Effect of Direct Mail as a Population-Based Strategy to Increase Mammography Use among Low-Income Underinsured Women Ages 40 to 64 Years

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Abstract

Women with inadequate health insurance have lower mammography rates than the general population. Finding successful strategies to enroll eligible women is an ongoing challenge for the National Breast and Cervical Cancer Early Detection Program. To test the effectiveness of a population-based strategy to increase mammography utilization among low-income underinsured women ages 40 to 64 years, a randomized trial was conducted to assess the effect of two mailed interventions on mammography utilization through Sage, the National Breast and Cervical Cancer Early Detection Program in Minnesota. Women (N = 143,467) ages 40 to 63 years [mean (SD), 49.7 (6.8)] with estimated household incomes below $50,000 (47.9% were <$35,000) from a commercial database were randomized to three groups: Mail, Mail Plus Incentive, or Control. Both the Mail and the Mail Plus Incentive groups received two simple mailings prompting them to call a toll-free number to access free mammography services. The Mail Plus Incentive intervention offered a small monetary incentive for a completed mammogram. After 1 year, both intervention groups had significantly higher Sage mammography rates than the Controls, and the Mail Plus Incentive group had a significantly higher rate than the Mail group. The Mail and Mail Plus Incentive interventions were estimated to produce increases in Sage screening rates of 0.23% and 0.75%, respectively, beyond the composite Control rate of 0.83%. Direct mail is an effective strategy for increasing mammography use through Sage. Coupling direct mail with an incentive significantly enhances the intervention’s effectiveness. Direct mail should be considered as a strategy to increase mammography use among low-income, medically underserved women. (Cancer Epidemiol Biomarkers Prev 2005;14(10):2346–52)

Introduction

Although mammography rates have been increasing overall, a 25% gap between the rates for insured and uninsured women has persisted (1). Women who are eligible for federal programs that cover all or part of the costs of mammography [Medicaid, Medicare, and the National Breast and Cervical Cancer Early Detection Program (NBCCEDP)] remain under-screened relative to the general population (2-4). Unfortunately, modest cost-sharing through copayments and deductibles seems to be a barrier to mammography use (3, 5-7), and even making free screening services available does not ensure screening (8-12).

A challenge for national screening programs has been to find effective population-wide strategies to recruit underserved women to use these services (13). There is a need for strategies that are relatively simple, inexpensive, sustainable, and capable of reaching many women (14). However, research on population-wide interventions is lacking. The vast majority of tested interventions have been individual-, hospital-, health plan-, or community-directed approaches involving strategies to address personal, systems, and/or cultural barriers to screening (9, 15-21). These interventions are unsuitable for population-wide implementation because of their complexity, high cost, relatively small reach, and limited generalizability. Although mass media can reach large audiences, it can be very expensive and may not expose the targeted audience to the intended message or change screening behavior (22, 23).

In contrast to mass media and more intensive approaches, direct mail interventions may represent a more promising population-based strategy for promoting mammography use among underserved women. Direct mail provides a relatively efficient and inexpensive way (24) to reach many geographically dispersed individuals in their homes, including those not typically exposed to mass media (23, 25). Although direct mail may not be an effective strategy for altering core attitudes and beliefs about health behaviors, mailed interventions can prompt behavior, enhance awareness, and reduce specific knowledge gaps (26-30). Finally, direct mail materials can be tailored to various target audiences, including older and low literacy populations (27, 31). At the population level, these advantages can offset limitations of direct mail, including its low intensity and relatively weak response rates (27, 31).

Although direct mail may be effective among only a small percentage of people, the population base of the national programs, which cover the costs of mammography for lower income and older women (Medicaid, NBCCEDP, and Medicare), is extremely large. Consequently, a small percentage increase in screening among those eligible for or enrolled in these programs could have a significant effect on the absolute numbers of women being screened and therefore on the public’s health. The main purpose of this study was to test the effectiveness of mailed interventions as a population-wide approach for increasing screening mammography use among women who are eligible for free screening services through NBCCEDP. A secondary purpose of the study was to investigate the utility of the National Cancer Institute’s (NCI) Consumer Health Profiles (32) for targeting direct mail interventions to increase mammography utilization.
Materials and Methods

Overview and Setting. A randomized, controlled trial was used to test the efficacy of two types of mail-based interventions to increase screening mammography rates among low-income Minnesota women ages 40 to 63 years through the Sage Screening Program. Sage is the NBCCEDP (33) in Minnesota. It provides free screening services to women who are ages ≥40 years, have household incomes at or below 250% of the federal poverty level, and are uninsured (i.e., have copayments or unmet deductibles for cancer screening). Sage screens ~13,000 women annually and is operated by the Minnesota Department of Health through a statewide network of >300 clinics.

