



Research-in-Brief

THE HEALTH BENEFITS AND COST-EFFECTIVENESS OF BREAST CANCER SCREENING

✓ Women between the ages of 50 and 69 who receive mammograms experience approximately a 30 percent reduction in mortality.

✓ The cost per year of life saved/gained from breast cancer screening is comparable to those of other regularly performed medical procedures.

✓ Screening programs can result in net savings of \$14.28 per mammogram when underscreened populations are targeted.

Breast cancer is the most common nonskin cancer in women (Fletcher et al., 1993).

- Approximately 175,000 women are diagnosed with breast cancer each year (U.S. Department of Health and Human Services, 1993).
- Breast cancer will kill approximately 46,000 American women in 1994 (Broder, 1994).
- Mammograms, clinical breast exams, and self exams can be used to detect breast cancer in its early stages; however, the cost and availability of mammograms are barriers to their utilization (Bird, 1991; Sickles et al., 1987).

Mammography: Underscreening and Overpricing

- In 1992, only 66 percent of American women over age 40 had ever had a mammogram. Only 51 percent of women over age 50 had received a mammogram within the last two years (National Center for Health Statistics, 1994).
- Disproportionate numbers of elderly women, poor women, and women with less than a high school education are underscreened, according to the 1987 National Health Interview Survey (U.S. Department of Health and Human Services, 1993).
- Women of color are less likely to be screened than white women: In 1987, 38 percent of white women over 40 had ever had a clinical breast examination and mammography, compared to only 28 percent of African-American women and 20 percent of Hispanic women (U.S. Department of Health and Human Services, 1993).

- Inefficient use of resources has unnecessarily driven up the price of mammograms, which adversely affects the cost-effectiveness of screening women. One study used data from the 1987 National Health Interview Survey to determine that although only 2,600 new machines were necessary in 1990, approximately 10,000 machines were added. The excess number of machines causes underutilization, pushing the price of some mammograms to exceed \$100 (Brown et al., 1990). One clinic in North Carolina conducted and interpreted mammograms for as little as \$29 (1991 dollars) and detected 91.5 percent of all tumors (Bird, 1991).

BENEFITS AND LIMITATIONS OF SCREENING FOR BREAST CANCER

FINDINGS BY AGE:

Women 50-69

Screening women between the ages of 50 and 69 reduces mortality:

- Women between the ages of 50 and 69 who receive mammograms experience approximately a 30 percent reduction in mortality, according to a meta-analysis of seven randomized studies after at least seven years of follow-up. The reductions in mortality range from approximately 20 percent in the Edinburgh study to 43 percent in the Stockholm trial (Fletcher et al., 1993).

Women under 50

Studies disagree on whether screening women ages 40 to 49 reduces mortality:

- Several randomized studies of women in their forties have not found any statistically significant difference in mortality between women in the study group and control group, five to seven years after entry into the study and uncertain benefits at 10 to 12 years. A meta-analysis of five randomized trials showed "no observable benefit to women under age 50 and a wide range of uncertainty" (Fletcher et al., 1993).

- In contrast to the Fletcher et al. review, a Swedish study in Göteborg found that after 10 years of follow-up, women in their forties who were screened at 18 month intervals with double-view mammography had about a 40 percent lower death rate from breast cancer compared to

INTERNATIONAL BREAST CANCER SCREENING GUIDELINES*

Country	Age (yr)	Frequency
USA:		
Amer. Cancer Soc.**	20-40	2-3 yr. CBE
	40-49	Annual CBE; 1-2 yr. MM
	50+	Annual CBE & MM
Nat'l Cancer Inst.	50+	Annual CBE & MM
Australia‡	40+	Biennial MM
Canada (no. of provinces)‡	50-69 (4)	Biennial CBE & MM
	40+ (1)	Annual CBE & MM
Finland†	50-63	Biennial MM
Iceland§	40-69	Biennial MM
The Netherlands	50-70	Biennial MM
Sweden	40-54	18 mo. MM
	55-74	Biennial MM
United Kingdom‡	50-64	3 yr. MM

* This table adapted from Shapiro, 1992.

