Should there be systematic screening of coronary heart disease in asymptomatic patients with risk factors alone? A decision analysis approach

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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 screening of coronary heart disease (CHD) in asymptomatic patients with risk factors.

Type of intervention
Screening and primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The study population was assumed to be a hypothetical cohort of 10,000 asymptomatic males, with a mean age of 55 years (range: 50 - 59).

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

Dates to which data relate
The effectiveness and resource use data were collected from studies published between 1971 and 1998. The cost data were taken from studies published between 1987 and 1997. The price year was not reported.

Source of effectiveness data
The effectiveness data were derived from a review of the literature.

Modelling
A 5-year decision analytic model was used to estimate the number of lives saved with each strategy, and the costs.

Outcomes assessed in the review
The outcomes assessed were:

the probability of CHD;

the sensitivity and specificity of the screening tests;

the 5-year fatal risk of untreated CHD;
the 5-year probability of nonfatal myocardial infarction (MI);

the effectiveness of primary prevention;

the fatal risk of coronary arteriography;

the fatal risk of the intervention; and

the utilities.

**Study designs and other criteria for inclusion in the review**
The authors noted that there were few, if any, prospective longitudinal studies which examined asymptomatic patients with CHD who had undergone an extensive screening procedure leading to a complete work-up and treatment.

**Sources searched to identify primary studies**
Not stated.

**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**
Forty-nine primary studies were included in the review.

**Methods of combining primary studies**
The results of individual primary studies were combined using a narrative method.

**Investigation of differences between primary studies**
Not stated.

**Results of the review**
The probability of CHD ranged from 0 to 50%.

The sensitivity of the exercise test was 60% (range: 30 - 100) and the specificity was 80% (range: 60 - 100).

The sensitivity of the thallium myocardial perfusion imaging test was 90% (range: 40 - 100) and the specificity was 80% (range: 60 - 100).

The sensitivity of coronary arteriography was 99% (range: 90 - 100) and the specificity was 99% (range: 90 - 100).

The 5-year fatal risk of untreated CHD was 20% (range: 10 - 50).

The effectiveness of primary prevention was 33% (range: 10 - 70).

The fatal risk of coronary arteriography was 0.5 pro mille (range: 0 - 2).
The fatal risk of the intervention was 0.5% (range: 0 - 2) when the patient had CHD, 0.25% (range: 0 - 2) when the patient did not.

The 5-year fatal risk of CHD after a positive coronary arteriography and an intervention was 4% (range: 0 - 8).

The 5-year fatal risk of CHD after a negative coronary arteriography and no intervention was 1% (range: 0 - 2).

The 5-year probability of nonfatal MI after an intervention on a patient who had CHD was 15%.

The 5-year probability of nonfatal MI after medical treatment on a patient who had CHD was 18%.

**Methods used to derive estimates of effectiveness**
The authors applied their own judgement to the literature evidence to derive the estimates of effectiveness.

**Estimates of effectiveness and key assumptions**
See the 'Results' section. It was assumed that a new MI would occur after the intervention, 2.5 years after the start of the follow-up, and this would require treatment for 2.5 years.

**Measure of benefits used in the economic analysis**
The benefit measure used was the number of lives saved. In fact, the authors stated that they calculated utilities. The morbidity was not taken into account when calculating the utilities.

The utility values were equal to the rate of survival. Given that the utility associated with no death was 1, the rate of every fatal event was subtracted from this value. Therefore, the number of survivors from the hypothetical cohort of 10,000 was 10,000 multiplied by the utility. This means that the (incremental) number of lives saved was 10,000 multiplied by the difference between the utility of the intervention and the utility of the comparator. Another way of calculating this was in terms of deaths: the number of lives saved equals the difference between the number of deaths occurring when using the comparator and the intervention.

**Direct costs**
The direct costs were not discounted even though the timeframe of the study was greater than one year. The quantities and unit costs were reported separately per test, and for treatment or prevention over a 5-year period. The direct costs were costs incurred by the hospital. These included the costs of the screening tests, the intervention (coronary artery bypass grafting (CABG) or percutaneous coronary angioplasty (PTCA)), medical treatment for MI or CHD, and primary prevention. The quantity/cost boundary adopted was that of the hospital. The cost estimates were taken from published studies that dealt with the cost of various types of hospital and ambulatory care for CHD. The price year was not reported.

**Statistical analysis of costs**
No statistical analysis of costs was reported.

**Indirect Costs**
The indirect costs were not included.

**Currency**
US dollars ($).
Sensitivity analysis
One-way and multi-way sensitivity analyses were conducted on the effectiveness parameters.

Estimated benefits used in the economic analysis
At a 1% probability of CHD (the maximum considered), the expected utilities were 0.9999 for screening, 1.0 for primary prevention, and 1.0 for no primary prevention.

