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Et al.

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Abstract

In order to improve compliance with the National Cancer Institute's breast cancer screening guidelines, we developed a multifaceted intervention designed to alter physician screening practice. A pre-post test, two-community design was used. Primary care physicians in one community served as the control. Data were collected by two mailed surveys (1987 and 1990). Response rates were 61% and 64%, respectively. The physician intervention program consisted of a hospital-based continuing medical education program and an outreach component which focused on implementing a reminder system. Outcome measures were self-reported attitudinal, knowledge, and screening practices changes. In spite of an impressive change in comparison community physicians' practice, the difference in change over time in the intervention community physicians' ordering of annual mammography compared to the change in the comparison community physicians' ordering was significant ($P = 0.04$). The adjusted odds ratio is nearly 8. We conclude that our in-service continuing medical education program was successful in improving breast cancer screening practices among primary care physicians.

Introduction

Breast cancer is the most common female cancer, affecting one in nine American women. Since the 1970s, breast cancer incidence rates have been rising about 1%/year (1). In 1991, the American Cancer Society estimated that 155,000 women would be diagnosed with the disease and 50,000 women would die from it (2). Unfortunately, despite aggressive medical and surgical treatment the mortality rates have not changed. More troublesome still, in spite of strong evidence indicating that screening asymptomatic women aged 50 and over will decrease mortality from breast cancer by 25-30%, universal screening is not a reality in this country (3). Accordingly, there is no overall national decrease in breast cancer mortality attributable to early detection. Efforts to understand the lack of universal breast cancer screening and to intervene effectively in improving compliance with national standards is therefore a critical endeavor in cancer control.

In order to improve compliance with its breast screening guidelines, the National Cancer Institute supported six community demonstration projects (4). The National Cancer Institute guidelines recommend annual CBE[3] and screening mammography for women 50 and older. This study reports the positive impact of a multifaceted intervention designed to increase physician compliance with the National Cancer Institute guidelines.

To understand screening behavior, we conceptualized our initial and subsequent survey questions according to the framework of Green (5) and Aday and Anderson (6). This framework identifies three concepts: predisposing, reinforcing, and enabling factors that affect behavior. Predisposing factors are those psychological and social forces which motivate an individual (knowledge, attitudes, beliefs). Reinforcing factors are those societal forces such as colleagues, family, or friends who encourage or discourage specific activities. Finally, enabling factors are those factors which enhance or inhibit an action such as resources, skills, or access. The Health Belief Model (7) suggests the importance of barrier or benefit factors, which were also included in our survey. We also included concepts from the social learning theory (8), such as perceived social norms and the importance of prior experience. Also, the survey questions reflected specific beliefs, attitudes, or barriers previously reported to affect screening such as physician concerns about patient resistance, cost to the patient, unnecessary radiation, reliability of the tests, equivocal reports, and low yield or such access barriers such as lack of reminder system or feedback (9-15). Our initial women's surveys have suggested that the most important factors associated with a woman's failure to follow the screening guidelines reflect her own lack of knowledge regarding the importance of regular mammography practice, particularly in the absence of symptomatology, and her physician's failure to specifically recommend mammography (16). Similar findings have been reported by others

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[3] The abbreviations used are: CBE, clinical breast examination; CME, continuing medical education.

(17–21). The importance of improving physician compliance with screening guidelines cannot be overemphasized.

The interventions in this project consisted of multiple components including a radiologist element, multifaceted community education efforts, and a primary physician component (22). Details of the community and radiologist interventions are reported elsewhere (23–26). Intervention content for primary care physicians was selected on the basis of results from the initial physician survey (27) and to a lesser extent the initial women's survey (16). Selection of what to target was made on the basis of whether there was an opportunity for change. Thus, we targeted key physician attitudes and beliefs which were associated with the lack of screening such as the belief that mammography does not improve prognoses, key reinforcement factors like the prevailing consensus in the medical community regarding screening, or enabling factors like not having a reminder system to prompt screening behavior. Given the medical climate in eastern Massachusetts, we selected a traditional format for the delivery of these interventions: CME courses (in-service education) and material and information distribution (outreach education).

