

The Effect Of A Comprehensive Breast Screening Program On Self-Reported Mammography Use By Primary Care Physicians And Women In A Health Maintenance Organization

Barbara K. Rimer, DPH, Eric Ross, MS, Andrew Balsbem, and Paul F. Engstrom, MD

Background: Mammography use is increasing in the United States, but most women older than 50 years still are not being screened regularly. A multicomponent program, with components for women and physicians, was conducted to increase screening among women aged 50 to 74 years in an independent practice association (IPA)-model health maintenance organization (HMO).

Methods: The participating women and physicians were surveyed in four waves to evaluate the program. We report on changes in mammography practices by both women and physicians between 1988 (preintervention year) and 1992 (postintervention year). Bivariate and multivariate analyses were calculated.

Results: The proportion of responding HMO physicians who recommended annual mammograms for women aged 50 to 74 years increased by 16 percent from 1988 to 1992 compared with an increase of 10 percent for control group physicians (nonsignificant). There was a 30 percent increase from 1988 to 1992 in the proportion of HMO women respondents who reported having had a mammogram in the past year compared with a 19 percent increase among control group women. The difference between these differences was highly significant. The intervention had the strongest effect on women with incomes of less than \$30,000.

Conclusions: A multicomponent program in an IPA-model HMO resulted in significant increases in the proportion of HMO women who had mammograms. Similar approaches should be tested in other settings. (J Am Board Fam Pract 1993; 6:443-51.)

Although use of breast cancer screening has improved dramatically in the past 5 years, most women still are not being screened according to recommended guidelines. In 1992 an estimated 180,000 new cases of breast cancer were diagnosed among women in the United States, and approximately 46,000 women died from this disease.¹ Screening programs that include regular mammograms can reduce mortality from breast cancer by as much as 40 percent in women aged 50 years and older.²⁻⁵ The recommended frequency for screening women younger than 50 years and those 75 years old and older is under debate⁶; however, the need for regular screening

of women aged 50 to 74 years has been endorsed by 11 major US medical organizations.⁷

Results of the 1987 National Health Interview Survey (NHIS) showed that only 38 percent of women 40 years of age and older reported ever having had a mammogram, and only 17 percent older than 40 years of age said they had one in the year preceding the interview.⁸ In the 1990 NHIS, only 29 percent of women older than 50 years reported getting mammograms according to recommended guidelines.⁹ Although US rates of mammography appear to be increasing, most women still are not getting mammograms on one commonly recommended schedule — annually for women aged 50 years and older.¹⁰

Many studies have examined the reasons why physicians and patients fail to comply with cancer prevention and screening recommendations. The reasons for patient noncompliance include lack of physician-initiated discussions of mammography, lack of patient understanding regarding the need to have a screening mammogram, cost, patient fear of radiation or a painful examination, and

Submitted, revised, 13 April 1993.

From the Cancer Prevention, Detection and Control Research Program, Duke Comprehensive Cancer Center, Duke University Medical Center, Durham, North Carolina. Address reprint requests to Barbara K. Rimer, DPH, Cancer Prevention, Detection and Control Research Program, Duke Comprehensive Cancer Center, Duke University Medical Center, Box 2949, Durham, NC 27710.

inconvenience.¹¹⁻¹⁴ Reasons for physician non-compliance include concern about cost to the patient, the daily demands of acute and chronic care, failure to remember to recommend prevention and early detection, and concern about equivocal radiology reports.¹⁵⁻²⁰

A number of strategies have been reported to increase physicians' referrals for mammography, including audits with periodic feedback, detailing strategies, and computerized reminders.¹⁹⁻²³ Most of these strategies have not been used widely outside academic medical centers. More recently, Costanza, et al.²⁴ found that a hospital-based in-service program significantly improved mammography referrals in their intervention community, and Fletcher, et al.²⁵ reported the results of a community-based program that increased mammography use significantly in the experimental community.

