the analysis. The authors did not state which strategy, if any, was meant to represent current practice.

Effectiveness/benefits:  
Effectiveness inputs and sources used to derive them were described clearly. The authors justified the choice to derive key effectiveness estimates from the CE-MARC study by stating that it was the largest prospective evaluation of the diagnostic accuracy of CMR compared to coronary angiography at that time. Only limited details of the CE-MARC study were reported so it was difficult to assess the reliability of estimates derived from the study without further reference to the clinical paper. The authors did not justify their selection of sources for other clinical inputs.

Details of the methods and sources used to derive utility values were described in an online supplement. There was no justification for their choice of sources to derive utility values. Future benefits were discounted appropriately.
Costs:
Costs were reported clearly. It appeared that all costs relevant to the perspective were included in the analysis. Appropriate sources specific to the UK were used to derive costs. The price year was reported clearly. Costs were adjusted appropriately.

Analysis and results:
The decision model was clearly described and diagrams were provided. Results of the various analyses were reported clearly. The methods used were well described and appropriate and a full incremental analysis was adopted; this represented the most appropriate methodology for assessing the cost-effectiveness of alternative strategies.

Appropriate sensitivity analyses assessed the impact of parameter uncertainty on the results. Distributions and methods used to derive probability distributions for parameter inputs were appropriate and reported clearly.

Concluding remarks:
Overall the study methodology and reporting was good. The authors' conclusion appears to be appropriate.

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