Materials and Methods

A pretest/posttest, two-community design was used. The intervention and comparison communities, each comprising three adjacent towns, were selected on the basis of their comparability on a number of socioeconomic factors as reported by 1980 census data. Each community was an industrialized mid-sized city located approximately 35 miles from metropolitan Boston. Each had a population size of approximately 100,000, with 20,000 women 50 or older. Both communities were relatively self-contained and had their own nonoverlapping media, both press and television, although both shared the major Boston television channels and papers. The medical communities were quite isolated from each other. Potential contamination of one community by the other is extremely unlikely, since there was no direct route connecting these cities and they were 70 miles apart.

A baseline cross-sectional mailed survey was conducted in fall 1987 (n = 189) before implementation of educational interventions. The follow-up cross-sectional survey was conducted in the spring of 1990 (n = 157). All primary care physicians, family or general practitioners, internists, and gynecologists with staff privileges at either of the two hospitals in the intervention community and at any of the three hospitals in the comparison community were included in the mailing. A separate postcard return identification system allowed us to track respondents while keeping survey responses anonymous. Up to three follow-up mailings were sent to nonrespondents followed by a telephone reminder; the response rates for the baseline and follow-up survey were 61% (n = 116) and 64% (n = 100), respectively. There was no statistical difference in the response rates between communities. The surveys collected data on physician characteristics, breast cancer screening practices, as well as beliefs and experiences that could influence breast cancer screening practices. The follow-up survey also collected data concerning exposure to intervention activities. Given the response rate and the small number of primary care physicians in each community, many of the same physicians were no doubt included in both the 1987 and 1990 cross-sectional surveys. There is no way to identify individual physician survey responses, since the surveys were deliberately made anonymous in an effort to decrease "correct" responses.

The physician interventions were implemented between 1987 and 1990 and consisted of two components: in-service education and outreach activities. These were complemented by an intervention aimed at women which indirectly targeted physicians.

In-Service Education. This intervention consisted of presentation of five special grand rounds cosponsored by the two intervention community hospitals and the local American Cancer Society. Topics included the importance of screening mammography in decreasing mortality from breast cancer; a review of perceived barriers to physician compliance, such as the importance of radiation in causing secondary cancers; and the legal consequences of screening or not screening. In addition, we focused on creating and informing the medical community of the consensus regarding breast screening activities. We also provided the opportunity for physicians to participate in a 1-h interactive experience with a "patient" instructor, focusing on the complete breast examination (CBE).

The format of this intervention was consistent with traditional continuing medical education (CME) programs. CME credits, including "risk management" CMEs required by the Massachusetts Board of Registration, were offered as incentives for participating physicians. Other presentations were made at departmental special meetings (see Table 1).

Practice Outreach Activities. This component included providing specific educational materials to the physicians, their staff, and patients. Newsletters focusing on building consensus among physicians were mailed three to four times a year. In addition, reminder system materials for use in the practice setting were sent to the physicians. These materials, developed to document screening activities, were to be used by physicians and patients. Several support staff workshops were also held.

Indirect Intervention. We attempted to influence physician recommendations indirectly by prompting women in the community to actively seek physician advice regarding screening and to ask their physicians for screening mammograms. We worked extensively with radiologists to improve radiology reporting, since the baseline survey identified ambiguous mammography reports as a significant issue for some primary care physicians (23, 24, 27).

Details of the intervention components are presented in Table 1.

