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Finding the Minimal Intervention Needed for Sustained Mammography Adherence

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Abstract

Background—Regular adherence to mammography screening saves lives yet few women receive regular mammograms.

Design—RCT.

Setting/participants—Participants were recruited through a state employee health plan. All were women aged 40–75 years and had recent mammograms prior to enrollment (*n*=3,547). Data were collected from 2004 to 2009.

Intervention—The efficacy was tested of a two-step adaptively designed intervention to increase mammography adherence over 4 years. The first intervention step consisted of three reminder types: enhanced usual care reminders (EUCR), enhanced letter reminders (ELR), both delivered by mail, and automated telephone reminders (ATR). After delivery of reminders, women who became off-schedule in any of the 4 years received a second step of supplemental interventions. Three supplemental intervention arms contained priming letters and telephone counseling: barriers only (BarriCall), barriers plus positive consequences of getting mammograms (BarriConCall+), and barriers plus negative consequences of not getting mammograms (BarriConCall−).

Main outcome measures—Average cumulative number of days non-adherent to mammography over 4 years based on annual screening guidelines (analyses conducted in 2009)

Results—All reminders performed equally well in reducing number of days of non-adherence. Women randomized to receive supplemental interventions had significantly fewer days of non-adherence compared to women who received EUCR (*p*=0.0003). BarrConCall+ and BarrConCall− conditions did not significantly differ in days non-adherent compared to women in the barriers-only condition (BarriCon).

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Conclusions—The minimal intervention needed for sustained mammography use is a combination of a reminder followed by a priming letter and barrier-specific telephone counseling for women who become off-schedule. Additional costs associated with supplemental interventions should be considered by organizations deciding which interventions to use.

Introduction

Each year, more than 192,000 U.S. women are diagnosed, and about 40,170 women die from breast cancer.[1] Numerous studies have shown that regular mammography use among women aged ≥40 years and reduces breast cancer morbidity and mortality.[2–5] Increased rates of annual screening could reduce mortality by 22% each year.[6] Although there have been impressive gains in proportions of U.S. women receiving recent mammograms, less than 50% of women receive two consecutive screening mammograms at recommended intervals.[7] After more than 1 decade of rising rates, some evidence suggests that mammography rates are no longer increasing in the U.S.[8] Thus, adherence to mammography among U.S. women remains a concern.

Until recently, most mammography interventions focused on encouraging short-term adherence (e.g., over 1–2 years). This was appropriate when mammography was at an earlier stage in the diffusion cycle; the primary challenge then was to move women from never having had mammograms to having their first mammograms or to move lapsed screeners back on schedule.[9] Now that most U.S. women have had one or more mammograms, the appropriate focus should be on sustained adherence over time. Most mammography intervention trials assessed outcomes across only one or two screening mammograms.[10–14] Efficacy of mammography promotion interventions over time is not known.

Relatively simple patient-directed strategies, such as reminders, are effective for increasing mammography adherence.[15–25] More-intensive patient-directed strategies (e.g., tailored messages, telephone counseling) are more effective than usual care or less-intensive strategies.[15, 17, 20, 24–28] Intensive intervention strategies, however, are more costly to develop, implement, and sustain[15, 29, 30] and may be beneficial for only some women. Many women may respond to minimal interventions that cue them to have their mammograms on schedule.

Adaptively designed interventions may be an effective strategy to promote sustained mammography adherence and to evaluate the "minimal intervention necessary for change" (MINC).[31] In adaptive designs, individuals receive different interventions or doses based on their responses to earlier interventions.[32] Few mammography intervention trials have used adaptive designs.[13, 33–36] Results of prior adaptively designed trials have been mixed but most found that more-intensive strategies, such as telephone counseling, outperformed less-intensive strategies and facilitated a return to adherence.[33–35] However, no trials were designed to sustain annual-interval adherence in average-risk, insured women aged ≥40 years. Moreover, none were designed to provide direct comparisons among various types of minimal and more-intensive intervention strategies over multiple screening opportunities.

