Computer-aided detection of breast cancer: a cost-effectiveness 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.

Health technology
The study examined computer-aided detection (CAD) of breast cancer as an add-on to a screening mammography programme. The three strategies compared were mammography, mammography plus CAD, and clinical observation.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
The study used three hypothetical groups of women aged between 40 and 79 years. The first group comprised women undergoing annual mammographic screening for breast cancer with CAD. The second group comprised women undergoing annual mammographic screening without CAD. The third group comprised women undergoing observation without screening.

Setting
The setting was unclear but it was likely to have been primary care. The economic study was conducted in the USA.

Dates to which data relate
The principal parameters in the model were obtained from studies published between 1982 and 2001. The costs were derived from papers published between 2002 and 2003. The costs were expressed in 2003 US dollars.

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

Modelling
A Markov model was developed for the groups undergoing mammography with and without CAD, and the group undergoing observation without screening. A commercial software product (Data 3.5 for Healthcare; TreeAge Software) was used to generate the model and to tabulate the costs and benefits accrued by each group. Each hypothetical group was followed from age 40 to 79 years. Mammography was assumed to take place annually in the screening groups. Each cycle was 1 year. However, not all transition probabilities have been reported. To validate the probability values used, cancer incidence was calculated using a Monte Carlo simulation of 32,000 women entering the three groups and cycling through the tree for 39 cycles.

Outcomes assessed in the review
The following outcomes were assessed:

patient survival based on stage at diagnosis,

the cancer detection rate in the three groups,

the interval cancer rate, and

deads (from breast cancer and other causes at different ages).

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

Sources searched to identify primary studies
Not reported.

Criteria used to ensure the validity of primary studies
Not reported.

Methods used to judge relevance and validity, and for extracting data
Not reported.

Number of primary studies included
Approximately 6 studies were included in the review.

Methods of combining primary studies
The primary studies were not combined.

Investigation of differences between primary studies
Differences between the primary studies were not reported and it was unclear if any were investigated.

Results of the review
The cancer detection rate was 3.2 per 1,000 women without CAD and 3.8 per 1,000 women with CAD.

The probability of a palpable mass was 0.01576.

The percentage of women detected with Stage 0 breast cancer was 29.3% with mammography alone, 34.7% with CAD and 11% with clinical detection.

The corresponding figures for Stage 4 were 2.4% with mammography alone, 2.0% with CAD and 7% with clinical detection.

Survival was 100% with Stage 0 cancer and 16% with Stage 4 cancer.

The recall for abnormal screening was 0.065 without CAD and 0.077 with CAD.

The positive predictive value of biopsy was 0.38.
Measure of benefits used in the economic analysis
The measure of benefit used in an incremental cost-effectiveness analysis was the additional life-years gained.

Direct costs
The costs were examined from the perspective of the third-party payer. The costs of procedures and imaging were based on average Medicare reimbursement in 2003. The cost of treatment was based on data from studies in the literature. The marginal cost was calculated as the difference between comparison groups. Discounting was carried out, which was appropriate as the costs were incurred during more than 2 years. Although the resource quantities were not reported separately, the unit costs were reported. The estimation of quantities was derived using modelling. The results were expressed in 2003 US dollars.

Statistical analysis of costs
The costs were treated deterministically.

Indirect Costs
The authors reported that a societal perspective was adopted for this analysis and all costs were counted, regardless of who incurred them. However, the indirect costs (productivity losses) included were not specified.

Currency
US dollars ($).

Sensitivity analysis
One-way sensitivity analyses were performed in order to examine cost-effectiveness after altering various parameters used for the reference case calculations. The breast cancer detection rates for mammography with and without CAD and the interval cancer rate were varied in the sensitivity analysis. The ranges selected for the sensitivity analysis were based on authors' assumptions. A sensitivity analysis with different stage distribution of breast cancers, as diagnosed by the various methods, was also conducted on the basis of distributions suggested by an expert. The costs were also subjected to sensitivity analysis. The cost of CAD was varied on the basis of authors' assumptions, while the costs of treating cancer at different stages were varied based on the literature.

Estimated benefits used in the economic analysis
The marginal effectiveness of mammography alone versus observation was 0.0823 life-years, while that of mammography with CAD versus mammography alone was 0.0285 life-years.

Cost results
The total cost for each strategy was not reported.

The marginal cost of mammography versus observation was $1,318.43, while that of mammography with CAD versus mammography alone was $448.45.

Synthesis of costs and benefits
The marginal cost per life-year saved (MCYLS) for screening mammography alone was $16,023. The addition of CAD to the mammography programme resulted in an MCYLS of $19,058.

Adding CAD to a mammography screening programme increased the marginal effectiveness of screening by 29% and the marginal cost of the programme by 34%.
Sensitivity testing showed that the MCYLS for adding CAD to a screening programme increased exponentially as the cancer detection rates decreased.

The MCYLS increased linearly with the cost of CAD.

The cost-effectiveness of CAD is dependent on the magnitude of the increase in detection rate with CAD. However, it is also affected by the stage distribution of those cancers diagnosed with CAD.

**Authors' conclusions**
The marginal cost per life-year saved (MCYLS) for the addition of computer-aided detection (CAD) to screening mammography was $19,058; this is within the range that is generally considered cost-effective. CAD not only adds to the cost of breast cancer screening but it also increases its effectiveness.

**CRD COMMENTARY - Selection of comparators**
The rationale for the choice of the comparators was clear. They represented standard practice in the authors' setting. You should decide if they represent valid comparators in your own setting.

**Validity of estimate of measure of effectiveness**
The model input parameters appear to have been obtained through an ad hoc review of the literature. No systematic review was undertaken. Although this is common practice with models, it does not always ensure that the best data available are used. Since there were no details of the studies from which the parameters were obtained, the quality of the studies could not be ascertained. The authors used a Monte Carlo simulation in an attempt to validate the parameters used, the results being compared with published incidence figures for the three groups. The results were found to be comparable.

**Validity of estimate of measure of benefit**
The measure of benefit used in the analysis was the life-years saved. This enables comparisons with other interventions. The authors highlighted the fact that not using quality-adjusted life-years as the benefit measure might have been a limitation of their study, but they presented a valid justification for their reasons for selecting life-years saved.

**Validity of estimate of costs**
Although the authors stated that a societal perspective had been adopted, it was not clear in the reporting whether productivity costs were taken into account. Discounting was carried out appropriately. Charges were reported as a proxy of costs, which may limit the generalisability of the results. In addition, given the perspective adopted (societal), some adjustment using a cost-to-charge ratio may have been applicable. A more comprehensive breakdown of the costs included would have enhanced the transparency of the analysis.

**Other issues**
The issue of generalisability to other settings was not explicitly addressed. The authors made appropriate comparisons of their findings with those of others and outlined many of the limitations of their analysis. The results do not appear to have been selectively reported and the conclusions were within the scope of the analysis.

**Implications of the study**
The authors made no recommendations for further primary or secondary research.

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