Participants. The target population—low-income, underinsured women ages 40 to 64 years—cannot be enumerated. Consequently, the sampling frame was a commercial mailing list of 145,467 Minnesota women ages 40 to 63 years from census blocks having household size and income characteristics consistent with Sage income guidelines. Sample characteristics are summarized in Table 1.

Intervention. A randomized, controlled trial design was used to test the efficacy of two types of mail-based interventions to increase mammography screening rates beyond those of a no-intervention control group. The two intervention groups are called Mail and Mail Plus Incentive. These interventions took place in the context of other, ongoing Sage program recruitment activities that included efforts by community health agency recruiters, occasional print and broadcast media advertisements, and individual participating clinicians promoting the Sage program to their patients. Women in all three study groups may have been exposed to these other recruitment activities.

Before the intervention mailings, the Minnesota Department of Health sent a letter to all primary care physicians in Minnesota informing them about the study. We wanted to avoid having physicians caught off-guard by patients asking for a mammogram through a state screening program with which the physician was unfamiliar. We encouraged doctors to support our efforts by referring patients for appropriate screening services if they requested a mammogram in response to our mailing. This should not have had a differential effect on the study groups as doctors of women in all groups should have had an equal chance of reading this letter. The HealthPartners Research Foundation institutional review board approved all research and procedures in this study.

Direct Mail Materials. Women in both intervention groups were sent two different mailers ~1 month apart. Both mailers consisted of a folded card with a very brief message about the availability of a free mammogram through the Minnesota Department of Health and a prompt to call its toll-free number for more information. The mailers were designed to grab the reader’s attention and prompt quick action.

The mailers for the Mail Plus Incentive group were identical to those for the Mail group except that they also offered a $10 monetary incentive to women who completed a Sage mammogram within ~1 year. The mailers were sent in Minnesota Department of Health envelopes personally addressed to the intended recipient. Each of the four mailers had a unique extension as part of the telephone number so that each resulting call could be linked to a specific mailer.

The intervention mailers were a product of 2 years of extensive formative work. In the first year, the study team conducted six focus groups with women from the target population to test initial designs and messages. Two small-scale pilot mailings were completed subsequently, but they yielded very low call response rates. Consequently, a marketing communications firm with direct mail expertise was hired to develop more sophisticated looking materials with eye-catching graphics and messages that would prompt women to call. Four rounds of pilot studies, consisting of 28 small-scale mailings, were conducted to test various designs and messages and to compare different incentive amounts, types of mail service (e.g., first-class versus standard), and the use of an envelope versus a self-mailer (a self-contained mailing that does not require an envelope). From these pilot studies, we concluded that (a) incentives seem to be effective, (b) standard (bulk rate) postage works almost as well as first-class, (c) materials should greatly limit text and rely on effective images, (d) the images (and related text) need to be evocative or engaging, and (e) there should be a clear and simple action step for the reader (e.g., “call this number now for an appointment”).