** Includes baseline MM at 35-39 years of age.

† The upper end of this guideline may be extended.

‡ Guideline also recommends breast self-examination instruction.

§ Includes baseline MM at 35 years of age.

CBE = Clinical Breast Exam

MM = Mammography

women in the control group. The full report and the statistical significance of the findings have not been published (*USA Today*, May 11, 1994).

- The Health Insurance Plan (HIP) study, which began in 1963 and offered annual two-view mammograms and clinical breast exams to over 30,000 women in New York, showed a **25 percent decrease in mortality for women in their forties, after 10 to 18 years of follow-up**. The statistical significance of this finding has been disputed (Chu et al., 1988; Fletcher et al., 1993).

- A variety of factors may explain the general lack of statistically significant health benefits of performing mammograms on women in their forties (Fletcher et al., 1993):

- Mammograms may be less sensitive in women aged 40-49 than in older women, or the development of breast cancer may differ in younger women.

- Because of recent awareness of the need for mammograms, many women in the control groups may be receiving mammograms at approximately the same intervals as the study participants, contaminating the results of the studies. Women in the study groups are offered periodic mammograms through the study's screening program. Although women in the control group are not offered screening through the program, they are permitted to obtain mammograms on their own.

- The sample sizes used in studies may be insufficient to analyze women in the 40-49 age group.

Women over 65

Screening women between the ages of 65 and 74 may reduce mortality, but the precise benefit has not been determined for women 75 and over (Broder, 1994; Fletcher et al., 1993)

- Screening women between the ages of 65 and 74 reduced mortality by 66 percent according to a study of Dutch women who received at least two biennial mammograms. Women over the age of 74 did not experience statistically significant effects (Van Dijk et al., 1994).

FINDINGS BY TYPE OF SCREEN

Studies have found that screening with either single-view or two-view mammography, with or without clinical breast exams, reduces mortality:

- The Stockholm and two-county randomized controlled studies in Sweden found that **single-view mammograms alone, offered at screening intervals between 24 and 33 months, reduced women's mortality between 18 percent and 32 percent relative to control groups** (0.68 to 0.82 relative risks of death) (Fletcher et al., 1993; Tabar et al., 1987).

- The Göteborg and Malmö randomized-controlled studies in Sweden screened women with **two-view mammography alone at 18 and 12 month respectively and found a decrease in mortality ranging from 14 to 19 percent** (Fletcher et al., 1993; Andersson et al., 1988).

MAJOR STUDIES TESTING THE EFFICACY OF SCREENING FOR BREAST CANCER

Trial	Location	Year Began	Screening Interval (months)	Type of Screen	Age of Women	Total Women	No. of Screens	% Screened at First Exam	Duration of Follow-up (years)	Relative Risk 95% Confidence Interval
RANDOMIZED CONTROLLED STUDIES										
Edinburgh*	UK	1976	12 and 24	2-view MM and CBE (then 1-view)	45-64	45,130	NA	61	10	0.84 (0.63-1.12)
Göteborg*	Sweden	1982	18	2-view MM	40-59	49,533	NA	84	7	0.86 (0.54-1.37)
Göteborg**	Sweden	1982	18	2-view MM	40-49	24,000	NA	84	10	0.60 (NA)
HIP*	New York	1963	12	2-view MM and CBE	40-64	60,995	3	67	10	0.71 (0.50-1.16)
Malmö* (Andersson et al., 1988)	Sweden	1976	12	2-view MM	45-69	42,283	5	74	12	0.81 (0.62-1.07)
NBSS1*	Canada	1980	12	2-view MM and CBE	40-49	50,430	NA	100 volunteer***	7	1.36 (0.84-2.21)
NBSS2*	Canada	1980	12	2-view MM and CBE	50-59	39,405	NA	100 volunteer***	7	0.97 (0.62-1.52)
Stockholm*	Sweden	1981	28	1-view MM	40-64	59,107	NA	81	8	0.80 (0.53-1.22)
Two-county, Sweden: Kopparberg Östergötland (Tabar et al., 1987)	Sweden	1977	24 (for ages <50); 33	1-view MM	40-74	134,867	3-4; (2 for over 70 years)	89	12	0.68 (0.52-0.89) 0.82 (0.64-1.05)
NON-RANDOMIZED CONTROLLED STUDIES										
Florence (Palli, 1986)	Italy	1970	30	2-view MM	40-70	15,184	2	60	7	0.53 (0.29-0.95)
UK (Chamberlain, 1988)	UK	1979	12 CBE; 24 MM	MM and CBE	45-64	236,594	4	60-72	7	0.80 (0.64-1.01)
DOM (Collette, 1984)	Netherlands	1974	12, 18, then 24	MM and CBE	50-64	14,796	NA	72	8	0.30 (0.13-0.70)
NON-RANDOMIZED UNCONTROLLED STUDIES										
BCDDP (Eddy, 1989)	USA	1973	12	2-view MM and CBE	over 39	280,000	NA	100 volunteer***	5	0.42 to 0.50 compared to SEER data (Eddy, 1989)