We applied what was known about how to influence women's and physicians' behavior to design interventions for about 800 primary care physicians in an independent practice association (IPA)-model health maintenance organization (HMO) and for about 50,000 women aged 50 to 74 years.¹⁵ The purpose of this report is to discuss the impact of the physicians' interventions on their self-reported ordering of mammograms and to present parallel information about women. We compared study findings from 1988, the pre-intervention year, with study findings from 1992, the postintervention year, for the bivariate analyses; the multivariate analyses accounted for all survey years.

Methods

Study Interventions

Fox Chase Cancer Center in Philadelphia collaborated with US Healthcare, an IPA-model HMO, to reduce avoidable mortality from breast cancer by directing interventions at women aged 50 to 74 years enrolled in an IPA-model HMO, their primary physicians, and associated radiologists. The main objective was to increase annual mammograms for women aged 50 to 74 years.

Compliance-enhancing interventions were developed and implemented between 1989 and 1991. During each of the 3 intervention years, more than 50,000 women aged 50 to 74 years in the HMO were sent packets of health education materials and were offered free referrals.^{15,26} In-

terventions were stepped and implemented in a graduated intensity so that women who failed to respond to earlier interventions would receive the most intensive interventions. Radiology reports were sent directly to a central screening office, where they were entered into our data base. The data base included each woman and the date of her last packet mailing, mammogram report, and information about follow-up procedures. Women for whom mammogram reports were not received 45 days after the packet mailing were sent a brief reminder letter. By 95 days, if a report had not been received, the woman was randomized to receive either a telephone call from a telephone counselor, a second reminder letter, or a letter from her physician's office encouraging her to schedule a preventive care office visit in which breast cancer screening would be discussed. The counseling telephone call, which usually lasted less than 10 minutes, was designed to elicit and overcome the woman's personal barriers to obtaining a mammogram.

Equally important, interventions also were directed at primary care physicians and radiologists. Primary care physicians, mostly family physicians and internists, received several types of interventions that were designed to be acceptable, convenient, and accessible to the busy practice styles of primary care physicians. In 1990 a self-paced tutorial program developed for this study entitled "Concepts in Cancer" was distributed by office staff to more than 800 primary care physicians. Physicians who successfully completed the test received 5 continuing medical education (CME) units. From 1990 through 1992, 680 physicians passed the test. We also conducted office-based training in the Mammacare²⁷ method of clinical breast examination at 50 physicians' offices. This technique for performing clinical breast examinations has been shown to increase lump detection performance. Finally, following the work of McPhee and others,^{19,28} we provided a tailored feedback report to physicians about mammography utilization by women in their practices.

Evaluation Design

Evaluation of the program was conducted through microevaluations of the interventions, analyses of tumor registry data, and four surveys of women and physicians. We used bivariate analyses to compare results from the baseline

(preintervention) and final physicians' and women's surveys (postintervention), and we used multivariate analyses to compare results from all four surveys for the endpoint of having had a mammogram in the past year.

Study Samples

For each survey we selected a random sample of 150 primary care physicians from a list of all such physicians affiliated with the HMO. Using a list of primary care physicians purchased from Business Mailers, Inc., we generated a comparison group of 150 physicians randomly selected who practiced in the same geographic area. The overall response rate for the 1992 survey was 70 percent; the refusal rate was 15 percent. Response rate was calculated conservatively and included in the denominator those physicians who could not be contacted. Similarly, for each of the women's surveys, we selected a random sample of 450 women from the HMO and 450 women not enrolled in the HMO through random digit dialing. The overall 1992 response rate was 82 percent, and the refusal rate was about 10 percent. These rates were similar to those in the other 3 survey years.