<table>
<thead>
<tr>
<th>Variable *</th>
<th>Total (N = 145,467), n (%)</th>
<th>Low MRC (n = 34,540), n (%)</th>
<th>High MRC (n = 110,927), n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age* (y)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>76,402 (52.5)</td>
<td>16,855 (48.8)</td>
<td>59,547 (53.7)</td>
</tr>
<tr>
<td>50-63</td>
<td>69,065 (47.5)</td>
<td>17,685 (51.2)</td>
<td>51,380 (46.3)</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>49.70 (6.79)</td>
<td>50.05 (6.93)</td>
<td>49.59 (6.74)</td>
</tr>
<tr>
<td>Estimated household income*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$15,000</td>
<td>9,999 (6.9)</td>
<td>250 (10.1)</td>
<td>6,527 (5.9)</td>
</tr>
<tr>
<td>$15,000-24,999</td>
<td>19,256 (13.2)</td>
<td>5,473 (15.8)</td>
<td>13,783 (12.4)</td>
</tr>
<tr>
<td>$25,000-34,999</td>
<td>40,419 (27.8)</td>
<td>13,821 (40.0)</td>
<td>26,598 (24.0)</td>
</tr>
<tr>
<td>$35,000-49,999</td>
<td>75,793 (52.1)</td>
<td>11,774 (34.1)</td>
<td>64,019 (57.7)</td>
</tr>
<tr>
<td>Geographic location*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twin Cities metropolitan</td>
<td>79,845 (54.9)</td>
<td>6,935 (20.1)</td>
<td>72,910 (65.7)</td>
</tr>
<tr>
<td>Nonmetropolitan area</td>
<td>65,622 (45.1)</td>
<td>27,605 (79.9)</td>
<td>38,017 (34.3)</td>
</tr>
<tr>
<td>Prior Sage screening*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>3,512 (2.4)</td>
<td>1,519 (4.4)</td>
<td>1,993 (1.8)</td>
</tr>
<tr>
<td>No</td>
<td>141,955 (97.6)</td>
<td>33,021 (95.6)</td>
<td>108,934 (98.2)</td>
</tr>
</tbody>
</table>

*P < 0.001.
Telephone Appointment Scheduling System. A telephone system was developed to handle a large volume of calls, collect caller information, and perform several key functions to facilitate scheduling. Women who called the toll-free number and gave informed consent were assessed for eligibility for the free screening program. Telephone staff encouraged eligible callers to schedule an appointment immediately using our direct appointment scheduling system. Telephone staff identified a clinic that best suited the caller’s needs and attempted to make a three-way call with the caller and the clinic to facilitate appointment making. The purpose of three-way direct appointment scheduling calls was to ensure that an appointment was made by the end of each call. Sometimes this was not possible because the clinic scheduler was unreachable (e.g., the clinic was closed), and some women preferred to make an appointment on their own. In these situations, telephone staff made follow-up calls to women to see if appointments had been made. Women who made appointments through direct appointment scheduling were sent appointment confirmation letters. Women who had been screened <9 months before their call were offered a reminder call 1 or 2 months before their due date to schedule an appointment. Ineligible women were referred to the American Cancer Society’s low-cost mammogram program.

Intervention Implementation. For both intervention groups, the first and second mailings were sent ~1 month apart, from May to July 2000. The mailings were staggered to spread out telephone call volume. Different classes of postage were used for the two mailers: standard (bulk) rate was used for the first mailer; the second mailer required first-class postage due to its unusual shape.

Objectives. The primary objective of the study was to determine the comparative effect of two direct mail interventions on mammography utilization through Sage. Specifically, we wanted to know (a) whether each direct mail intervention group differed in Sage mammography rate from the no-intervention control group and (b) whether the Mail Plus Incentive intervention group mammography rate differed from that of the Mail intervention group. The secondary objective was to assess the value of NCI’s Consumer Health Profiles by determining whether the effects associated with the direct mail interventions differed between the low MRC and the high MRC groups.

Outcomes. The primary outcome was completion of a mammogram through Sage within 13 months after the intervention’s onset (i.e., between May 2000 and June 2001; cf. ref. 34). Outcome status was determined by probabilistic matching (35) of the study mailing list and the Sage patient record database, augmented by telephone calls to questionable match cases and Social Security number information from the mailing list supplier. Exclusion of 100 questionable matches that could not be confirmed led to an overall 6.3% reduction in the number of women screened and thus likely a more conservative estimate of intervention effects. Project staff who participated in the matching and adjudication process were blind to the intervention condition assignment of the participants. Because callers requested a telephone extension associated with their intervention, telephone staff were not blinded. We also tracked call outcomes to ascertain the percentage of callers who were eligible for Sage and the percentage of eligible women who scheduled appointments.