Notes: * Fletcher et al., 1993.

** Unpublished, according to news reports (*USA Today*, May 11, 1994).

*** Study design included randomization of volunteers after clinical breast examination; accordingly, virtually 100% had their first screening examination.

Abbreviations: CBE = Clinical Breast Exam; MM = Mammography; NA = Not Available

- Women participating in randomized controlled trials in New York and Canada, in which women were screened annually with **two-view mammography and a clinical breast exam**, experienced **29 percent and three percent reductions in mortality**, respectively, compared to the control groups (0.71 and 0.97 relative risks of death) (Fletcher et al., 1993).

FINDINGS BY SCREENING FREQUENCY

Studies find that screening every 12 to 42 months reduces mortality:

- **The relative risk of death for women was reduced to between 0.71 and 0.97** according to two randomized controlled studies, which provided annual two-view mammograms with clinical breast exams in New York and Canada. The Breast Cancer Detection and Demonstration Project (BCDDP), a non-randomized study in the U.S., found approximately a 50 percent reduction in mortality.
- **Women screened at intervals between 18 and 42 months using either a single or two-view mammogram by itself or with a breast clinical exam had relative risks of death of 0.53 and 0.86 compared to the control groups** (Fletcher et al., 1986; Palli, 1986; Tabar et al., 1987).

POTENTIAL BENEFITS OF CONTINUOUS SCREENING

If women were screened continuously from age 40 on, the benefits would be even greater than those observed in the studies, which screened women only a few times.

- Annual clinical breast exams and mammograms for 10 years would reduce a woman's risk of mortality from breast cancer from between 90 to 125 per 10,000 to between 50 to 117 per 10,000, according to the computer model CAN*TROL, based on outcomes from the HIP and BCDDP studies (Eddy, 1989).
- If 25 percent of American women were screened annually from age 40 to 75 with both breast physical exams and mammography starting in 1989, by the year 2000 between 96,000 and 210,000 person-years of life would be saved, according to the computer model CAN*TROL, based on outcomes from the HIP and BCDDP studies (Eddy, 1989).

CLINICAL BREAST EXAMS

Clinical exams detect tumors not found by mammograms:

- **Nine percent of the cases of breast cancer identified in the BCDDP study were found by clinical breast exams** obtained during the annual screenings (Foster et al., 1992).
- **Combining mammography and physical examination was shown to increase screening sensitivity to 75 percent**, compared to 62 percent for mammography alone and 24 percent for physical examination alone (Winchester, 1992).

BREAST SELF-EXAMS

Breast self-exams may improve women's health outcomes:

- Self-exams can help detect the thirteen percent of cancers that surface between screenings (Champion, 1992).
- A study of women in the state of Vermont beginning in 1975 found that women who performed breast self exams had a cancer mortality rate half that of women who did not perform the exams (Foster et al., 1992).
- Although other trials also find that self-exams have beneficial health outcomes, a few studies question the health benefits of self-examinations. These studies, however, have a number of methodological problems such as the practice of grouping women who perform infrequent breast self exams with those who never perform them (Foster et al., 1992).
- Preliminary data from a study of 301 randomly selected women indicated that teaching or attitudinal intervention related to breast self exams did improve the women's proficiency in performing self exams and the frequency at which they performed them (Champion, 1992).