Evaluation Questions and Measures. The physician intervention was evaluated at several different levels. For example, to assess whether targeted intervention community physicians were exposed to intervention components they were asked if they had participated in the grand rounds and, if they had, to identify those sessions they had attended; they were specifically asked if they had attended the session on CBE skills with the patient instructor. Physicians were also asked whether they had

Table 1 Physician interventions by type, format, and focus, including examples

Format	Focus	Example
In-service		
Grand rounds and department meetings	Benefits of mammography	Mammography improves prognosis
	Barriers to mammography	Radiation is not a significant cause of new breast cancers
	Consensus building	Most physicians in Massachusetts are following screening guidelines
	Physician benefit	Screening decreases exposure to malpractice
	Mammography limits	Need for complementary CBE
	Mammography reports	What is expected and acceptable
Skills building	CBE with personal instructor	Review of elements of CBE and mammography advocacy
Outreach		
Newsletters, flyers, posters	Consensus building	Improvement in community's screening compliance
	Mammography barriers	Legal ramifications of informed refusal
	Mammography benefits	Third-party coverage for mammograms
Patient literature	Patient education	"Once is not enough" for mammogram screening
Chart forms/stickers, posters, wallet cards	Reminder system for M.D. and patient	Calendar with spaces for screening due dates; chart insert for documenting screening activities
Workshop	Support staff education	Instruct in use of reminder system
Indirect		
Intervene with radiologist	Course for radiologists to improve mammogram readings	Provide physician with uniform clear and definitive reports
Intervene with community women	Educational effort	Prompt women to ask physicians for mammograms

received the newsletters and patient education and office management materials.

The impact of intervention on knowledge and beliefs concerning breast cancer screening was assessed on the basis of change over time in the responses to certain questions included on both the baseline and follow-up surveys. For example, physicians were asked on each survey to indicate the level to which they agreed with the following statements: mammography reduces mortality from breast cancer; it improves prognosis; and it protects me legally. They were provided with a 7-point response scale ranging from 1 (strongly agree) to 7 (strongly disagree). In assessing the impact of intervention on knowledge and beliefs, physicians were questioned about nine potential barriers to compliance with breast cancer screening guidelines and the degree to which these concerns affected their ordering of screening mammography; the choice of responses ranged from 1 (doesn't affect) to 7 (strongly affects ordering). Potential barriers examined included ambiguity in mammography reports; fear of radiation exposure; associated patient discomfort; appropriateness for patients considered at low risk for breast cancer; the high price of mammography in general; the cost of mammography to the patient; the cost effectiveness of mammography; increases in unnecessary biopsies generated by mammography; and spending too much time discussing mammography with patients.

Primary care physicians were asked to respond to several questions designed to indicate whether there was a consensus of opinion regarding certain screening issues. For example, they were asked how many of their colleagues routinely screen women over 50 (1 = most do; 2 = many do; 3 = some do; 4 = few do). In addition, they were asked if they agreed that screening mammography recommendations by expert groups were helpful (1 = agree strongly through 7 = disagree strongly) and if there was a consensus among community physicians advocating annual screening for women 50 and over (yes, no).

To indirectly assess whether specific project interventions targeted at community women and radiologists altered the breast cancer-related experience of the physician, physicians were asked how often patients re-

Table 2 Physician and practice characteristics by study year and community

Characteristic	1987		1990	
	Intervention	Comparison	Intervention	Comparison
Sample size	52	64	45	55
Physician's gender				
Male	80.4	82.8	76.7	83.3
Female	19.6	17.2	23.3	16.7
	$P_1 = 0.739$[a]	$P_2 = 0.940$[b]	$P_3 = 0.909$[c]	$P_4 = 0.719$[d]
Year of graduation				
≤1965	36.0	34.9	40.0	32.1
1966-1976	30.0	33.3	22.2	34.0
≥1977	34.0	31.8	37.8	34.0
	$P_1 = 0.945$	$P_2 = 0.751$	$P_3 = 0.949$	$P_4 = 0.819$
Specialty				
Internal medicine	51.0	53.1	44.4	46.3
Family practice	27.5	21.9	31.1	25.9
Gynecology	21.6	25.0	24.4	27.8
	$P_1 = 0.647$	$P_2 = 0.619$	$P_3 = 0.914$	$P_4 = 0.995$
Practice type				
Individual	68.6	37.5	65.9	40.0
Other	31.4	62.5	34.1	60.0
	$P_1 = 0.001$	$P_2 = 0.780$	$P_3 = 0.924$	$P_4 = 0.692$
Health maintenance organization affiliated				
Yes	45.1	90.6	56.8	89.1
No	54.9	9.4	43.2	10.9
	$P_1 \leq 0.001$	$P_2 = 0.782$	$P_3 = 0.502$	$P_4 = 0.385$

