Detroit's Avoidable Mortality Project: Breast Cancer Control for Inner-City Women

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Synopsis

Mammography remains substantially under-used in low-income minority populations despite its well-established efficacy as a means of breast cancer control. The Metropolitan Detroit Avoidable Mortality Project is a 2-year controlled clinical trial of coordinated interventions which seek to improve the use of early breast cancer detection services at five clinical sites providing primary health care services to inner-city women. Baseline assessment for two of the five participating clinic populations demonstrated that only one-quarter of women who visited these clinics were referred for mammography in 1988, and only half of those who were referred were able to complete the procedure. Patient characteristics including age, marital status, ethnicity, and insurance status were not associated with use of mammography during the baseline period.

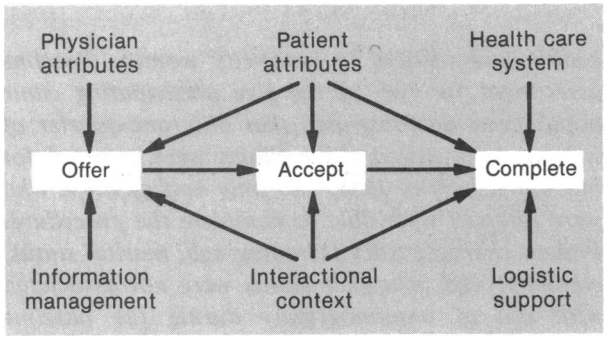
Each of the project's intervention components is a cue to action: a physician prompt for mammography referral within the medical record of procedure-due women, a reminder postcard for scheduled appointments, and a telephone call to encourage rescheduling of missed appointments. The interventions are initiated by a computerized information management system in the existing network of health care services. The patients' out-of-pocket mammography expense has been eliminated in three of the five sites.

Although their efficacy as individual interventions has been well established, a controlled trial of computer prompts to physicians, reduced expense for patients, and patient appointment reminders as an integrated system in inner-city medical care settings has not been previously described. We have implemented the prompting, facilitated rescheduling procedures, and eliminated patient expense for mammography at three of five eventual clinical sites. This report provides an overview of the study's design, data management system, and methodology for evaluation.

MAMMOGRAPHY REMAINS SUBSTANTIALLY under-used despite its well-established efficacy as a means of breast cancer control (*1*). This pattern of under-use reflects issues of accessibility as well as incomplete acceptance of mammography by physicians and women. The adverse breast cancer experience of black women, whose 5-year relative survival is 62.2 percent compared with the 75.0 percent observed among white women, may reflect delayed detection (*2*). For example, in metropolitan Detroit from 1983 to 1985, 43.1 percent of breast cancers among black women were diagnosed as localized (node negative) compared with 52.2 percent among white women. (Source of these data is the Metropolitan Detroit Cancer Surveillance System.)

Given the importance of mammography for the early detection of breast cancer, differential access and use of this procedure among populations may account in part for observed differences in outcome. An analysis of responses in the 1989 National Health Interview Survey Supplement on Cancer Control, National Center for Health Statistics, noted that 25 percent of black women reported ever having had a mammogram, as con-

Figure 1. Determinants of accomplishing screening mammography within the personal health care system: a model of early cancer detection



trasted with 31 percent of white women (*1*). Among women over age 50, the 37 percent of black women who had never heard of mammography was twice the 18 percent among white women (*1*). The experience of women in the project's target areas is similar. In a 1987 survey, only 28 percent of women ages 60–74 reported having had a mammogram within the preceding 2 years (Health Assessment Survey, Michigan Cancer Foundation, 1987, unpublished data). The underuse of mammography and the observed delayed detection of breast cancer in our local community have led to a plan for intervention entitled the "Metropolitan Detroit Avoidable Mortality Project."

This project operates within the personal health care system. Although public education and community programs have complementary roles, the personal health care system offers direct access to an estimated 75 percent of the U.S. population who visit a physician each year (*3*), as well as the motivating effect of the personal recommendation of a physician and existing mechanisms for clinical followup. Our conceptual model (fig. 1) reflects the premise that obtaining a mammogram within the primary care setting requires that physicians offer the procedure to patients who accept the recommendation within a clinical environment that facilitates its completion. Previous work in similar settings has suggested that physicians' failure to offer mammography, compounded by patients' reluctance to accept or inability to complete the procedure, or both, substantially limits the completion rate (*4,5*).