Sample Size and Allocation to Intervention. The sampling frame provided 145,467 possible participants for the study; 34,540 (23.7%) were from low MRC strata and 110,927 (76.3%) were from high MRC strata. Because Sage screening percentages and intervention effects were anticipated to be small, samples were allocated in a manner that would permit detection of modest intervention effects. In the smaller low MRC stratum, the mailing list names were allocated in essentially equal proportions. To constrain costs in the much larger high MRC stratum, names were allocated in a ~1:1:5.9 ratio to the Mail, Mail Plus Incentive, and Control groups, respectively. These sample size allocations gave ≥90% power to detect intervention effects of 1% in absolute size while controlling the overall z level at <0.05. We overallocated to the Control group because this could be done at minimal cost and with a substantial increase in power. Statistical analyses of intervention effects were conducted within each MRC stratum, thereby avoiding difficulties from the confounding of MRC and intervention caused by the differential allocation proportions in the two strata.

Randomization. Cases were split into the low and high MRC strata. Within each stratum, SAS uniform random function RANUNI was used to assign random numbers to cases, which were then sorted based on the random number value. The sorted lists were then segmented into Control, Mail, and Mail Plus Incentive groups.

Statistical Analysis. The primary analyses concerned overall postintervention Sage screening rate differences between intervention groups within MRC strata. Contingency tables (3 intervention groups × 2 screening outcome status groups) were constructed for each MRC stratum, and associations between intervention group and screening rates were evaluated by χ² or Fisher’s exact test. On finding significant results, contrasts between pairs of intervention groups and 95% confidence intervals (95% CI) were calculated.

To evaluate whether intervention effects differed between MRC strata, contrasts comparing interventions effects between the two strata were calculated (with 95% CIs). When no significant MRC strata differences in intervention effects were detected, pooled estimates of intervention effects (and corresponding 95% CIs) were calculated, with the effects estimate from each stratum weighed by the inverse of its variance. For benchmark purposes, composite control group screening rates were estimated for each sample by calculating the weighted average of the low and high MRC control group screening rates.

In the course of data analysis, it became apparent that MRC stratum was confounded with history of enrollment in Sage before the direct mail intervention. Women in the low MRC stratum were ~2.5 times as likely to have been screened previously through Sage than were high MRC women (see Table 1). To untangle the screening history and MRC effects, the analyses were poststratified based on Sage screening history.

Results

Sample Characteristics. Comparison of the intervention groups’ demographic characteristics and history of prior screening through Sage within the MRC strata suggested that the groups were equivalent and randomization successful. As shown in Table 1, the two MRC strata had similar age distributions but large, statistically significant differences in income, geographic location, and screening history existed. Compared with women in the high MRCs, women in the low MRCs had lower household incomes, were more likely to reside outside of the Twin Cities metropolitan area, and were substantially more likely to have had a Sage mammogram before the intervention.

Call Outcomes. During the intervention period, 2,011 calls were made to the toll-free line in response to the mailers (see Table 2). Because the two interventions were assigned different extension numbers, we could almost always determine which intervention prompted the call. However, a very limited
number of calls came from women who were not the intended recipient (and therefore not assigned to an intervention group). Anecdotal evidence suggests that this usually occurred because the intended recipient shared their mailers with friends or neighbors. More than four times as many calls came to the Mail Plus Incentive extension as the Mail extension. However, proportionately fewer Mail Plus Incentive callers were program eligible (29.9% versus 42.8%). More than half of the callers (1,163 or 52.8%) did not meet the eligibility criteria for Sage. Another 199 (9.9%) callers declined to complete the telephone eligibility screening or only wanted program information. Their eligibility was not determined.

Similar proportions of the eligible callers from the two interventions made appointments during the time of the call (73.6% and 75.5% for Mail and Mail Plus Incentive callers, respectively). As expected, the vast majority of women called within the first 2 months: two-thirds of the 2,011 calls were received by the end of July 2000. Thereafter, the volume of calls dropped dramatically but continued at a fairly consistent rate during the remaining intervention period.

### Postintervention Screening Outcomes

Postintervention Sage screening rates by intervention group and by MRC stratum are reported in Table 3 for all women in the study as well as for subgroups of women with no prior Sage screening and women with prior Sage screening. Results for all women in the study are presented in the top section of Table 3. Omnibus tests detected significant ($P < 0.001$) intervention group differences in postintervention Sage screening rates for women in both low and high MRC strata. As shown in the top of Table 4, follow-up pair-wise contrasts for women in low MRCs detected significant ($P < 0.001$) differences between the Mail Plus Incentive group and the Control and Mail groups; the Control versus Mail groups comparison approached statistical significance ($P = 0.063$). Among women in the high MRCs, significant ($P < 0.01$) differences were detected among all three intervention groups. Point estimates of absolute gains (versus the Control group) in screening rates associated with the Mail Plus Incentive interventions were 1.03% and 0.67% for the low MRC and high MRC strata, respectively. The screening rates in the Control group were 1.68% and 0.56% for the low and high MRC strata, respectively.