[a] P_1 = significance of the test that there was no difference between the intervention and comparison community at baseline (1987).
[b] P_2 = significance of the test that there was no change between 1987 and 1990 in the comparison community.
[c] P_3 = significance of the test that there was no change between 1987 and 1990 in the intervention community.
[d] P_4 = significance of the test that the change over time in the intervention and comparison community did not differ.

quested mammograms, how often they resisted mammography recommendations, and how frequently they received ambiguous mammography reports.

Last, the evaluation plan attempted to assess the impact of intervention on change in physician practice organization and/or breast cancer screening behavior. Regarding the impact on office practice organization, primary care physicians were asked whether or not they had a reminder system for screening mammograms, whether a checklist incorporating screening mammograms was included with the patient chart, and whether they sent regular check-up reminders to their patients. To assess whether physician breast cancer screening behavior changed, they were asked if they annually screened women aged 50 to 75 (mammography and clinical breast examination). To assess whether physician characteristics were associated with these outcome measures, the relationship of specialty, practice setting, year graduated from medical school, and sex to annual screening was investigated.

Statistical Analyses. The statistical analysis involved fitting a series of models containing terms for community, time, and the community-by-time interaction. The parameter estimates in the fitted models were used as a basis for comparison of the communities. These comparisons were expressed in terms of four hypotheses whose *P* values are reported in the tables. The tests were as follows: (*a*) no difference between cities at baseline, reported as P_1; (*b*) no change in the control community between 1987 and 1990, reported as P_2; (c) no change in the intervention community between 1987 and 1990, reported as P_3; and (*d*) comparison of the changes over time in the two communities, reported as P_4.

The exact statistical model used varied depending on the scale of measurement of the dependent variable being modeled. For example, logistic regression was used for dichotomous variables, such as sex of the physician. Polytomous logistic regression was used for discrete nominal scaled variables at more than two levels, and linear regression was used for continuous-scale variables.

For analyses involving the primary outcome variable, the percentage of physicians who report ordering annual mammograms, logistic regression was used. Intervention effects and comparisons are presented in terms of the odds ratios obtained from the fitted model using methods described elsewhere (28).

Results

The characteristics of the physicians surveyed and their practices are shown in Table 2 by study year and community. There was no difference by sex, year of graduation, or specialty between the communities at either time or with regard to the change over time. There was, however, a significant difference between communities with regard to practice setting. At the time of the baseline survey, significantly more physicians in the intervention community were in individual practice as compared to group practice, and significantly fewer were affiliated with a health maintenance organization. These differences were also observed at the time of the follow-up survey.

The impact of the interventions was assessed on the basis of change occurring in the communities over time

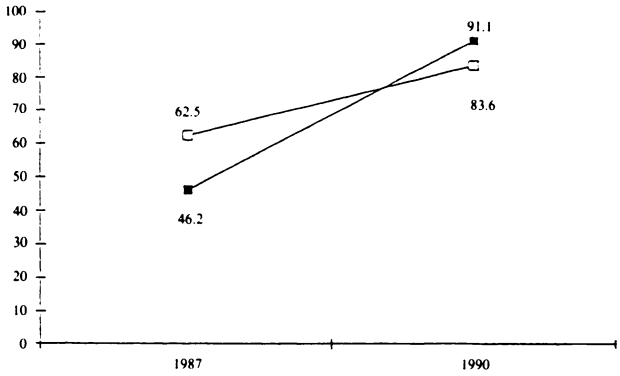

Fig. 1. Physicians' report of ordering annual mammography. $P = 0.043$. ■, demonstration; □, comparison.

and by the difference in change observed between comparison and intervention communities.

