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 study evaluated the cost-effectiveness of the National Health Service (NHS) breast screening programme. The authors concluded that there was a moderate probability of breast screening being cost-effective at a willingness-to-pay of £20,000 per QALY. The analysis was reported clearly and additional information was presented in appendices. The analysis was comprehensive but the lack of relevant data makes the results uncertain.

Type of economic evaluation
Cost-effectiveness analysis, cost-utility analysis

Study objective
The study evaluated the cost-effectiveness of the NHS breast screening programme.

Interventions
Two interventions were compared: breast screening for women at the age of 50 and every three years until age 70 with a 75% uptake and no screening.

Location/setting
UK/Public Health

Methods
Analytical approach:
A life table approach was used to model two cohorts of healthy 50 year-old women for 35 years. Each cohort comprised 364,500 women, which was the population of 50 year-old women in England and Wales in 2009 who were eligible for screening. The perspective was not stated explicitly but appeared to be UK NHS perspective.

Effectiveness data:
The primary effectiveness data were relative risks. Relative risks parameters in the model included: relative risk of mortality associated with regular screening; relative risk of death from non-breast cancer causes after breast cancer diagnosis; and relative over-diagnosis of breast cancer related to screening. These were derived from published literature and an independent review of the benefits and harms of breast cancer screening (see Other Publications of Related Interest). Baseline age-specific breast cancer incidence was generated via logistic regression.

Three assumptions were made: incidence of breast cancer in screened women was higher; diagnosis occurred five years earlier between age 50 and 69; and after cessation of screening there was a 10% reduction in incidence.

Monetary benefit and utility valuations:
Utility scores were generated by taking general population utility at age 50 and adjusting for aging and disutility due to breast cancer diagnosis.

Measure of benefit:
The primary measure of benefit was quality-adjusted life years (QALYs). Other outcomes evaluated breast cancer deaths, person years of survival and person years of survival after breast cancer diagnosis. Future survival related benefits were discounted 3.5% annually.

Cost data:
The estimated cost of the screening programme was derived from a published estimate from the NHS screening programme. The overall cost figure reported was divided by 20 to represent years of screening. Costs for treating primary and metastatic breast cancer were derived from NHS reference costs. Costs were calculated for treating clinically detected cancer and cancer detected through screening, with an assumption that the treatment of clinically detected cancers was more expensive. Costs for treating over-diagnosed patients in the screened cohort were included.

Analysis of uncertainty:
The authors conducted scenario and probabilistic sensitivity analyses. The scenarios varied in how many years earlier breast cancer was diagnosed and whether the reduction of incidence after screening was 10% or 20%. Each scenario, including the base case (five-year advance screening, 10% reduction in incidence) were subjected to 5,000 probabilistic simulations where variables were subjected to costs using mostly custom distributions to define parameter uncertainty.

Results
The base case scenario produced 2,040 additional QALYs for the screening programme, compared to no screening, at an additional cost of £42.5 million. The incremental cost-effectiveness ratio (ICER) was approximately £20,800 per QALY.

Varying the assumptions that diagnosis occurred five years earlier between age 50 and 69 (to three years) and that after screening cessation there was a 10% reduction in incidence (to 20%) resulted in ICERS between £15,590 and £27,650. Results showed that the earlier the diagnosis of breast cancer the greater the ICER and increasing the reduction in breast cancer incidence after breast screening stopped resulted in lower ICERS.

Sensitivity analysis indicated that results were highly influenced by the reduction in deaths for breast cancer and over-diagnosis, both parameters that the author's indicated had very little good quality evidence surrounding their estimates. At a willingness-to-pay for a QALY of £20,000 there was a 47% probability of cost-effectiveness for breast cancer screening.

Authors' conclusions
The authors concluded that there was only a moderate probability of a breast screening being cost-effective at a willingness-to-pay of £20,000 per QALY.

CRD commentary
Interventions:
The intervention was the breast cancer screening programme. As the authors indicated in their discussion of other studies, there was some variance in the techniques of breast cancer screening. Other screening interventions could include dual view mammography, digital mammography, breast ultrasound and genetic testing for breast cancer risk. As the authors indicated, risk based screening was not considered by the study and may be another intervention.

Effectiveness/benefits:
The authors acknowledged a lack of relevant data available to inform the decision problem. Input parameters were all uncertain due to the lack of data. However, the authors used appropriate methods to try and characterise the uncertainty and did not appear to oversell the results obtained. The model assumed that early stage diagnoses resulted in the same utility as late stage diagnoses and this may have warranted further analyses. There may have been differences between early diagnosis and later diagnosis with relation to disease progression and relapse outcomes and these may link to utility outcomes.

Costs:
The authors cited a screening programme annual cost of £96 million and divided this by 20 to produce the annual cost for the age 50 cohort that began the model. This was a crude adjustment and may underestimate costs for the younger cohort, which was likely to make up a larger proportion of the cohort due to age-related mortality. It was unclear whether costs of the screening programme included costs of breast cancer treatment. The relative cost of treating clinically detected cancer versus cancer diagnosed through screening was based on an assumption. An additional cost of £20,000 was assumed for patients who died of breast cancer; it was unclear how this estimate was derived.

Analysis and results:
The results of the analyses were well reported. Distributions used in probabilistic sensitivity analysis were graphically displayed and this enabled good appraisal of the effect of the authors' assumptions. The use of probabilistic methods will help to characterise some of the uncertainty but this relies on distributions being appropriately informed. The lack of relevant data made it unclear that all distributions were appropriately informed hence it was unclear that sufficient uncertainty was captured in the model.

Concluding remarks:
The analysis was clearly reported and additional information was presented in appendices. The analysis was comprehensive but the lack of relevant data makes the results uncertain.

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