Among women who had not screened previously through Sage (shown in the middle sections of Tables 3 and 4), omnibus tests of screening proportions detected significant intervention group differences for women in both MRC strata. Follow-up pair-wise contrasts indicated significant ($P < 0.005$) differences between all intervention groups in both MRC strata (Table 4). Results for women who had prior Sage screening experience are reported in the bottom sections of Tables 3 and 4. No significant intervention effects were detected for the high MRC stratum women in this subsample. For women in the low MRC stratum of this subsample, the omnibus test of intervention effects only approached significance ($P = 0.051$). Thus, the statistically significant differences observed in the contrasts reported for this stratum in Table 4 should be interpreted cautiously.

Evidence regarding possible differential effect of the interventions on women in the low MRCs compared with

### Table 2. Call outcomes for direct mail intervention groups

<table>
<thead>
<tr>
<th>Intervention group</th>
<th>All callers, n (%)</th>
<th>Callers eligible for Sage</th>
<th>Callers scheduling Sage appointments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>% of Sample</td>
<td>n</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Mail (n = 25,633)</td>
<td>400 (1.56)</td>
<td>167</td>
<td>123</td>
</tr>
<tr>
<td>Mail + Incentive (n = 25,633)</td>
<td>1,611 (6.28)</td>
<td>482</td>
<td>364</td>
</tr>
<tr>
<td>Total (n = 51,266)</td>
<td>2,011 (3.92)</td>
<td>649</td>
<td>487</td>
</tr>
</tbody>
</table>

### Table 3. Postintervention Sage screening rates by MRC, intervention group, and prior Sage screening history

<table>
<thead>
<tr>
<th>Sample/MRC</th>
<th>Controls</th>
<th>Mail</th>
<th>Mail + Incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>All women in study</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low MRC cases*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total n</td>
<td>11,514</td>
<td>11,513</td>
<td>11,513</td>
</tr>
<tr>
<td>Screened</td>
<td>194</td>
<td>232</td>
<td>313</td>
</tr>
<tr>
<td>Screened % (95% CI)</td>
<td>1.68 (1.45-1.92)</td>
<td>2.02 (1.76-2.27)</td>
<td>2.72 (2.42-3.02)</td>
</tr>
</tbody>
</table>

High MRC cases* |
Total n | 82,687 | 14,120 | 14,120 |
Screened  | 467 | 110 | 175 |
Screened % (95% CI) | 0.56 (0.51-0.62) | 0.78 (0.63-0.92) | 1.24 (1.06-1.42) |

Women with no prior Sage screening |
Low MRC cases* |
Total n | 10,983 | 11,010 | 11,028 |
Screened  | 74 | 116 | 174 |
Screened % (95% CI) | 0.67 (0.52-0.83) | 1.05 (0.86-1.24) | 1.58 (1.35-1.81) |

High MRC cases* |
Total n | 81,186 | 13,870 | 13,878 |
Screened  | 187 | 61 | 124 |
Screened % (95% CI) | 0.23 (0.20-0.26) | 0.44 (0.33-0.55) | 0.89 (0.74-1.05) |

Women with prior Sage screening |
Low MRC cases |
Total n | 531 | 503 | 485 |
Screened  | 120 | 116 | 139 |
Screened % (95% CI) | 22.60 (19.04-26.16) | 23.06 (19.38-26.74) | 28.66 (24.64-32.68) |

High MRC cases |
Total n | 1,501 | 250 | 242 |
Screened  | 280 | 49 | 51 |
Screened % (95% CI) | 18.65 (16.68-20.62) | 19.60 (14.68-24.52) | 21.07 (15.94-26.21) |

*P < 0.001.
The primary goal of this study was to determine whether women with prior Sage screening (women with no prior Sage screening) achieved high response rates, ranging from 37% to 92% (37-40), their applicability in the United States is questionable given the absence of national medical registries in the United States and differences in health insurance and access to health care for the general population. Although the Hurley et al. population-based study in Australia (24) observed mammography rates exceeding 30% among direct mail recipients, the absence of a no-treatment control group in the presence of an intensive public recruitment effort makes the studies hard to compare. Comparability is also limited because population screening levels were extremely low and all unscreened women receiving the invitation were eligible for their program.