At a 50% probability of CHD, the expected utilities were 0.9743 for screening, 0.9330 for primary prevention, and 0.9000 for no primary prevention.

The utility values associated with the three strategies were sensitive to changes in the sensitivity of the exercise test and of the thallium myocardial perfusion imaging test. They were also sensitive to the effectiveness of primary prevention and the fatal risk of CHD.

At a probability of CHD of 10%, the number of deaths occurring over a 5-year period was 52 with screening, 133 with primary prevention, and 200 without primary prevention.

The number of MIs occurring during the 5-year follow-up was 105 for the strategy of screening with the intervention (CABG or PTCA) only, or 141 for the strategy of screening with the combined medical and intervention treatments. The values for with and without primary prevention were 463 and 807, respectively.

Cost results
The cost of primary prevention with statins over 5 years ranged from $1,000 to $4,000. The total cost of the screening strategy (in millions of dollars) was 74.62 with the intervention (CABG or PTCA), or 50.36 with the combined intervention and medical treatments. The total costs (in millions of dollars) ranged from 25.45 to 55.45 with primary prevention, and were 25.26 without primary prevention. The origins of the figures for including treatment, and the origin of the range for prevention, were unclear.

Synthesis of costs and benefits
Compared with no intervention, the incremental cost-effectiveness (in millions of dollars per life saved) of the screening strategy was 0.334 with the intervention (CABG or PTCA) only, and 0.170 with the combined intervention and medical treatments. The incremental cost-effectiveness for primary prevention with statins ranged from 0.003 to 0.45. Primary prevention would become the most cost-effective strategy if there was a marked increase in the effectiveness of primary prevention, and there was a sharp decrease in the sensitivity of the exercise and thallium tests. An increased death rate from CHD and a higher CHD probability favours screening.

Authors' conclusions
"Screening of patients at risk of coronary heart disease (CHD) favourably modifies the prognosis and is more cost-effective than the currently popular prescription of statins."

CRD COMMENTARY - Selection of comparators
A justification was given for the comparators used, primary prevention and no intervention. You should decide if these health technologies are relevant to your own setting. As the authors acknowledged, the data in the studies used did not fit the stated technologies. For example, primary prevention could take many forms, but data relating to statins were used.

Validity of estimate of measure of effectiveness
The authors did not state that a systematic review of the literature had been undertaken. More information about the design of the review could have been reported, such as the sources searched and the methods used to select and assess...
the studies, and extract the data. Some of the effectiveness estimates were obtained from studies of patients with MI or with a medical history suggestive of CHD. As the authors acknowledged, these were conditions markedly different from that of asymptomatic patients. However, the authors made adjustments for this when calculating effectiveness estimates, although this required some judgement. The authors did not incorporate morbidity in their utility values, but they used the resource implications of morbidity (i.e. MI), which could produce a bias.

**Validity of estimate of measure of benefit**

The benefits were estimated directly from the effectiveness analysis. The use of the term utility was misleading, since it implies the measure of effectiveness was evaluated in comparison with other measures. In fact, only the rate of survival was used.

**Validity of estimate of costs**

A good feature of the cost analysis was that all the relevant direct cost categories seem to have been included. The quantities and unit costs were reported separately for testing only, which reduced the generalisability of the results. The price year was not reported, which would make relflation exercises in other settings difficult. No statistical analyses were conducted on the costs or quantities. In addition, few sensitivity analyses were conducted. The authors did not report on how the cost estimates were pooled from the individual studies.

**Other issues**

The authors made appropriate comparisons of their findings with those from other studies, and addressed the issue of generalisability to other settings. The authors do not appear to have presented their results selectively. The study considered men at risk of CHD and this was reflected in the authors’ conclusions. Whereas the benefit measure only incorporated mortality, the cost estimates reflected both the incidence of mortality and morbidity. The benefits and direct costs were not discounted even though the study horizon exceeded one year.

The authors calculated the cost-effectiveness of each strategy compared with no intervention. However, they did not calculate the cost-effectiveness of screening compared with primary prevention. In fact it was impossible, given that a range was reported, to know which values for the cost of primary prevention should be used. The effect of this range was not shown in terms of the cost-effectiveness. The upper limit was used to make a comparison with screening, the lower limit being considerably lower. The lack of a comparison between screening and primary prevention will also have biased the cost-effectiveness of screening shown.

**Implications of the study**

The authors argued that screening patients at risk of CHD favourably modified the prognosis and was more cost-effective than the favoured prescription of statins. The authors stated that prospective studies are needed to examine whether the capacity to detect a one-, two-, or three-vessel disease is associated with a decrease in the death rate. However, the validity of the conclusions was seriously affected by flaws in the accuracy of the cost-effectiveness.

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