Study Instruments

All physicians and women in the study samples were interviewed by professional telephone interviewers. The study instrument, a questionnaire, which was administered in about 10 minutes, was made up of core items used by the National Cancer Institute (NCI) Breast Screening Consortium (1990) (a group of six NCI grantees awarded similar grants)¹¹ in addition to other items designed to assess not only screening practices but also the impact of the interventions. These questions elicited information about the physicians' socio-demographic characteristics, breast self-examination (BSE), clinical breast examination (CBE) and mammography practices, and perceived barriers to screening. Most items were closed-ended, and answers fell into discrete categories using Likert scales ranging from not at all to a great deal. The women's questionnaire also included questions about perceived susceptibility to and knowledge about breast cancer.

Analyses

Bivariate relations were tested for independence using chi-square tests or a generalized Fisher

exact test. Logistic models examined the impact of the independent variables (after adjusting for confounders) on receipt of (or recommendation for) a mammogram in the past year for both women and physicians. For the critical outcome variables, we also calculated the difference of increases between the 1988 and 1992 mammography rates to determine whether the changes from pre-intervention to postintervention were significant.²⁹

Results

Physicians' Surveys

Characteristics of Physician Respondents

Table 1 summarizes the demographic and practice characteristics of respondents to the 1988 and 1992 survey questionnaires. Not surprisingly, a greater proportion of HMO physicians were in group practices. Most physicians were family physicians, and by 1992 most were board certified.

Mammography Practices

As Table 2 shows, in 1988, 70 percent of HMO physicians reported annual screening for women aged 50 to 74 years compared with 86 percent in 1992; in 1988, 64 percent of control physicians reported annual screening compared with 74 percent in 1992. Thus, from 1988 to 1992, there was a 16 percent increase in the proportion of HMO physicians who reported annual screening for women aged 50 to 74 years compared with a 10 percent increase among control group physicians. The difference between these increases was not significant.

Ordering Mammograms and Physician Characteristics

In 1992 we investigated whether physician characteristics, such as sex, number of years since graduation, specialty, board certification, and type of practice, were associated with ordering mammograms (Table 3). Only practice type and specialty were consistently related to physician screening practices for women aged 50 to 74 years. Physicians in individual private practice were significantly less likely to report ordering mammograms annually ($P = 0.001$). Board-certified physicians were more likely than nonboard-certified physicians to order mammograms annually for women aged 50 to 74 years ($P = 0.001$). Obstetricians-gynecologists were more likely to report ordering mammograms annually than family physicians or internists ($P = 0.01$).

Table 1. Demographic and Practice Characteristics of Health Maintenance Organization (HMO) Physicians and Control Physicians in 1988 and 1992 Surveys.

Characteristics	HMO		Control	
	1988 (n = 159) No. (%)	1992 (n = 155) No. (%)	1988 (n = 138) No. (%)	1992 (n = 152) No. (%)
Practice setting				
Individual private practice	64 (41)	70 (45)	99 (72)	98 (64)
Group practice or other	93 (59)	85 (55)	39 (28)	54 (35)
Primary medical specialty				
Family practice or general practice	112 (70)	85 (56)	75 (54)	57 (43)
Internist or other	47 (30)	67 (44)	57 (46)	75 (57)
Board certified				
Yes	112 (70)	120 (77)	71 (51)	86 (57)
No	47 (30)	35 (23)	67 (49)	66 (43)
Age (years)				
40 or younger	88 (56)	67 (44)	38 (28)	32 (21)
41-60	66 (42)	84 (54)	63 (46)	72 (47)
Older than 60	3 (2)	4 (3)	35 (26)	48 (32)
Sex				
Men	137 (87)	137 (88)	118 (89)	123 (81)
Women	20 (13)	18 (12)	15 (11)	29 (19)
Years since medical school graduation				
Less than 10 years	63 (39)	43 (28)	29 (21)	22 (15)
11-20 years	52 (33)	66 (43)	39 (28)	43 (28)
More than 20 years	44 (28)	45 (30)	71 (51)	87 (57)

Use of Reminder Systems

Although numerous studies testify to the benefit of reminder systems,^{19,21} only 58 percent of HMO physicians and 53 percent of the control group physicians said they used any kind of reminder system. The most common form of reminder system was a manual checklist, which was used by 43 percent of control physicians and 49 percent of HMO physicians; less than 10 percent used a computerized reminder system.

