

The Cost-effectiveness of Mammographic Screening Strategies

Karen K. Lindfors, MD, C. John Rosenquist, MD

Objective.—To compare and analyze the cost-effectiveness of different mammographic screening strategies.

Design.—A computer simulation model was developed to compare mammographic screening with observation without screening. Cost-effectiveness was expressed as marginal cost per year of life saved (MCYLS) and was calculated for the following mammographic screening strategies: (1) annual for ages 40 to 79 years; (2) annual for ages 50 to 79 years; (3) biennial for ages 50 to 79 years; (4) annual for ages 40 to 49 years with biennial for ages 50 to 79 years; (5) annual for ages 40 to 64 years with biennial for ages 65 to 79 years; (6) biennial for ages 40 to 49 years with annual for ages 50 to 79 years; and (7) annual for high-risk and biennial for normal-risk women aged 40 to 49 years with annual for ages 50 to 79 years.

Data Sources.—The probability and cost of all outcomes were established from previously published data or community experience.

Results.—The most cost-effective screening strategy is biennial mammography for women aged 50 to 79 years, with an MCYLS of \$16 000. Adding annual mammography for women aged 40 to 49 years increases the MCYLS to \$20 200, but is more cost-effective than other tested protocols that included women in their 40s; annual mammography for ages 40 to 49 years with biennial for ages 50 to 79 years is also more cost-effective than annual mammography for ages 50 to 79 years.

Conclusion.—Screening programs that include women in their 40s can be as cost-effective as some that exclude such women. Choice of a screening strategy depends on financial resources and desired effectiveness.

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MAMMOGRAPHIC screening is effective in reducing deaths from breast cancer, yet the optimal screening strategy remains unknown. There is controversy regarding the ages at which women should undergo mammography and the necessary frequency of such testing. The American Cancer Society and 10 other national organizations support mammographic screening every 1 to 2 years between the ages of 40 and 49 years with annual screening beginning at age 50 years.¹ The National Cancer Institute has rescinded its support for these guidelines. The American Academy of Family Practice recommends annual screening for women aged 50 to 75 years. The US Preventive Services Task Force recommends annual or biennial screening for ages 50 to 75 years.² Medicare reimburses for screening mammograms on a biennial basis for older women.

Studies have shown that the lead time gained with mammographic screening

in women aged 40 to 49 years is 12 to 24 months,^{3,4} while in women older than 50 years it is 3.5 to 4 years.³ These data have led some authorities to suggest that the most effective screening strategy is annual mammography for younger women with biennial screening for those aged 50 years and older.³⁻⁵

The variety of mammographic screening strategies advocated by different experts and organizations are mainly based on differing views of the efficacy of mammography in reducing mortality from breast cancer. In this time of increasing concern about the cost of health care, consideration must also be given to the cost-effectiveness of different mammographic screening strategies. In this study, a computer model was used to assess the cost-effectiveness of a variety of possible mammographic screening strategies. When combined with data on effectiveness, this information may be useful for establishing mammographic screening policies.

MATERIALS AND METHODS

Study Model

A Markov model was developed to compare two hypothetical populations of women—one undergoing mammographic

screening for breast cancer and the other undergoing observation without screening. A commercially available software product (Smltree, Version 2.9, James Hollenberg, Roslyn, NY) was used to generate the model and to tabulate all costs and benefits accrued in each group. All outcomes (states of health) for both screened and unscreened women during each year from the beginning age of screening to age 79 years were included. The basic model has been described in detail and validated elsewhere.⁶

In this model, women undergoing mammographic screening could have positive or negative results of mammography. Outcomes for those with positive studies included biopsy or short-interval (6 months) follow-up mammography. In the group undergoing biopsy, it was assumed that 50% had surgical biopsies, 50% had needle-core biopsies, and the accuracy of these two procedures was equal.⁷ Biopsies could be benign or malignant. If short-interval follow-up mammography showed the lesion to be unchanged, it was assumed that the woman would resume her annual screening schedule 6 months later. Women with diagnoses of malignancy were assumed to undergo definitive treatment. Outcomes (states of health) in these women included death from breast cancer, death from other causes, and presentation for annual screening mammography the next year. Women with negative mammograms could die of other causes, develop an interval palpable breast mass (which could be benign or malignant), or present for annual screening mammography the next year.

In the observed group, the outcomes included continued observation without mammographic screening, death from a cause other than breast cancer, and development of a palpable breast mass with subsequent testing and either a benign or malignant diagnosis. Those with breast cancer were then assumed to undergo annual screening mammography.

The probability and cost of each outcome were established from previously published data⁸⁻¹⁶ or community experience (Tables 1 through 3). We used data from the National Cancer Institute¹⁷ for the following age-specific incidences of breast cancer per 100 000 population: 40

From the Department of Radiology, University of California, Davis, School of Medicine, Sacramento.

Reprint requests to the Department of Radiology, University of California, Davis, School of Medicine, 2516 Stockton Blvd, Ticon II 216, Sacramento, CA 95817 (Dr Lindfors).