Personalizing mammography by breast density and other risk factors for breast cancer: analysis of health benefits and cost-effectiveness

Schousboe JT, Kerlikowske K, Loh A, Cummings SR

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 breast cancer screening, using mammography, at different intervals taking account of risk factors, such as age, breast density, history of breast biopsy, and family history of breast cancer. The authors concluded that the frequency of mammography screening should be personalised to a woman's age, breast density, history of breast biopsy, and family history of breast cancer. The analysis was conventional and the uncertainty was considered. The authors' conclusions appear to be robust.

Type of economic evaluation

Cost-utility analysis

Study objective

This study assessed the cost-effectiveness of breast cancer screening, using mammography, at different intervals taking account of risk factors, such as age, breast density, history of breast biopsy, and family history of breast cancer.

Interventions

The intervention was mammography performed every three to four years, every two years, or annually in women with different profiles of breast cancer risk. This was compared with no mammography.

Location/setting

USA/primary and secondary care.

Methods

Analytical approach:

The analysis was based on a Markov micro-simulation model, with a lifetime horizon. The authors stated that the analysis was carried out from the perspective of the national health payer.

Effectiveness data:

The clinical inputs were from a selection of relevant published sources. The Surveillance, Epidemiology, and End Results (SEER) database from 1975 to 2005 was used to estimate the incidence of invasive breast cancer. The Breast Cancer Surveillance Consortium from 1996 through 2006 was used for the proportion of false-positive mammography results, which was a key input for the model. Other data were generally from databases, or published studies conducted in the USA.

Monetary benefit and utility valuations:

The utility values for the different stages of breast cancer were from a sample of 361 Swedish women who had breast cancer and who completed the European Quality of life (EQ-5D) questionnaire.

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 costs of film mammography, breast cancer care (by stage and severity), and false-

positive mammography results. The costs of mammography were median Medicare reimbursements and those for breast cancer were from published studies and Medicare reimbursements. False-positive mammography results were assumed to generate additional procedures and these costs were from a published study. All costs were in US dollars ($) and the price year was 2008. A 3% annual discount rate was applied.

Analysis of uncertainty:
One-way sensitivity analyses were carried out on the key inputs. The ranges of values were from published sources or authors' opinions. A probabilistic sensitivity analysis was performed, by assigning probability distributions to all the model inputs, except for the cost of mammography, which was fixed at its base-case value.

Results
At a cost-effectiveness threshold of $100,000 per QALY gained, biennial mammography was cost-effective for women aged 40 to 49 years whose breast density was Breast Imaging Reporting and Data System (BI-RADS) category three or four, or who had previously undergone a breast biopsy and had a family history of breast cancer.

It was cost-effective for women aged 50 to 59 years who had category two, three, or four breast density, or who had category one breast density, had undergone a previous breast biopsy, and had a family history of breast cancer. For all other women in this age range, with category one breast density, mammography every three to four years was cost-effective.

Biennial mammography was cost-effective for all women aged 60 to 69 years, except those with category one breast density and no additional risk factors, for whom mammography every three to four years was cost-effective.

Biennial mammography was cost-effective for women aged 70 to 79 years, with category three or four breast density, and those with either a previous breast biopsy or a family history of breast cancer. For those with category one or two breast density and no additional risk factors, mammography every three to four years was cost-effective.

The cost per QALY with annual compared with biennial screening was greater than $340,000 for all ages and categories of breast density. Annual mammography was never cost-effective.

At a threshold of $50,000 per QALY, biennial mammography was cost-effective for women aged 40 to 49 years, with category three or four breast density and either a previous breast biopsy or a family history of breast cancer.

These results were sensitive to variations in the disutility for a false-positive mammography result and the accuracy of screening. The likelihood of mammography every three or four years being cost-effective was generally low, and biennial mammography had the highest chance of being cost-effective for most patients.

Authors' conclusions
The authors concluded that the frequency of mammography screening should be personalised to a woman's age, breast density, history of breast biopsy, and family history of breast cancer.

CRD commentary
Interventions:
The selection of the comparators was appropriate as the best frequency for mammography was controversial. Annual or biennial mammography was recommended in the authors' setting.

Effectiveness/benefits:
No systematic review was reported to identify the relevant sources of evidence, but nationally representative databases were used for most inputs. These databases include many people, but they were not specifically designed for the study objective. Little information was provided on the other sources of data, but they appear to have been US studies. Extensive sensitivity analysis was conducted on all the model parameters. QALYs were an appropriate benefit measure, as they capture the impact of cancer on survival and quality of life. The utility weights were obtained using a valid and established instrument, from patients with breast cancer. It was unclear whether data from Swedish patients were applicable to US patients.

Costs:

The categories of costs, items included, and their sources reflected the perspective of the third-party payer. In general, the data were presented as category totals, and resource use and unit costs were not separated. Breast cancer care costs were from a review of the literature that selected two studies that reported their results by breast cancer stage. Other data were from common US sources. The costs were treated stochastically in the probabilistic sensitivity analysis.

Analysis and results:

The results were selectively presented, as only the incremental cost-utility ratios were reported. The incremental approach was appropriate for identifying the best frequency of screening. Valid approaches were used to investigate the uncertainty and the results of these analyses were extensively reported in an appendix. A description of the key pathways of the model was provided and its results were validated against real-world data on the incidence of breast cancer. The authors stated that their results did not apply to women who had the breast cancer gene (BRCA) 1 or BRCA2 mutations, for whom more frequent mammography and magnetic resonance imaging might be indicated. The transferability of the results was not discussed and they appear to be specific to the USA.

Concluding remarks:

The cost-effectiveness framework was conventional and various areas of uncertainty were considered. The authors' conclusions appear to be robust.

Funding

Funding received from Eli Lilly, the Da Costa Family Foundation for Research in Breast Cancer Prevention of the California Pacific Medical Center, and the Breast Cancer Surveillance Consortium.

Bibliographic details

Schousboe JT, Kerlikowske K, Loh A, Cummings SR. Personalizing mammography by breast density and other risk factors for breast cancer: analysis of health benefits and cost-effectiveness. Annals of Internal Medicine 2011; 155(1): 10-20

PubMedID

21727289

DOI

10.7326/0003-4819-155-1-201107050-00003

Original Paper URL

http://www.annals.org/content/155/1/10.abstract

Indexing Status

Subject indexing assigned by NLM

MeSH

Adult; Aged; Biopsy; Breast /anatomy & histology /pathology; Breast Neoplasms /epidemiology /genetics /prevention & control /radiography; Cost-Benefit Analysis; Early Detection of Cancer /adverse effects /economics /methods; False Positive Reactions; Female; Genetic Predisposition to Disease; Humans; Incidence; Mammography /adverse effects /economics /methods; Markov Chains; Mass Screening /adverse effects /economics /methods; Middle Aged; Quality of Life; Quality-Adjusted Life Years; Risk Factors; Sensitivity and Specificity; Time Factors

AccessionNumber

22011001224

Date bibliographic record published

16/11/2011

Date abstract record published

20/02/2012