Measure of Screening Behavior Change. The ultimate focus of the interventions was to increase the number of physicians ordering annual mammography for women 50 and over. The difference in the changes in the communities over time was significant ($P = 0.043$), with 91.1% of the physicians in the intervention community in 1990 reporting annual screening intervals for women aged 50–75 (see Fig. 1). When we compare the communities it is important to note that the intervention community physicians had a lower reported compliance rate in 1987 than the control community, and that by 1990, the intervention community recommendation rate *exceeded* that of the control community.

Measure of Intermediate Variables. Perceptions regarding the benefits of mammography were analyzed by collapsing various response categories to three variables: mammography improves prognosis; mammography decreases mortality; and mammography protects one legally. Only the perception that "mammography improves prognosis" demonstrated a significant change. This change was observed between 1987 and 1990 in the intervention group ($P = 0.038$). Given the small but nonsignificant change in the comparison group, the resulting difference in change between the cities over time was not significant ($P = 0.143$).

A second set of impact measures focused on changes in perceptions regarding the extent that potential barriers affect mammography ordering. These results are shown in Table 3. At baseline, there were significant differences between communities concerning the impact of three barrier variables, including concern that mammograms are not cost effective, interpretation of ambiguous reports, and the high price of mammography; a significantly greater percentage of physicians in the control community reported these to have only slight or no influence on ordering.

There was a significant change over time in both communities with respect to the impact on mammography ordering of potential barriers, including concerns about radiation and screening of patients at low risk of breast cancer. Specifically, the proportion of physicians who believed these concerns do not effect ordering increased in both communities. Perceptions regarding certain potential barriers to mammography ordering were observed to change significantly over time for the intervention community only. These barriers included the concern that mammography is not cost effective, interpreting ambiguous mammography reports, and concern about unnecessary biopsies. In all three cases, the proportion of physicians reporting that the potential barrier did not affect mammography ordering increased from 1987 to 1990.

Considering the shifts in beliefs occurring over time in the intervention and control communities, significant differences in change were observed for two mammography barriers ($P_4 \leq 0.05$). Although the proportion of physicians in the control community indicating that concern over the cost effectiveness of mammography and interpreting ambiguous reports did not affect ordering increased, it did so to a much smaller degree than among intervention community physicians.

The third group of attitudinal or belief measures reflected changes in perceptions about consensus of opinion regarding screening. There was a significant difference at baseline between intervention and control physicians regarding their opinion as to the number of their colleagues who recommend screening for women over 50 ($P = 0.018$); comparison community physicians believed that more of their colleagues were screening (40% *versus* 21.4%). Over time both communities reported more screening by their colleagues ($P_2 = 0.066$, comparison; $P_3 = 0.007$, intervention), although there was not a significant difference between changes in the two communities. With respect to the belief that there is a consensus for an annual screening interval, the two communities differed significantly at baseline; a lower percentage of physicians believed that there was consensus for an annual screening interval in the intervention community (35.8% *versus* 80.7%; $P_1 = 0.003$). Changes in consensus belief did not reach significance.

Measure of Effects of Indirect Intervention. A target of the women's community campaign was to encourage women to ask their physicians for mammography as well as to give the women information about its benefits and relative safety. Despite the intervention efforts, the number of mammography requests and refusals failed to differ between intervention and control communities. The radiology program targeted improvement in the reporting of mammography results in response to prior claims that ambiguous reports were important in affecting the ordering of mammography. The number of ambiguous reports received also failed to demonstrate a significant impact.

To summarize the results for the intermediate variables described above, only two demonstrated a significant difference between changes seen in the two communities over time. These included lessening the impact on ordering of concerns about interpreting equivocal reports and lessening concerns about mammography not being cost effective. However, it is important to note that while physician attitudes and beliefs changed in the control community, these were neither as frequent nor as dramatic as the changes in the intervention community. Furthermore, while no significant changes were reported only in control community attitudes or beliefs, frequent significant changes were observed only in the intervention community.