This project, a controlled clinical trial of coordinated interventions, seeks to improve use of early breast cancer detection services by a traditionally underserved population. It targets low-income minority women within the system where they usually receive personal health care services. The project's primary objectives are to (*a*) increase the proportion of eligible women offered mammography by their physicians and (*b*) increase the proportion of completed mammograms among women referred for the procedure. Each study intervention is a cue to action: a mammography reminder to the physician at the visit of a woman due for mammography, a postcard to the woman as a reminder of a scheduled appointment, and a telephone recall procedure as encouragement to reschedule a missed appointment. Women randomized to the intervention group are subject to each cue to action while control group women receive the site's usual care procedures. Out-of-pocket mammography expense for the patient has been eliminated at three of the five study sites.

Methods

Participating sites. The three health care institutions participating in this project include a health department, a health maintenance organization, and a private hospital. Although these providers serve similar populations, they differ in their organizational and financial structures, and they will allow a comparison of the effectiveness of the intervention in three organizational models; all of them are likely to continue as important sources of primary care for Detroit's low-income population. Candidates for the study are women 40 years and older who are patients at the three institutions.

The health department provides health care services to approximately 60,000 persons through its system of eight primary care centers. Two health department clinics will participate: Site 1 that serves approximately 750 women 40 and older annually and Site 2 that serves 1,000 women 40 and older annually. Site 3 is the main clinical facility of a large health maintenance organization (HMO) established in 1972. The HMO provides care to 50,000 persons; the majority are Medicaid recipients and residents of Detroit. Site 3 presently serves approximately 1,500 women 40 and older. Sites 4 and 5 are two components of a larger network of hospital-based clinics that have provided care for the poor in Detroit for more than 60 years. These two sites serve a total of 1,500 women 40 and older.

Two breast cancer detection centers will provide mammography services for patients referred from the clinic sites. Examination procedures include patient history and breast cancer risk assessment, breast physical examination conducted by a nurse examiner, instruction in breast-self examination,

bilateral low-dose film-screen mammogram using a Mammomat, and same-day feedback of examination results to patient and physician.

Study design. The project has two study components: a retrospective assessment of subjects' characteristics and mammography use during the baseline year and a 2-year prospective controlled trial of the intervention. Subjects from the five sites are being enrolled. A baseline year has been identified for each site. All female patients ages 40 years or older who lack a history of breast cancer and who visited a primary care physician during the baseline year will be eligible for enrollment. The sample sizes at each site all exceed 140 which was the sample size determined necessary to have sufficient power (0.80) to detect an absolute change in two rates of 17 percent (baseline estimate of 20 percent) when the significance level was 0.05. In the clinic with the smallest number of eligible women, 360 women were assigned to the intervention group and an equal number to the control group. In the clinic with the most patients, 668 women were randomized to each group. A stratified randomization procedure (*6*) was used to assign women within 5-year age categories to intervention and usual care.

Institutional agreements. Prior to the initiation of the project, no organized program of breast cancer screening had been available to the women who used these health care services. This project establishes a formal mechanism of referral to the two breast cancer detection centers and provides no cost mammography examinations for patients from three sites. The insurers of those women with third-party coverage at all sites will be billed in standard fashion. Mammography costs for uninsured women referred from health department Sites 1 and 2 will be paid for by outside sources. Patients referred from the HMO will be covered for screening mammography at a per capita rate established in agreement between the HMO and the detection centers. Women from the two private-hospital clinics are subject to the same cue-to-action interventions; however, funding limitations of these sites preclude giving no cost mammograms to uninsured women. The hospital's usual billing procedures will be followed.

Data Collection and Management

Physician prompts. The medical record prompt, referred to as the prompt encounter form (PEF), is used to (*a*) indicate to the physician that a woman is due for mammography as of the current visit, (*b*) store and display information concerning the woman's risk factors for breast cancer and results of past mammograms, and (*c*) serve as a data collection instrument concerning the physician's offer of mammography and the woman's response. The woman's clinical history and previous use of mammography is collected during the baseline medical record review and printed on the PEF. The PEF is inserted into the medical record of intervention group women 1 month in advance of the mammography due date as defined by guidelines of the National Cancer Institute that recommend a mammogram every 2 years for women between the ages of 40 and 49 and annually after age 50.