Rationale for Study Design

Personally Relevant Information on Screening Mammography (PRISM) was designed to test effects of two-step adaptively designed interventions to increase sustained mammography adherence. PRISM began with the least intensive evidence-based interventions, reserving more-intensive interventions for those who needed them. After delivery of one of three minimal reminder interventions, women who became non-adherent in any of the study's 4 years received more-intensive supplemental interventions. Depending on study condition, some women received additional content that elaborated on positive consequences of receiving or negative

consequences of skipping regular mammograms. PRISM sought to answer the following research questions.

1. Which reminder type is most effective for reducing days' non-adherent to mammography screening over 4 years?
2. To what extent do supplemental interventions reduce the number of days of non-adherence to mammography screening over 4 years compared to reminders only?
3. Which supplemental intervention is most effective for reducing the number of days non-adherent to mammography screening over 4 years?

Methods

Study Participants and Recruitment

Study eligibility and recruitment are described elsewhere.[37] Briefly, PRISM participants were identified through the North Carolina State Health Plan for Teachers and State Employees (SHP). Eligible women were residents of North Carolina, aged 40 to 75 years, had no personal history of breast cancer, and had recent mammograms (8 to 9 months before enrollment). Recruitment occurred between October 2004 and April 2005. Participants (n=3547) completed 30-minute baseline telephone interviews and agreed to participate in interventions and follow-up interviews over 4 years. IRBs for the University of North Carolina and Duke University approved this research.

Study Objective and Design

Study Objective and Design—The primary study objective was to identify minimal intervention needed for sustained mammography adherence over 4 years. PRISM was a two-step adaptively designed intervention (Figure 1). The two-step process resulted in nine intervention strategies into which participants were randomized (Table 1). The first intervention step consisted of yearly mammography reminders. After delivery of reminders, women who became off-schedule in any of the 4 years received a second step of supplemental interventions.

In the first step, women received one of three reminders: enhanced usual care reminders (EUCRs), enhanced letter reminders (ELRs), and automated telephone reminders (ATRs). Twenty-five percent of eligible participants were allocated to EUCR, 37.5% to ATR and 37.5% to the ELR so that sample sizes would be sufficient for assessing efficacy of supplemental interventions. PRISM did not include a non-intervention control. Since multiple studies have shown that reminders are effective for promoting mammography use compared to non-intervention controls;[15] study investigators and the SHP concluded that it would be unethical to include a non-intervention group. Thus, a usual care reminder was created since none existed at the time of the study and it was referred to as enhanced, because it was more detailed than many minimal reminders.

All supplemental interventions consisted of priming letters (tailored letters which prepared women for counseling calls) and telephone counseling to address women's barriers to mammography adherence. In addition to a supplemental intervention condition that focused on barriers only (BarriCall), other supplemental intervention conditions emphasized positive consequences of having (BarriConCall+) or negative consequences of not having regular mammograms (BarriConCall−) to determine whether these additions improved adherence over barriers alone. Only women in the ATR and ELR groups could receive supplemental interventions. This design enabled assessment of the incremental impact of supplemental interventions compared to usual care reminders (EUCR). Inclusion of a supplemental intervention control arm that received only PRISM reminders (ATR/ELR only) permitted a

comparison of the efficacy of different supplemental intervention arms. Equal proportions of women were allocated to BarriCall (25%), BarriConCall+ (25%), BarriConCall− (25%) and PRISM reminder (25%) groups.