Table 3 Impact of physician interventions on beliefs regarding barriers to mammography by study year and community

Barrier to mammography	1987		1990	
	Intervention	Comparison	Intervention	Comparison
Sample size	52	64	45	55
Concern that mammogram is not cost effective				
Doesn't affect (1)	43.1	65.6	72.7	66.7
Other (2-7)	56.9	34.4	27.3	33.3
	$P_1 = 0.017$[a]	$P_2 = 0.905$[b]	$P_3 = 0.013$[c]	$P_4 = 0.040$[d]
Concern about interpreting ambiguous reports				
Doesn't affect (1)	27.5	41.3	55.6	51.9
Slight affect (2-3)	29.4	39.7	31.1	31.5
Other (4-7)	43.1	19.0	13.3	16.6
	$P_1 = 0.012$	$P_2 = 0.328$	$P_3 = 0.011$	$P_4 = 0.043$
Concern about high price of mammograms				
Slight affect (1-2)	33.3	53.1	48.9	50.9
Moderate affect (3-4)	29.4	20.3	37.8	21.8
Other (5-7)	37.3	26.6	13.3	27.3
	$P_1 = 0.045$	$P_2 = 0.827$	$P_3 = 0.092$	$P_4 = 0.088$
Concern about radiation				
Doesn't affect (1)	41.2	46.9	75.6	67.3
Does affect (2-7)	58.8	53.1	24.4	32.7
	$P_1 = 0.541$	$P_2 = 0.027$	$P_3 \leq 0.001$	$P_4 = 0.277$
Concern about patient at low risk				
Doesn't affect (1)	30.0	32.3	55.6	60.0
Slight affect (2-3)	40.0	37.1	31.1	20.0
Other (4-7)	30.0	30.6	13.3	20.0
	$P_1 = 0.917$	$P_2 = 0.005$	$P_3 \leq 0.001$	$P_4 = 0.998$
Concern about unnecessary biopsies				
Doesn't affect (1)	29.4	40.6	53.3	53.7
Slight affect (2)	23.5	26.6	17.8	20.4
Other (3-7)	47.1	32.8	28.9	25.9
	$P_1 = 0.126$	$P_2 = 0.199$	$P_3 = 0.026$	$P_4 = 0.362$
Concern about cost to patient				
Slight affect (1-2)	21.6	35.9	33.3	34.6
Moderate affect (3-5)	43.1	37.5	44.4	47.3
Other (6-7)	35.3	26.6	22.3	18.2
	$P_1 = 0.097$	$P_2 = 0.658$	$P_3 = 0.247$	$P_4 = 0.368$
Concern about patient discomfort				
Doesn't affect (1)	37.3	34.4	44.4	38.2
Slight affect (2)	31.4	31.3	31.1	29.1
Other (3-7)	31.4	34.3	24.5	32.7
	$P_1 = 0.707$	$P_2 = 0.717$	$P_3 = 0.664$	$P_4 = 0.707$
Concern about time explaining mammography results				
Doesn't affect (1)	64.7	73.4	75.6	70.9
Other (2-7)	35.3	26.6	24.4	29.1
	$P_1 = 0.313$	$P_2 = 0.759$	$P_3 = 0.487$	$P_4 = 0.289$

[a] P_1 = significance of the test that there was no difference between the intervention and comparison community at baseline (1987).
[b] P_2 = significance of the test that there was no change between 1987 and 1990 in the comparison community.
[c] P_3 = significance of the test that there was no change between 1987 and 1990 in the intervention community.
[d] P_4 = significance of the test that the change over time in the intervention and comparison community did not differ.

Measure of Intervention Exposure. Two methods were used to measure the exposure of the target community physicians to specific intervention activities: one was verified by a sign-in for the CME portion of the course, and the other (shown in Table 4) relied on the physician's self-report. While 58% of surveyed intervention community physicians reported attending at least one grand rounds, 68% of the 82 community primary care physicians did actually attend at least one grand rounds. With respect to the self-report of receiving office materials and reminder system materials, between 73% and 84% of physicians reported receiving the various materials and commented on their usefulness. Because of the anonymity of the physicians' survey, no relationship between the dose of the intervention and the response (alteration in screening behavior or other independent variables) could be drawn. When physicians in both communities were asked whether they had attended related CME courses in the prior 2 years, 13% in the comparison and 22% in the intervention community reported that they had.