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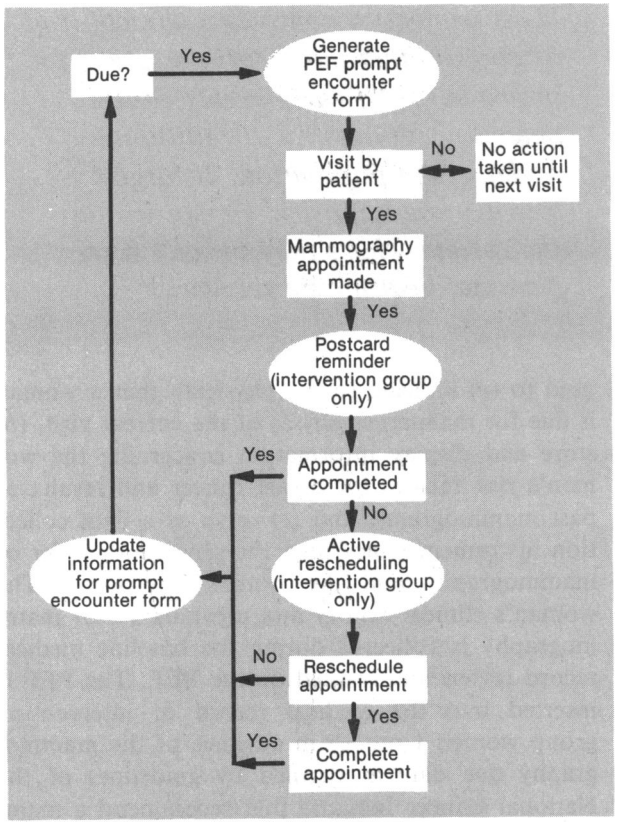
Completion of the PEF (the form is available on request to the authors) provides information concerning both physician and patient behavior. When mammography is offered, the indication (screening versus evaluation), initiator (patient versus physician), and patient response (accept, defer, refuse) are ascertained. When mammography is not offered, the physician's explanation is recorded and, when necessary, the due date is adjusted appropriately. For example, confirmation of a physician's indication that a mammogram has been accomplished subsequent to the baseline medical record review leads to a revised due date. Indication by the physician that mammography is not clinically appropriate is reviewed by project consultants and may lead to patient exclusion (for example, bilateral mastectomy, terminal illness). Other explanations (insufficient time, alternative provider) are noted but lead to reissuance of the original prompt.

Nurse referral form. The physician's referral is implemented by the nursing staff who schedule the appointment, reinforce its importance, and provide educational materials to the patient concerning the procedure. A nurse referral form documents the

Figure 2. The information management system



appointment and also collects information required by the breast cancer detection center for subsequent contact with the patient.

Reminders and appointment rescheduling protocol. All women referred to the breast cancer detection centers from each study site are monitored for completion of mammography; only women randomized to the intervention group are sent postcard reminders, and their rescheduling is facilitated. A postcard is sent to the woman 1 week in advance of the scheduled appointment; it reminds her of the date and time, the address of the mammography center, directions for parking, and the telephone number to call for further information.

Women in the intervention group who miss their appointments enter the active rescheduling protocol and receive a letter and up to four telephone calls over a 2-week period to facilitate rescheduling of the appointment.

Information management. A computerized information management system was designed to organize and integrate patient-specific information from multiple sources and produce intervention prompts required by the study protocol. There are two components to the system, prompting and tracking. Figure 2 is a diagram of the information management system. Each PEF form defines a transaction which begins with an intervention group woman's visit and concludes with documentation of mammography outcome or a returned PEF indicating no referral. Once a mammogram is completed, the next due date is recomputed by the PEF System and a new PEF is generated 1 month before the next due date. When mammography is not completed, the system automatically generates another PEF form.

All appointments scheduled as a consequence of a patient's referral for mammography (that is, for all intervention, control, and nonstudy women) enter the tracking component. Mailing labels for postcards to intervention group women are generated according to the study protocol, as are prompts to followup coordinators who investigate completion of appointments. Failure to complete a scheduled appointment initiates the active rescheduling protocol. This intervention results in a completed or failed appointment or a refusal to schedule. These outcomes and the results and recommendations from the mammogram are transmitted to the prompting component and are used to produce an updated PEF.