In the United States, mailed interventions have been tested extensively as a method to increase screening among patients of managed care organizations or large group practices (28, 30, 41-45), but these studies are not directly comparable with the present study. Clinic-based studies typically have lists of women known to be eligible for the intervention because they are probably due for a mammogram and have all or part of their screening costs covered. In contrast, population-based strategies cannot know a priori the income, health insurance, or screening status of the target audience.

The very limited research in the United States on mailed interventions used outside of a clinic-based population has shown mixed results. Fox et al. (46) mailed materials to female Medicare beneficiaries, which informed them of their screening costs covered. In contrast, population-based strategies cannot know a priori the income, health insurance, or screening status of the target audience.

The intervention effects in this study are smaller than those reported in some other mailed intervention studies (36), but these differences may be principally due to the fact that most of these studies have been conducted either in countries that have national screening registries or in medical clinics in the United States. Several countries, including Sweden and the United Kingdom, have used mailed invitations as part of a "call system" for general population recruitment to mass screening programs. Although many of these programs have achieved high response rates, ranging from 37% to 92% (37-40), their applicability in the United States is questionable given the absence of national medical registries in the United States and differences in health insurance and access to health care for the general population. Although the Hurley et al. population-based study in Australia (24) observed mammography rates exceeding 30% among direct mail recipients, the absence of a no-treatment control group in the presence of an intensive public recruitment effort makes the studies hard to compare. Comparability is also limited because population screening levels were extremely low and all unscreened women receiving the invitation were eligible for their program.

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The very limited research in the United States on mailed interventions used outside of a clinic-based population has shown mixed results. Fox et al. (46) mailed materials to female Medicare beneficiaries, which informed them of their breast cancer risk and where they could obtain low-cost screening mammograms in their community. Only Hispanic women reported significantly higher mammography rates at the end of the 2-year intervention period. McCaul and Wold (47) found that various types of reminder letters had no effect on mammography utilization among Medicare recipients who had not had a mammogram in the previous 30 months. Bastani et al. (14) is the only other population-based mailed intervention study; however, they used survey participants captured by random digit dialing rather than a

### Table 4. Comparison of intervention effects on Sage screening rates for low and high MRC women

<table>
<thead>
<tr>
<th>Sample/MRC</th>
<th>Mail vs Control, effect (95% CI)</th>
<th>Mail + Incentive vs Control, effect (95% CI)</th>
<th>Mail + Incentive vs Mail, effect (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All women in study (N = 145,467)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low MRC</td>
<td>0.33 (−0.02 to 0.68)</td>
<td>1.03* (0.65-1.41)</td>
<td>0.70* (0.31-1.10)</td>
</tr>
<tr>
<td>High MRC</td>
<td>0.21* (0.06-0.37)</td>
<td>0.67* (0.49-0.86)</td>
<td>0.46* (0.23-0.69)</td>
</tr>
<tr>
<td>Low MRC vs high MRC effect difference</td>
<td>0.12 (−0.26 to 0.50)</td>
<td>0.36 (−0.06 to 0.78)</td>
<td>0.24 (−0.21 to 0.70)</td>
</tr>
<tr>
<td>Pooled estimate of effect</td>
<td>0.23 (0.09-0.37)</td>
<td>0.75* (0.58-0.92)</td>
<td>0.52* (0.32-0.72)</td>
</tr>
</tbody>
</table>

NOTE: Effects are arithmetic differences in percentages of women screened between contrast groups.

*P < 0.01.

*P < 0.05.

*P < 0.001.

P < 0.005.

P < 0.05.

those in the high MRCs is shown in Table 4. Intervention effects were calculated as the arithmetic difference in screening percentages between intervention groups within each MRC stratum, and between-MRC strata differences in these effects and the associated 95% CIs were calculated. No significant differences in intervention effect size were found between the MRC strata. Thus, it seems that the interventions produced similar increases in screening in both high and low MRCs.