Regression Analysis. There were significant differences between several physician demographic characteristics at baseline. These factors were significantly related to the annual ordering of mammography as noted in a previous

Table 4 Physicians reporting on the various intervention efforts (n = 45)

Intervention effort	%
In-service	
Aware of grand rounds	69
Attended grand rounds	58
Number of grand rounds attended	
1	7
2	33
3 or more	16
Attended CBE skills workshop	40
Outreach	
Received outreach materials	
Newsletters	80
Brochures	84
Display	73
Posters	78
Office practice	
Specific office management materials received	
Chart checklist	80
Chart stickers	60
Wall chart	64
Wallet cards	62
Tickler file card	71

Table 5 Crude and adjusted odds ratios and 95% confidence interval estimates of the effect of intervention on change over time in annual ordering of screening mammography

Comparison	Crude analysis		Adjusted analyses[a]	
	OR	95% CIE	OR	95% CIE
Intervention *versus* comparison community at baseline	0.44	(0.21, 0.93)	1.37	(0.49, 3.89)
"Intervention" effect				
Change in comparison community over time	2.68	(1.11, 6.46)	3.05	(1.06, 8.80)
Change in intervention community over time	11.96	(3.74, 38.20)	23.95	(10.68, 53.71)
Comparison of effect				
Ratio of intervention effect of intervention to comparison community	4.46	(1.03, 19.20)	7.85	(1.22, 50.66)

[a] Adjusted for variables noted in text. OR, odds ratio; CIE, confidence interval estimate.

analysis (27). Accordingly, to identify which factors were independently related to annual screening ordering, logistic regression modeling was undertaken (Table 5).

Candidate variables for the model included all variables previously mentioned, except the consensus for annual screening for women 50 and older, since this variable had too many missing responses to include in the analysis. Variables were then selected on the basis of their contribution to a model containing terms for city, time, and the interaction of city and time. In order to control adequately for confounding, a significance level of 15% was used in a forward stepwise selection. Variables identified by this method included individual practice and HMO affiliation, level of agreement with the statements that mammography improves breast cancer prognosis and mammography protects one legally, and concern about the high price of mammograms.

Assessment of intervention effect is presented in Table 5 in the form of odds ratios. Crude odds ratios are obtained from a logistic regression model containing only city, time, and their interaction. Adjusted odds ratios are obtained from a model containing city, time, the interaction of the city by time and the variables selected by the stepwise method described above.

After adjustment, the two communities were found to be similar at baseline, as indicated by the confidence interval for the adjusted baseline odds ratio which includes 1.0. The intervention effect is expressed as the ratio of the odds ratios for change over time within each community; both the crude odds ratio and the odds ratio adjusted for important variables were significant. The adjusted ratio of 7.85 (= 23.95/3.05) is interpreted to mean that the ratio of change in the demonstration community was nearly 8 times larger than that of the control community with respect to ordering annual mammography.

Discussion

This study shows a significant improvement ($P = 0.04$) in physicians' ordering of annual mammography in women 50 and older, following a series of interventions in one of two medical communities. When confounding factors are accounted for (such as the relative overpenetration of health maintenance organization and group practice in the comparative communities), there is an 8-fold difference in the relative improvement in mammography ordering over the 3-year intervention. The only possibility of accounting for such a change between the physicians in the two communities was provided by our mammography education program. Supporting this conclusion are the generally positive changes in the intermediate-group variables: physician attitudes regarding mammography's benefits and barriers and physician beliefs regarding consensus issues. Of 15 intermediate variables studied, two showed significant differences between the amount of change in the intervention and in comparison communities. For the remaining 13 intermediate variables, the changes in attitudes and beliefs were improved but not significantly so in the intervention community or paralleled those occurring in the comparison community. While the chance of falsely "significant" differences increases with the number of analyses, it is important to note the consistently positive results when intervention and comparison communities are compared. Such a consistently positive picture is unlikely to be due to chance.