Multivariate Analyses

Logistic regression modeling was used to assess whether there were differences between the HMO and control group physicians in ordering of annual mammograms for women aged 50 to 74 years, utilizing survey data from 1988, 1989, 1990, and 1992. Group practice physicians were 1.7 times more likely than other physicians to order annual mammograms for women aged 50 to 74 years. In 1988 and 1989, the HMO and control physicians reported similar ordering practices. In 1990 and 1992, both HMO and control physicians had about twice the odds of ordering annual mammograms for women aged 50 to 74 years compared with 1988. For all years combined, HMO physicians were 1.4 times as likely as control group physicians to report

ordering annual mammograms for women aged 50 to 74 years. All of these differences except the 1988-1989 comparison were significant.

Women's Surveys

Characteristics of Women Respondents

Table 4 summarizes the characteristics of women responding to the 1988 and 1992 surveys. About one-half the women were high-school graduates, 80 to 85 percent were white, about one-third earned \$15,000 to \$30,000 a year, and most reported having a regular physician.

Mammography Experiences

There was an almost 30 percent increase from 1988 to 1992 in the proportion of HMO women who reported having had a mammogram in the past year compared with a 19 percent increase for women in the control group (Table 5). The difference between these increases was significant ($P = 0.01$). There was a 30 percent increase from 1988 to 1992 in the proportion of HMO women reporting that they were extremely likely to get a mammogram in the next year compared with a 15 percent increase in the control group. The difference between these increases was highly significant ($P = 0.007$). In 1992, there were highly sig-

Table 2. Mammography Practices of Health Maintenance Organization (HMO) Physicians and Control Physicians in the 1988 and 1992 Surveys.

Mammography Interval by Age Group	HMO		Control		P-value 1992 Comparison
	1988 (n = 159) No. (%)	1992 (n = 155) No. (%)	1988 (n = 138) No. (%)	1992 (n = 152) No. (%)	
50–74 years					
Annually	112 (70)	96 (86)	89 (64)	74 (74)	< 0.001*
Every 2 years	29 (18)	15 (14)	27 (19)	18 (18)	
Other	18 (11)	0 (0)	23 (17)	8 (8)	
60–74 years with co-morbidity†					
Annually	N/A	136 (89)	N/A	102 (70)	0.001
Every 2 years		13 (8)		31 (21)	
Other		4 (3)		13 (9)	

*Difference between increases not significant.

†Not asked in 1988.

nificant differences between the HMO and control groups on mammography practices: 88 percent of HMO women versus 81 percent of control women reported ever having had a mammogram, and 70 percent of HMO women compared with 58 percent of control women said that they had one in the past year ($P < 0.001$). Figure 1 shows the proportion of women who reported a mammogram in the past year by group and income for each of the 4 survey years. Particularly noteworthy is the clear postintervention difference between the HMO and control group women for those with incomes less than \$30,000.

Multivariate Analyses

Multivariate analyses were conducted to assess the impact of an intervention on women's self-reported receipt of mammography, using data from the four surveys. Because previous analyses had shown that income modified the impact of the intervention ($< \$30,000$ and $> \$30,000$), two separate analyses were calculated.³⁰

For women with incomes less than \$30,000, HMO and control women were equally likely to have had mammograms in 1988. In 1989 compared with 1988, HMO women were 3.2 times as likely as control women to have had a mammogram in the past year; in 1990 compared with 1988, HMO women were 3.1 times as likely, and in 1992 compared with 1988, they were 1.8 times as likely as control women to have had a mammogram. Overall, women with a regular source of health care and women with a previous breast problem were nearly twice as likely to have had a mammogram in the past year as women without these characteristics. Married women were nearly

twice as likely to have had a mammogram within the year compared with unmarried women. All differences except baseline were significant. These results indicate that the breast screening program was very successful in improving mammography use for women with incomes of \$30,000 or less. The effect was diminished in 1992.