In the absence of evidence for differential intervention effects between the MRC strata, pooled estimates of effects for the two interventions were calculated, and these are reported in the bottom row of each section of Table 4. For the total sample and for women not screened previously through Sage, all of the pooled estimates of intervention effects were statistically significant. For women screened previously through Sage, the pooled estimates showed a significant (P < 0.05) intervention effect for Mail Plus Incentive versus Control.

### Incentive Claims

A total of 145 women called to claim the incentive. Of these, 123 (84.8%) could be found on the Mail Plus Incentive group mailing list. These claimants represent about one-forth of the 488 women in the Mail Plus Incentive group list. The remaining 22 callers presumably reflect diffusion of the intervention beyond the intended recipients.

### Discussion

The primary goal of this study was to determine whether direct mail could increase mammography use through a federally funded screening program that targets underserved women. Strategies to increase the effect of direct mail—monetary incentives and use of an enhanced mailing list that included behavioral and lifestyle data—were also compared. Overall, this study showed that direct mail (when used in conjunction with our toll-free telephone appointment scheduling system) significantly increased mammography through Sage in the 13 months after onset of the intervention among all women in the sample as well as among the subset of women who had not been screened previously through Sage.

Although the effect sizes are modest, the order of magnitude achieved high response rates, ranging from 37% to 92% (37-40), their applicability in the United States is questionable given the absence of national medical registries in the United States and differences in health insurance and access to health care for the general population. Although the Hurley et al. population-based study in Australia (24) observed mammography rates exceeding 30% among direct mail recipients, the absence of a no-treatment control group in the presence of an intensive public recruitment effort makes the studies hard to compare. Comparability is also limited because population screening levels were extremely low and all unscreened women receiving the invitation were eligible for their program.

In the United States, mailed interventions have been tested extensively as a method to increase screening among patients of managed care organizations or large group practices (28, 30, 41-45), but these studies are not directly comparable with the present study. Clinic-based studies typically have lists of women known to be eligible for the intervention because they are probably due for a mammogram and have all or part of their screening costs covered. In contrast, population-based strategies cannot know a priori the income, health insurance, or screening status of the target audience.

The very limited research in the United States on mailed interventions used outside of a clinic-based population has shown mixed results. Fox et al. (46) mailed materials to female Medicare beneficiaries, which informed them of their breast cancer risk and where they could obtain low-cost screening mammograms in their community. Only Hispanic women reported significantly higher mammography rates at the end of the 2-year intervention period. McCaul and Wold (47) found that various types of reminder letters had no effect on mammography utilization among Medicare recipients who had not had a mammogram in the previous 30 months. Bastani et al. (14) is the only other population-based mailed intervention study; however, they used survey participants captured by random digit dialing rather than a...
consumer mailing list to identify their target population. They found that a single, multipiece mailing did not significantly increase mammography use. The apparent lack of effect on self-reported mammography may have been due to a testing effect from the baseline survey or the effect of the mailing sent to the control group.

Our study also showed that adding a modest financial incentive to direct mail roughly tripled its effectiveness. Surprisingly, only slightly more than a quarter of the women who were eligible for an incentive claimed it. We speculate that for some women the provocative offer of the incentive increased the likelihood that the mailers would be read and considered, but receipt of the incentive was not the primary motivator for getting screened. Other women were probably motivated by the incentive, and a subset of these women may have either forgotten to request it or decided it was too much trouble to obtain.

Financial incentives have been shown to be generally effective in enhancing compliance within patient populations (48). The present study shows the effectiveness of incentives in a population-based intervention, a phenomenon that may be relevant to a variety of public health problems. An important question that remains unanswered is whether screening behavior among women who responded to the incentive will be sustained in the absence of an incentive.

The relatively low response rate and large scope of population-based direct mail interventions raises questions about the cost and cost-effectiveness of this strategy. Our study was not designed to determine the cost-effectiveness of direct mail. No attempt was made to control the intervention development or implementation costs. Thus, the cost per woman screened would be misleading. Our subsequent implementation of direct mail as an ongoing Sage recruitment strategy has shown that cost can be greatly reduced. Direct mail has become the primary intervention strategy for Sage because it is effective and the cost per women screened is among the lowest of all our recruitment strategies.