COST-EFFECTIVENESS AND COST-BENEFIT ANALYSIS OF BREAST CANCER SCREENING

Cost-effectiveness is determined by the ages of the women screened, the frequency of the screening interval, the costs of screening and treatment, the participation rate, the prevalence of breast cancer in the population, the sensitivity of the screen, and the length of follow-up when results are assessed. More frequent screening intervals usually detect more cancers and cost more money.

Compared to other health interventions, breast cancer screening is cost-effective:

- **The cost per life-year saved/gained in 1991 dollars ranges from \$3,400 to \$126,000, with a median cost of \$8,400**, according to a literature review of nine studies based on computer simulations, observational trial data, or both (Mushlin and Finton, 1992). The \$3,400 estimate was based on the Swedish two-county study, which screened women ages 40 to 49 with single-view mammography at 24 month intervals, and women ages 50 to 74 at 33 month intervals. The \$126,000 figure was obtained based on the 1963 New York HIP study, which provided annual double-view mammograms and physical exams to women between the ages of 40 and 64.
- **The cost of adding a year of life by screening women between the ages of 55 and 65 is between \$8,113 and \$15,536 using a clinical breast exam and between \$21,717 and \$83,830 using both clinical breast exams and mammography**, according to the computer model CAN*TROL, based on outcomes from the BCDDP and HIP studies (Eddy, 1989).
- **The cost of providing biennial screening for women 50-70 in the Netherlands is estimated to be \$4,850 per woman per year of life saved** (based on a computer analysis of breast cancer incidence, survival rates, and costs from the Nijmegen and Utrecht screening trials). This would result in a 12 percent decrease in mortality due to breast cancer (Van der Maas et al., 1989).

- One analysis of the HIP study found a net gain for the health care system of \$1,497,960 as a result of the screening program. The screening and treatment costs for screened patients were only 73 percent of the costs of treating unscreened patients who are later diagnosed with breast cancer (Moskowitz, 1987).

- The cost per case of breast cancer detected in the HIP study has been estimated at \$23,403, comparable to the cost per year of renal dialysis (\$23,000 to \$32,000) (Moskowitz, 1987).

When underscreened populations are targeted, early detection screening programs can result in net savings:

- An early detection program for low income women in Dade County, Florida, saved the county \$169,497: \$14.28 per mammogram performed or \$2,873 per cancer patient diagnosed, when the costs of an early detection screening and treatment program are compared to the costs of treating these patients without the screening program. This program saved one life per 1,000 mammograms (Zavertnick et al., 1992).

THE COST OF SCREENING FOR BREAST CANCER IS COMPARABLE TO THE COSTS OF OTHER COMMON MEDICAL INTERVENTIONS

Screening for breast cancer costs between \$3,400 and \$126,000 (1991 dollars) per year of life saved, depending on the type of screening, the frequency and the costs.

Comparatively:

- The cost of a coronary artery bypass graft for someone with angina is \$7,300 (1991 dollars) per year of life saved (Mushlin and Fintor, 1992).

- The cost of treating a forty year old man for high blood pressure is \$32,600 (1991 dollars) per year of life saved (Mushlin and Fintor, 1992).

- The cost of a liver transplant is \$225,000 (1991 dollars) per year of life saved (Mushlin and Fintor, 1992).

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IWPR has produced eight fact sheets and annotated bibliographies on the benefits and cost-effectiveness of women's preventive health services relating to breast cancer, cervical cancer, domestic violence, family planning, mental health, prenatal care, osteoporosis, and sexually transmitted diseases. Each fact sheet/bibliography pair is available from IWPR for \$5.00; the entire Kit, which includes all topics and comes in a three-ring binder, is available from IWPR for \$20.00. Members of IWPR receive discounts on this kit and all publications. Please contact IWPR for information on membership and bulk order discounts.