There was no significant interaction between being in the intervention group and survey year for women with incomes of more than \$30,000. Mammography rates among these HMO women and control women were nearly identical in 1988 and 1989. In 1990, all women were 2.6 times as likely as women in 1988 to have had a mammogram and 2.8 times as likely in 1992 compared with 1988. For all years, HMO women were 1.4 times as likely as control women to have had a mammogram. Women with a regular source of

Table 3. Ordering of Mammograms by Physician Characteristics: Results of 1992 Survey (n = 307 HMO and Control Physicians).

Physician Characteristics	No. (%)	P-value
Practice setting		
Individual private practice	126 (77)	0.005
Group	106 (89)	
Other	12 (80)	
Specialty		
Family practice or general practice	113 (81)	0.01
Internist	57 (76)	
Obstetrics-gynecology	59 (95)	
Sex		
Men	207 (82)	0.95
Women	37 (82)	
Board certified		
No	69 (71)	0.003
Yes	175 (87)	

Table 4. Demographic Characteristics of Women Survey Respondents in 1988 and 1992 Surveys.

Characteristics	HMO		Control	
	1988 (n = 465) No. (%)	1992 (n = 475) No. (%)	1988 (n = 474) No. (%)	1992 (n = 443) No. (%)
Education				
11th grade or less	77 (17)	65 (14)	71 (15)	69 (15)
High-school graduate	254 (55)	258 (55)	250 (53)	222 (50)
Some college or trade school	88 (18)	94 (20)	93 (20)	80 (18)
College graduate and beyond	44 (10)	54 (11)	53 (12)	75 (17)
Currently employed	285 (61)	288 (61)	184 (39)	176 (39)
Marital status				
Married (or living as)	348 (75)	373 (68)	315 (67)	287 (65)
Race-ethnicity				
White (not Hispanic)	390 (85)	375 (80)	402 (86)	376 (85)
African-American (not Hispanic)	59 (13)	78 (17)	62 (13)	61 (14)
Other	11 (2)	17 (3)	5 (1)	5 (1)
Age (years)				
50-54	115 (25)	77 (16)	91 (20)	114 (25)
55-59	116 (25)	162 (34)	122 (26)	86 (19)
60-64	95 (20)	134 (28)	106 (23)	84 (19)
65-69	108 (23)	58 (12)	89 (19)	81 (18)
70-74	31 (7)	44 (9)	58 (12)	83 (19)
Household income last year				
Less than \$15,000	71 (18)	62 (15)	105 (26)	89 (24)
\$15,000-\$30,000	173 (44)	159 (39)	157 (38)	119 (32)
\$31,000-\$45,000	98 (25)	87 (21)	73 (18)	69 (19)
>\$45,000	53 (13)	98 (24)	73 (18)	94 (25)
Have a regular physician*	N/A	464 (98)	N/A	416 (93)
Have a family history of breast cancer	72 (17)	94 (16)	76 (18)	65 (25)

*Not asked in 1988.

health care and those with a previous breast problem were about twice as likely as those without these characteristics to have had a mammogram in the past year. Those with a family history of breast problems were 1.6 times as likely as those without such a family history to have had a mammogram. These differences all were significant.

Discussion

There are some limitations to this study. Two are most important. First, the study design was quasi-experimental in that randomly selected HMO physicians were compared with control physicians randomly selected from outside the HMO but within the same geographic area. Similarly, randomly selected HMO women were compared with non-HMO women in the community, because HMO physicians and administrators did not believe it would be ethical or even legal to randomize physicians or women to a no-treatment control group. Second, the data were based on self-report. Although a previous study conducted among this population

showed women's self-reports to be highly valid, the validity of physicians' self-reports in this population is not known.³¹ Cost considerations and ethical concerns precluded an audit of physicians' records for the women participating in the surveys. Unfortunately, the radiology report data base was not completely reliable, because some radiology practices were noncompliant with the reporting requirements. Also, it is not possible to separate the impact of physician interventions from the impact of the interventions delivered to the women. Finally, some questions were added to the questionnaire in 1992 that were not asked earlier.