Feedback. Feedback to the participating institutions and physicians is provided at quarterly intervals. Initial orientation sessions are conducted with the physicians and nursing staff at each clinical site. These sessions provide an overview of the project's activities and focus specifically upon the prompting system for physicians and on scheduling reinforcement for nursing staff. Subsequent physician feedback includes referral and completion rates by physician and site for the baseline and study periods. Intervention women are the only group for whom complete data are available on a quarterly basis. The feedback sessions are intended to reinforce physician use of the prompt system and to provide an opportunity to discuss issues of mutual concern.

Evaluation Plan

Primary objectives of this intervention trial are to increase physicians' referrals for mammography and to increase women's completion of mammography upon referral. The impact of the intervention on physicians and clinic staff at each site will be assessed in terms of change in the rate of

referral. Impact upon the communities served will be evaluated in terms of change in the rate of mammogram completion. The effects of the intervention upon individual behavior (referrals made, referrals accepted, and mammograms completed) will be evaluated using models that describe interrelationships among behavior, intervention exposure, and other relevant predictors.

We will assess the intervention's effectiveness among all women who are established users and its efficacy among all mammography-due women who visit the physician and are thus exposed to the intervention. Intervention and control groups will be compared at baseline and at the end of each study year. Changes in rates for each group will also be evaluated. Measures of efficacy require specific dates of clinic visits and of previous mammography to determine that a visit occurred when the woman was due for mammographic screening. These data are available only for the 2-year study period and, consequently, efficacy can be measured only at the end of the 2 study years. Measures of effectiveness that assess use among all women in a cohort can be determined at baseline and during the study.

We define "crude rate" as that observed among all women in the intervention or control groups (that is, it is a measure of effectiveness). The "procedure-adjusted rate" refers to the women known to be due for mammography at the time of their visit (that is, it is a measure of efficacy). Crude rates will be used to contrast baseline and study periods while procedure-adjusted rates will be used to contrast within study years.

Baseline measures. For each year of the study, rates are computed separately for groups of women classified as new patients and as established patients. Women are defined as new patients during the year of their initial visit to a clinical site and as established during all subsequent years. The study cohort was defined by all women who had visited a clinical site during the baseline year (for example, 1988 for Site 1). Woman in the study cohort who also visited during the preceding year (1987) constitute the established patient group for the baseline year. Women whose initial visit occurred during the baseline year constitute the new patient group for the baseline year.

Evaluation measures. Use of mammography by the intervention and control groups will be examined over time. Comparability of the two groups at baseline (demographic, clinical, and previous exposure to mammography) will be evaluated using information available from the retrospective record review. When the intervention begins, our evaluation plan anticipates changes over time in control group behavior based on (*a*) reduction in the financial barrier to mammography (an institution-wide intervention) (*b*) secular change (co-interventions unrelated to project activities), and (*c*) project-related physician and nursing staff education and feedback. The magnitude of these joint effects will be estimated by differences of rates of mammography use among established patients in the control group at baseline and at the end of the first study year. Project-specific interventions include the prompt component and the active rescheduling components. Comparison of rates of mammography use by the intervention group at baseline and at the end of the first study year will assess the combined effect of these project interventions operating in conjunction with the secular and institutional effects. The specific effect of project intervention will be estimated by comparing rates of mammography use between the intervention and control groups at the end of the first study year, after adjustment for any differences at baseline.

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The overall effect of the active rescheduling intervention includes the postcard effect and the telephone rescheduling. While all intervention women are subject to the postcard reminder, only those who fail to keep their initial appointment are subject to telephone rescheduling. Since women in the control group are unlikely to receive multiple referrals or rescheduled appointments as contrasted with women in the intervention group, the postcard effect will be measured as the difference in the proportions of intervention and control women who keep their initial appointment for mammography during the study year.

The active rescheduling intervention (postcard and telephone rescheduling) is evaluated at the end

Table 1. Reasons for exclusion of subjects during enrollment at two study sites

Status and reasons	*Site 1*	*Site 2*
Total randomized	505	362
Enrolled	468	310
Not enrolled	37	52
Reasons not enrolled:		
History of breast cancer	1	0
No 1988 visits	12	17
Age less than 40	0	1
Deceased	0	1
Duplicate	0	1
Male	2	2
Transfer	17	0
Pending	3	0
Not found	2	30

of the study year. For those women who scheduled an appointment during the year, the difference in the proportions of women who complete the initially scheduled mammogram in the intervention and control groups will be used to measure the overall effect.