A well-targeted mailing list is crucial to the success of direct mail interventions. The fact that more than half of callers responding to our mailing were not eligible for Sage points to the efficiencies that could result from a more effectively targeted list. There is ambiguous evidence about the value of creating more targeted lists by using PRIZM clusters to identify women who are more likely to be in need of mammography screening services. Sage enrollment rates among women in the low MRCs were typically twice as high as those of high MRC women across all treatment conditions. Even after adjusting for age, income, and metropolitan/nonmetropolitan status (data not presented), more women living in the low MRCs enrolled in Sage postintervention than did their counterparts among both first-time and repeat Sage screeners and across all study conditions. However, the enrollment gains attributable to the direct mail interventions (defined as arithmetic differences in enrollment percentages between treatments) were similar for the two MRC strata because more than thrice as many women in the low MRC Control groups were also screened. This suggests that the low MRCs successfully identified women who are more likely to get screened through Sage but were not helpful in predicting the response to the intervention.

To our knowledge, this is the only study to have used NCI's PRIZM cluster-based Consumer Health Profiles in a randomized screening trial. The PRIZM-based list has the potential to be an effective tool for population-based public health efforts, and our study suggests that more formal testing of the PRIZM-based clusters is needed to determine their effectiveness in identifying underscreened populations responsive to direct mail interventions.

It is important to note that Sage was attempting to influence screening through a variety of other statewide recruitment campaigns during the direct mail intervention period. Sage conducted a statewide television campaign and provided grants to communities to recruit women for screening through Sage. These activities may have potentiated the effect of the direct mail interventions through, for example, repeated exposure to messages about getting screened. Thus, to the extent that direct mail was unintentionally supplemented with other supporting media, its effect may have been increased. Conversely, other recruitment activities almost certainly attenuated the observed effect size by increasing the background levels of screening in the Control group. To the extent that this occurred, direct mail may have a greater net effect in populations that do not have other effective activities promoting screening. Furthermore, there was no way to determine if the intervention recruited women into Sage who otherwise would have been screened elsewhere, whether women in the Control group obtained mammograms outside the Sage network, or whether women in either intervention group obtained mammograms outside the Sage network in response to the mailing.

The generalizability of the findings may be affected by the extensive pilot testing used to develop the intervention materials (including significant involvement from a marketing communications firm). Our experience showed that paying a great deal of attention to the quality of the materials and the nature of the message was critical to their success. Inadequate attention to materials development or use of a poorly targeted mailing list would probably lead to disappointing results. The degree to which the materials developed for this study will work as well in other settings or with other populations is unknown.

The study's generalizability may also be limited by the Minnesota's demographic characteristics. Direct mail will be more challenging in states that have lower literacy levels and more diversity in primary language than Minnesota. On the other hand, direct mail may be more successful in states that have higher numbers of program-eligible women. Minnesota's relatively low proportion of uninsured women makes it substantially harder to find program-eligible women. Furthermore, we cannot ascertain whether the direct appointment scheduling system is a key component for the success of the direct mail intervention, and this may limit generalizability.

Our findings may be important to the other 67 states, tribal organizations, districts and territories participating in the NBCCEDP because many of these programs are struggling to find effective outreach strategies to increase utilization of their free mammography services. The Centers for Disease Control and Prevention estimated that ~3.5 million women were eligible for mammograms through the NBCCEDP in their 2000 to 2001 reporting year, but only 373,078 women were screened (49). If direct mail had a similar effect on the other NBCCEDP participating programs, it could clearly contribute substantially to reaching their underserved populations.

Direct mail may have broader application as a population-based tool to increase mammography use. For example, with ~20 million women having Medicare Part B coverage for breast cancer screening, a direct mail intervention that had an effect of similar magnitude would have substantial effect on the public's health. Organizations such as Quality Improvement Organizations (formerly known as Peer Review Organizations) charged with promoting the use of preventative services among Medicare beneficiaries may find that direct mail holds promise. We conducted a similar study among Medicare recipients and will soon be able to report the effectiveness of direct mail for this much larger older population.
References

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Effect of Direct Mail as a Population-Based Strategy to Increase Mammography Use among Low-Income Underinsured Women Ages 40 to 64 Years

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