The results of the study presented here indicate that a comprehensive breast screening program resulted in a modest and nonsignificant impact upon physicians' self-reported screening behavior but a much more dramatic impact upon women's self-reported receipt of mammograms. The modest physician impact was more than offset by the strong impact observed for women. This difference in impact could have been partly the result

Table 5. Self-Reported Mammography Experience of Women Aged 50 to 74 Years Responding to the 1988 and 1992 Survey.

Experience	HMO		Control		P-value 1992 Comparison
	1988 No. (%)	1992 No. (%)	1988 No. (%)	1992 No. (%)	
Ever had a mammogram	278 (61)	416 (88)	271 (60)	359 (81)	0.005*
Number of mammograms					
Zero	175 (39)	58 (12)	179 (40)	84 (19)	0.001
One	142 (31)	50 (11)	96 (21)	59 (14)	
Two	62 (14)	50 (11)	79 (18)	43 (10)	
Three or four	43 (10)	144 (31)	57 (13)	87 (20)	
Five and more	29 (6)	168 (35)	37 (8)	163 (37)	
Had mammogram within past year	184 (41)	333 (70)	174 (39)	258 (58)	< .001†
Likelihood of getting mammogram within next year					
Not at all	69 (16)	54 (11)	97 (21)	70 (16)	0.008‡
A little or somewhat	200 (45)	92 (20)	162 (35)	108 (25)	
Extremely	172 (39)	324 (69)	204 (44)	257 (59)	

*Change from 1988 to 1992 $P = 0.12$.†Change from 1988 to 1992 $P = 0.01$.‡Change from 1988 to 1992 $P = 0.007$.

of the fact that most of the interventions were directed at the women.

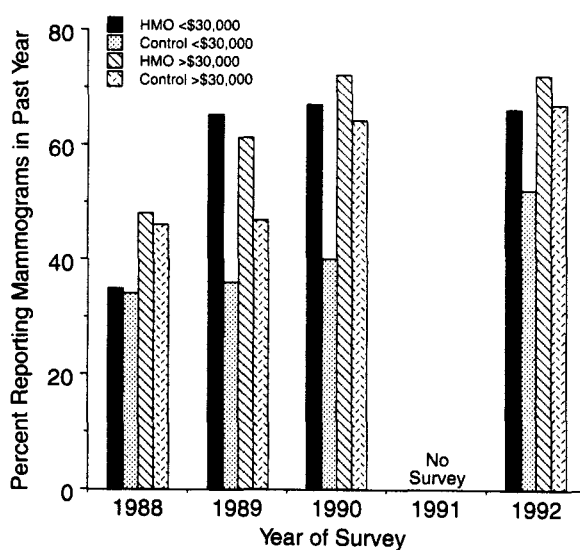
The greatest impact was seen for HMO women in 1989 and 1990, the first and second intervention years, and the greatest benefit was observed for women with incomes of less than \$30,000. The HMO intervention seemed to equalize the lower income HMO women with the higher income control women who did not receive interventions. This finding is encouraging, because women with lower incomes are less likely to get mammograms. Although the larger impact among women with lower incomes could have been due, in part, to the provision of free mammograms, our previous research has shown that free mammograms were necessary but not sufficient to increase use of mammograms.¹⁴

It is of some concern that the increase in mammography use in both HMO and control women peaked in 1990 and then remained stable. More effort will be needed to raise use of mammography above current levels. Those women who have not yet embraced mammography could be an especially challenging group.

In 1992, 86 percent of HMO physicians said they referred women aged 50 to 74 years for mammograms yearly; we also found that in 1993, 70 percent of women in the HMO compared with 58 percent of control women said they had a

mammogram in the past year. That physicians were reporting a *general* practice whereas women were reporting their *specific* behavior could account for some of the discrepancy between the physicians' and women's reports.