There are various limitations to our study. The quasi-experimental design of one study permits its internal validity to be threatened by a secular trend. The secular trend was impressive. Interviews with radiologists and a routine review of the local newspapers indicated significant mammography activity in the comparison community. This included the aggressive marketing of a new free-standing mammography service by a new radiology group. Other threats included a comparison city radiologist who actively advocated for mammography. However, such threats to internal validity only underscore the final difference.

Another limitation of this study is the reliance on self-reported, unverified answers of physicians to the survey. The scope of the project precluded chart review to validate annual CBE and mammography ordering.

However, indirect evidence, available from the women's survey, corroborates physician reports of recommendation rates. Women's reports of physician recommendations for mammography were within 10% of the physician self-report of routinely recommending mammography in both the intervention and control communities (16, 26). Another limitation of this study is the potential for bias due to nonresponse on the part of doctors. We do not know how nonrespondents would compare to respondents. However, we do know that the rate of response and the types of physicians responding in the intervention and control communities were similar.

Another limitation of the study is that it is not designed to test a dose-response relationship because of the anonymity of the survey responses. Nevertheless, we do have objective independent evidence that over one-half of the primary care physicians took our CME course. Three-quarters stated they had received our materials and answered questions about their usefulness. It seems safe to conclude that the majority of physicians did receive our interventions. Although there was the possibility that intervention or comparison community physicians had taken other breast cancer screening courses which could have influenced their screening behavior, only a small percentage of physicians in each community indicated that they had had such an exposure.

We were disappointed that two key targeted interventions did not appear to change physician attitudes. The legal protection issue, which had been identified as an important predictor of mammography screening (27), was strongly stressed, with two grand rounds devoted to this issue and many references to the beneficial legal impact of regular screening in other meetings or newsletters. Nonetheless, there was no documented change in the intervention community physicians' attitude. Since the intervention was delivered to at least 50% of physicians, it would appear that they were skeptical of the merits of legal protection as a benefit of mammography referral.

The main outreach intervention, reminder system intervention, designed to influence the practice setting in order to facilitate annual screening, does not appear to have been successful. Other investigators have reported that organized intense working sessions with an office staff can be successful (29, 30). It is possible that the reminder system interventions of this study were insufficient, since our project effort was restricted due to limited resources. In conversations with intervention community physicians, it was noted that many were in solo practice without nursing staff and with poor systems management. Many indicated they were frightened by the prospect of documenting screening recommendation practices or reminder efforts, feeling that this left them more vulnerable to litigation than if they simply ignored the reality of screening guidelines. Anecdotal evidence suggests the issue of cancer screening and legal liability is a complex one requiring more attention. We feel that more attention to the benefits rather than to the disadvantages of clear documentation of screening efforts is certainly warranted.

Summary. The cumulative effect of the interventions favorably altered the screening behavior of intervention community physicians. They clearly report an improvement in mammography screening not only over time but also in comparison to the degree of improvement in the control community. While the outreach intervention (the reminder system) was not effective, the CME program and messages were associated with positive changes in attitudes and practices. Process evaluation suggests that personal interaction of the project physician with key local physicians, followed by delivery of live messages at grand rounds, as well as interaction with primary care physicians regarding the clinical breast exam, was an essential part of this successful intervention package. We believe that structuring the intervention on the predisposing-reinforcing-enabling framework and identifying key variables by survey or prior investigations is a productive and manageable strategy for cancer control activities. While only two of the 15 intermediate variables were clearly associated with screening behavior change, it would be a mistake to discount the importance of the other intermediate beliefs or attitudes. With such marked mammography activity in the "control" community, it is quite possible that a secular trend could have masked initial associations. Since the variables did reflect previously identified key factors, it would seem prudent to incorporate them into future cancer control activities.

This study demonstrates that primary care physicians will change their screening practice in response to interventions aimed at altering beliefs regarding mammography benefits or to barriers and their sense of consensus development. On the whole, the in-service interventions described here could be adapted to the CME program format of the community hospital. Further studies should evaluate this potential generalizability.

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