Models for referral and completion. Secondary evaluation objectives include description of referral and appointment keeping behaviors and investigation of the relation of these behaviors to characteristics of physicians and patients. Our conceptual model (fig. 1) specifies a relationship among offering, acceptance, and completion behaviors. The potential predictor variables are intercorrelated, and each may affect each outcome (referral offers, referral acceptance, and mammogram completion). For example, a family history of breast cancer may influence the probability that a woman is offered a mammogram by the "prompted" physician, the likelihood that she will accept the offer, and the probability that she will complete the initially scheduled appointment. Furthermore, factors related directly to a proximate outcome (offering or acceptance) may manifest an indirect effect on completion. Study physicians will describe their reasons for offering or not offering mammography in response to the prompt. As data become available, the relationship of previous referral and completion behaviors to subsequent behaviors will be integrated into the models.

We will also assess the costs of the intervention components. To the extent that we can partition the effects of the individual components, we will contrast the relative cost-effectiveness of the prompt system, active rescheduling protocol, and mammography charge reduction.

Statistical Methods

The evaluation of the intervention effects uses changes in referral and completion rates for each specific clinic population separately. The age-stratified randomization procedure produced a stratified random sample of women in both intervention and control groups. Consequently, crude rates and procedure-adjusted rates for the intervention and control groups are estimates of the rates for the entire clinic population under intervention conditions and usual care conditions, respectively. In the absence of significant measurement error, the estimated variance of a crude rate, p is

$$var(p) = \left[1 - \frac{n}{N}\right] \frac{p\,(1-p)}{n}$$

where n is the sample size and N is size of the population (*7*). For procedure-adjusted rates that are computed for women who visit the clinic when due for mammography, the estimated variance is

$$var\left[\frac{x}{v}\right] = \left[\frac{x}{v}\right]^2 \left[\frac{var(x)}{x^2} + \frac{var(v)}{v^2} - 2\frac{cov(x,v)}{xv}\right]$$

where x is the number of referrals (completions), v is the number of women who visit when due; $var(x)$ and $var(v)$ are the estimated variances of x and v; and $cov(x,v)$ is the estimated covariance between x and v (*8*). Contrary to most designs, where the sample is very small compared with the size of the population ($n \div N$ is approximately zero), in this project approximately 50 percent of each clinic population was assigned to one of the two groups.

In evaluation, two types of comparisons will be made: (*a*) two groups observed for the same period and (*b*) one group observed for two different periods. For crude rates, a t-test for independent groups will be used for the former comparison and a paired t-test will be used for the latter comparison. Weighted least squares analyses (*9*) will be used to compare procedure-adjusted rates to adjust for unequal rate variances and different patterns of eligible visitors over time.

Logistic regression analysis will be used to identify significant relationships between referral offers, referral acceptance, and mammography completion and individual characteristics (*10*). Multivariate models describing interrelationships between co-dependent outcomes and predictor variables will be developed and evaluated using goodness-of-fit statistics (*11*).

Results

The results describe patient characteristics and use of mammography at two clinical sites for the baseline year of 1988. At this time, medical record reviews have been conducted only for women assigned to the intervention group. As noted in table 1, 505 women have been randomized to the intervention group at Site 1 and 362 at Site 2. The major reasons for exclusion are indicated in table 1. Of the 468 and 310 women at Sites 1 and 2 who will be followed during the first study year, 327 and 198 were established users for the baseline period.

The demographic characteristics of the established user cohort for the baseline period are presented in table 2. Age-specific referral and mammography completion rates (by 5-year cohorts) among established patients at the two clinical sites are presented in table 3 for the baseline year of 1988. Overall, approximately one-quarter of these women had been referred for mammography during the baseline year. Women 50–54 years of age appear most likely to have been referred, and referral rates tended to decline with advancing age. The rates of referral during the first half of each age decade appear to exceed those observed for the second half.

Not all referrals resulted in a completed mammogram (table 3). Similarly, not all mammograms were accompanied by a documented referral. Overall, between 13 and 17 percent of study women received a mammogram in 1988. As was noted for referral rates, completion rates tended to be lowest among the oldest women. The age of those with the highest completion rate was 10 years older in Site 2 (65–69 years) than in Site 1 (55–59 years). The proportion of referrals resulting in a completed mammogram appeared to differ substantially by age group (with no apparent pattern) and between the two sites. Approximately two-thirds of referrals at Site 2 were completed as contrasted with one-half at Site 1.