What are the practice implications for physicians? The interventions described here were implemented in an IPA-model HMO in which physicians delivered care in their private offices. The

**Figure 1. Proportion of women reporting mammograms in the past year, by study group and income.**

interventions were meant to address the barriers to mammography for both women and physicians. Offering free mammograms was a central part of the strategy. In private practice, some women might lack insurance coverage and would have to pay for the procedure. Although the reminder systems for women were distributed centrally, the printed reminders were simple, effective (42 percent of women who were noncompliant 45 days after receiving their referral subsequently obtained mammograms compared with 29 percent of those who did not get the letter), and inexpensive (\$0.91 per reminder letter). Such reminders could be used by physicians in private practice. The cost of telephone counseling was about \$3.50 per call. After the call, 29 percent of the women who were still noncompliant 95 days after being mailed the referral obtained mammograms compared with about 14 percent of those who received the letters. Although physicians might not have dedicated staff to provide telephone counseling, nurses and women with bachelor's degrees have been trained to conduct these calls using a standardized protocol. Counseling could be used selectively for women who do not follow through on referrals. The physician interventions were well-received by the study group physicians. Strategies, such as tutorial programs that can be used by physicians on their own time, feedback reports, and office-based training could meet the needs of busy physicians. Even more intensive strategies, however, might be required in the future.

Further studies are needed to extend these findings to HMOs and other types of practices that serve poor and underserved populations, because these women have the lowest rates of breast cancer screening.⁹ Finally, the positive impact of computerized reminders on cancer detection has been shown,^{20,21} but the data from our study suggest that many practicing physicians still have not adopted one of the most effective tools for promoting cancer screening — the reminder system. More research is needed to learn how best to integrate cancer screening within the fabric of family medicine as it is practiced in nonacademic, community settings.

We are grateful for the support of Jay Rosan, DO, David Badalato, and others at US Healthcare. We also thank Mark Conaway, PhD, and Karen Catoe, MPH, for statistical consultation.

References

1. American Cancer Society. 1992 Cancer facts & figures. Atlanta, GA: American Cancer Society, 1992.
2. Tabar L, Fagerberg G, Duffy SW, Day NE. The Swedish two county trial of mammographic screening for breast cancer: recent results and calculation of benefit. *J Epidemiol Community Health* 1989; 43:107-14.
3. Shapiro S, Venet W, Strax P, Venet L, Roeser R. Selection, follow-up, and analysis in the Health Insurance Plan Study: a randomized trial with breast cancer screening. *Natl Cancer Inst Monogr* 1985; 67:65-74.
4. American Cancer Society. Breast cancer detection awareness: questions and answers. New York: American Cancer Society, 1986.
5. Elwood JM, Cox B, Richardson AK. The effectiveness of breast cancer screening by mammography in younger women. *Online J Curr Clin Trials* 25 Feb 1993; 1993(Doc. No. 32).
6. Miller AB, Baines CJ, To T, Wall C. Canadian National Breast Screening Study: 1. Breast cancer detection and death rates among women aged 40 to 49 years. *Can Med Assoc J* 1992; 147:1459-76.
7. Fox SA, Murata PJ, Stein JA. The impact of physician compliance on screening mammography for older women. *Arch Intern Med* 1991; 151:50-6.
8. Dawson DA, Thompson GB. Breast cancer risk factors and screening: United States, 1987. Vital and Health Statistics. Series 10. Hyattsville, MD: US Department of Health and Human Services, 1990; DHHS publication no. (PHS)90-1500:1-33.
9. Rakowski W, Rimer BK, Bryant SA. Integrating behavior and intention for the study of mammography: data from the 1990 supplement to the national health interview survey. *Public Health Rep* (in press).
10. Greenwald P, Sondik E, editors. Cancer control objectives for the nation: 1985-2000. Bethesda, MD: National Cancer Institute, Monograph 2, publication (PHS) 86-2880, 1986.
11. Screening mammography: a missed clinical opportunity? Results of the NCI Breast Cancer Screening Consortium and National Health Interview Survey Studies. *JAMA* 1990; 264:54-8.
12. Rimer BK, Davis SW, Engstrom PF, Myers RE. Some reasons for compliance and noncompliance in a health maintenance organization breast cancer screening program. *J Compliance Health Care* 1988; 3:103-14.
13. Zapka JG, Chasan L, Barth R, Mas E, Costanza ME. Emphasizing screening activities in a community health center: a case study of a breast cancer screening project. *J Ambul Care Manage* 1992; 15(1): 38-47.
14. Rimer BK, Keintz MK, Kessler HB, Engstrom PF, Rosan JR. Why women resist screening mammography: patient related barriers. *Radiology* 1989; 172:243-6.
15. Rimer BK, Trock B, Balshem A, Engstrom PF, Rosan J, Lerman C. Breast screening practices among pri-

- mary physicians: reality and potential. *J Am Board Fam Pract* 1990; 3:26-34.
16. Costanza ME, Zapka JG, Stoddard AM, Gaw VP, Barth RS. Physician compliance with mammography guidelines: barriers and enhancers. *J Am Board Fam Pract* 1992; 5:143-52.
17. Burg MA, Lane DS. Mammography referrals for elderly women: is Medicare reimbursement likely to make a difference? *Health Serv Res* 1992; 27: 505-16.
18. American Cancer Society. 1989 survey of physicians' attitudes and practices in early cancer detection. *CA* 1990; 40:77-101.
19. McPhee SJ, Richard RJ, Solkowitz SN. Performance of cancer screening in a university general internal medicine practice. Comparison with the 1980 American Cancer Society guidelines. *J Gen Intern Med* 1986; 1:275-81.
20. Pommerenke FA, Weed DL. Physician compliance: improving skills in preventive medicine practices. *Am Fam Physician* 1991; 43:560-8.
21. McDonald CJ, Hui SL, Smith DM, Tierney WM, Cohen SJ, Weinberger M, et al. Reminders to physicians from an introspective computer medical record. A two-year randomized trial. *Ann Intern Med* 1984; 100:130-8.
22. Nattinger AB, Panzer RJ, Janus J. Improving the utilization of screening mammography in primary care practices. *Arch Intern Med* 1989; 149:2087-92.
23. Soumerai SB, Avorn J. Principles of educational outreach ('academic detailing') to improve clinical decision making. *JAMA* 1990; 263:549-56.
24. Costanza ME, Zapka JG, Harris DR, Hosmer D, Barth R, Gaw VP, et al. Impact of a physician intervention program to increase breast cancer screening. *Cancer Epidemiol Biomarkers Prev* 1992; 1:581-9.
25. Fletcher SW, Harris RP, Gonzalez JJ, Degnan D, Lannin DR, Strecher VJ, et al. Increasing mammography utilization: a controlled study. *J Natl Cancer Inst* 1993; 85:112-20.
26. Rimer BK, Trock B, Engstrom PF, Lerman C, King E. Why do some women get regular mammograms? *Am J Prev Med* 1991; 7(2):76-81.
27. Fletcher SW, O'Malley MS, Earp JL, Morgan TM, Lin S, Degnan D. How best to teach women breast self-examination. A randomized trial. *Ann Intern Med* 1990; 112:772-9.
28. Madlon-Kay DJ. Improving the periodic health examination: use of screening flow chart for patients and physicians. *J Fam Pract* 1987; 25:470-3.
29. Kish L. Survey sampling. New York: Wiley, 1965.
30. Trock B, Rimer BK, King E, Balshem A, Cristinzio CS, Engstrom PF. Impact of an HMO-based intervention to increase mammography utilization. *Cancer Epidemiol Prev Biomarkers* 1993; 2:151-6.
31. King ES, Rimer BK, Trock B, Balshem A, Engstrom P. How valid are mammography self-reports? *Am J Public Health* 1990; 80:1386-8.