The relationship of patients' demographic characteristics other than age to the referral and completion of mammography is also presented in table 3. The few nonblack women preclude meaningful comparisons by ethnicity. No consistent relationship of marital status to referral or completion is apparent. Perhaps most interestingly, women lacking health insurance coverage appeared no less likely to be referred for mammography or to complete the procedure, than did women with commercial or other forms of coverage.

Table 2. Demographic characteristics of the established user cohort at baseline

Characteristic	Site 1 = (N=327)		Site 2 (N=198)	
	Number	Percent	Number	Percent
Age as of Jan. 1, 1988:				
40–49	48	14.7	50	25.3
50–59	88	26.9	47	23.7
60–69	133	40.7	69	34.8
70 or older	58	17.7	32	16.2
Ethnicity:				
Black	299	91.4	174	87.9
White	13	4.0	6	3.0
Other	5	1.5	5	2.5
Missing	10	3.1	13	6.6
Marital status:				
Married	69	21.1	37	18.7
Widow	65	19.1	60	30.3
Other	72	22.8	65	32.8
Missing	121	37.0	36	18.2
Insurance:				
Commercial	32	9.8	16	8.1
Medicare	70	21.4	36	18.2
Medicaid	19	5.8	18	9.1
General assistance	28	8.6	20	10.1
Other	5	1.5	6	3.0
None	129	39.4	81	40.9
Missing	44	13.5	21	10.6
Number of chronic conditions:				
0	22	6.7	11	5.6
1	77	23.5	56	28.3
2	116	35.5	75	37.9
3	77	23.5	36	18.2
4	30	9.2	16	8.1
5	5	1.5	4	2.0
Cancer				
Stated yes	3	0.9	2	1.0
Not stated	324	99.1	196	99.0
Diabetes:				
Stated yes	99	30.3	45	22.7
Not stated	228	69.7	153	77.3
High blood pressure:				
Stated yes	275	84.1	161	81.3
Not stated	52	15.9	37	18.7
Congestive heart failure:				
Stated yes	30	9.2	22	11.1
Not stated	297	90.8	176	88.9
Chronic obstructive pulmonary disease:				
Stated yes	42	12.8	21	10.6
Not stated	285	87.2	177	89.4
Atherosclerotic coronary vascular disease:				
Stated yes	64	19.6	41	20.7
Not stated	263	80.4	157	79.6
Osteoarthritis:				
Stated yes	172	52.6	106	53.5
Not stated	155	47.4	92	46.5
Family history of breast cancer:				
Stated yes	18	5.5	10	5.1
Not stated	309	94.5	188	94.8
History of cancer:				
Stated yes	2	0.6	1	0.5
Not stated	325	99.4	197	99.5

Table 3. Rates of referral and completion by selected demographic characteristics for the established user cohort at baseline

Characteristic	Site 1					Site 2				
	Referral			Completion		Referral			Completion	
	Number	Percent	S.E.	Percent	S.E.	Number	Percent	S.E.	Percent	S.E.
Age as of Jan. 1, 1988:										
Overall	327	26.7	1.7	12.8	1.3	198	26.6	2.2	16.7	1.8
40–44	10	50.0	11.2	20.0	8.9	17	41.1	8.4	17.7	6.5
45–49	38	23.7	4.9	7.9	3.1	33	18.2	4.7	21.2	5.0
50–54	46	37.0	5.0	6.5	2.6	21	42.9	7.6	19.1	8.6
55–59	42	33.3	5.1	26.2	4.8	26	30.8	6.4	7.7	3.7
60–64	68	29.4	(3.8)	19.1	(3.4)	38	31.6	(5.3)	18.4	(4.4)
65–69	65	27.7	3.9	10.8	2.7	31	12.9	4.3	22.6	5.3
70–74	26	11.5	4.4	7.7	3.7	17	23.5	7.3	11.8	5.5
75–79	32	3.1	2.2	3.1	2.2	15	6.7	4.6	6.7	4.6
Ethnicity:										
Black	299	26.4	2.0	13.0	1.4	174	24.1	2.3	17.2	2.0
White	13	15.4	7.1	0.0	...	6	50.0	14.4	16.7	10.8
Other	5	40.0	15.0	40.0	15.0	5	20.0	12.6	0.0	...
Missing	10	40.0	11.0	10.0	6.7	13	38.5	9.5	15.4	7.0
Marital status:										
Married	69	39.1	4.2	18.8	3.3	37	27.0	5.2	16.2	4.3
Widow	65	24.6	3.8	12.3	2.9	60	33.3	4.3	16.7	3.4
Other	72	30.6	3.8	8.3	5.6	65	23.1	3.7	16.9	3.3
Missing	121	18.2	2.5	12.4	2.1	36	16.7	4.4	16.7	4.4
Insurance:										
Commercial	32	21.9	5.2	15.6	4.5	16	37.5	8.6	37.5	14.0
Medicare	70	15.7	3.1	5.7	2.0	36	13.9	4.1	13.9	4.1
Medicaid	19	26.3	7.1	21.1	6.6	18	27.8	7.5	16.7	6.2
General assistance	28	25.0	5.8	10.7	4.1	20	20.0	6.3	20.0	6.3
Other	5	40.0	15.5	0.0	...	6	16.7	10.8	40.0	14.1
None	129	31.8	2.9	14.7	2.2	81	29.6	3.6	13.6	2.7
Missing	44	31.8	5.0	15.9	3.9	21	28.6	7.0	9.5	4.5

NOTE: SE = standard error.

Discussion

If breast cancer control efforts are to succeed in our settings, barriers to the use of mammography must be diminished. These barriers include failure of physicians to offer the mammography, patients' reticence or inability to complete the procedure, and out-of-pocket patient expense. Interventions that target each barrier have previously been demonstrated as effective. Computer-generated prompts improve physician performance (*12*), elimination of expense increases patient completion of scheduled mammography (*13*), and postcard reminders increase compliance with recommended procedures (*14*). The joint effectiveness of these interventions has not been assessed. In addition, our population may respond differently to them than have the populations previously studied. Thus, this is not a demonstration project, but rather a controlled clinical trial of integrated and carefully documented interventions. Furthermore, in an era of increasing concern and publicity regarding cancer control among minority populations, the experimental design allows us to distinguish secular changes from experimental effect.

Our baseline assessment demonstrates that only one-quarter of women in these sites were referred for mammography in 1988, and only half of those referred were able to complete the procedure. The need for intervention in this population is thus apparent. We have successfully effected institutional collaboration in support of the project. The information management system that is requisite to the physician and patient prompting systems, the core of the intervention, is operational and has been implemented in two study sites. Initial experience suggests that our physician and patient populations have enthusiastically received the interventions. We are thus confident that the intervention trial, as planned, is feasible.

We anticipate a number of potential problems. Clearly our clinical populations are not static, and the enrollment of nonstudy women at the clinical sites increases information management and other costs, since all referred women are tracked and no woman from the mammography "charge exempt"

sites is billed for the service. Our initial calculation of sample size was based upon reasonable disenrollment projections, and thus we do not anticipate a problem with loss of patients.

We recognize that spillover of the intervention into the control group is a consequence of our design. Physicians at each site care for both intervention and control patients and thus may increase referral practices among the control group based upon their experience with intervention patients. We were unable to randomize physicians because the prompt system is patient specific while the assignment of patients to physicians varies over time. To the extent that a prompt effect is observed, however, we can be confident that the effect is attributable to the reminder function as opposed to a more general physician education effect, since the same physicians see both groups of patients.

A final limitation of the design is difficulty in partitioning the specific effects of the component interventions since they are applied jointly. It will not be possible to measure the effect of the financial barrier since there is no concurrent control group for that intervention. We will, however, be able to contrast two sites that provide mammography at usual cost with the three that have eliminated patient cost. Similarly, while the effect of the physician prompt can be specifically assessed in terms of referrals, its impact upon completion cannot be separated from the postcard reminder effect. Finally, the reinforcement sessions conducted with the physicians are intended to sustain prompt-system responsiveness, but they may also influence physician referral behavior. Our primary research objective, however, is to assess the overall effect of an integrated set of interventions. Our design will also support, within the limits noted, conclusions regarding specific intervention components.

This project focuses upon reducing administrative and logistic barriers to mammography. Our conceptual model, however, also recognizes that personal beliefs and interpersonal interaction may be important elements in breast cancer control efforts. If physicians choose not to heed our prompts or patients ignore our reminders, a sophisticated information management system may prove ineffective. Although we are optimistic that these interventions will improve the use of mammography in our settings, we recognize that important barriers remain unaddressed. Complementary studies of the context within which people make health care decisions can only improve our ability to impact favorably upon breast cancer and its control in our community.

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