PRISM Interventions

Theoretic Orientation—Because maintenance of repeated, infrequent behaviors, such as mammography, is likely controlled by deliberative reasoning processes and past experiences, this project integrated constructs from several predominant theories of health behavior and strategies for behavior enaction. Key constructs and strategies come from the Health Belief Model,[38] Theory of Planned Behavior,[39] Model of Goal-Directed Behavior,[40] and the Elaboration Likelihood Model.[41]

Both the Health Belief Model and Theory of Planned Behavior identify factors that motivate behavior change, such as risk perceptions, disease susceptibility and severity, self-efficacy, intentions, and assessments of barriers and benefits to engaging in a behavior. Model of Goal-Directed Behavior focuses on strategies that translate motivation to action, differentiating habitual behaviors, like getting regular exercise, from those performed infrequently. Model of Goal-Directed Behavior strategies include elaboration on positive consequences of engaging in and negative consequences of not engaging in a behavior. Elaboration Likelihood Model focuses on the role of information processing on attitude and behavior change, postulating that interventions motivating deep information processing are more likely to result in sustainable attitude and behavior changes.

Reminders—Details of PRISM reminders are provided elsewhere.[37] Briefly, EUCRs were printed letters reminding women they were due for their next mammograms. ELRs were printed booklets similar in content to EUCRs but contained several additions (e.g., reminder stickers, theory-guided information). ATRs contained identical content to EUCRs but were delivered as automated telephone messages using a female voice. All provided information about when women were due for their next mammograms and motivational messages to encourage them to be screened.

Supplemental interventions

Tailoring: Supplemental interventions consisted of tailored priming letters and telephone counseling. Intervention materials were tailored to individual women by converting raw data from interviews into calculated variables that reflected characteristics of interest (e.g., women's mammography barriers).[42, 43] Tailoring algorithms determined which message each woman received from a message library. Women who reported no barriers or did not complete recent follow-up interviews received default messages.

Priming Letters: Priming letters primed or prepared women for subsequent telephone counseling calls. They were four-page printed booklets with cover art of colorful quilts and contained four sections: (1) text reminding women that they were overdue for their next mammograms; (2) tailored messages about overcoming barriers to mammography based on participants' self-reported barriers at annual telephone interviews; (3) narrative that addressed key barriers selected by researchers (BarriCall) plus a focus on either the positive consequences of getting (BarriConCall+) or the negative consequences (BarriConCall−) of not getting regular mammograms; and (4) text reminding women of screening mammography guidelines and telephone information for the health plan, NCI's Cancer Information Service (1-800-4-CANCER), and text informing women they would receive a call from a PRISM telephone counselor.

Priming letters addressed up to four barriers. On average, women reported two barriers (range 0–11). Barriers related to forgetting to make/keep mammography appointment, being too busy, or having competing problems or priorities (e.g., family or personal illness) were the most common.

Priming letters were pretested for content and appearance with a volunteer group of SHP members who were not part of PRISM. The priming letters' appearance, tailoring algorithms, and content was varied slightly each year so that they would not be identical to previous PLs, but the content was largely the same. Priming letters were developed in collaboration with People Designs Inc. of Durham, NC. People Designs printed priming letters each week based on weekly data transfers received from PRISM researchers. Study staff reviewed PLs' accuracy prior to delivery.

Telephone Counseling: The goal of telephone counseling calls was to review and facilitate elaboration on priming letter content and assist women in overcoming their mammography-related barriers. Each counseling call was unique, based on each woman's needs, but structured, based on a computer-assisted telephone counseling program developed in an earlier study and revised for this one.[12, 44] Calls started with brief introduction and confirmation of previous mammography dates. Counselors then asked women what was getting in the way of obtaining their next mammograms and suggested ways to overcome these barriers. Counselors repeated the process until women offered no additional barriers to screening. Barriers related to being too busy, difficulty scheduling appointment, competing priorities, and cost of mammography were the most common ones addressed during telephone counseling.

Depending on study condition, counselors also encouraged elaboration on either the positive (BarriConCall+) or negative (BarriConCall−) consequences of getting or skipping regular mammograms. Finally, counselors summarized key points of the session and helped women make a plan to be screened soon. Telephone counseling content was pretested with a volunteer group of women SHP members who were not part of PRISM.

Women who confirmed they had not received their mammograms at the time of calls received full counseling consisting of all components described above (mean 13.20 minutes; range 3.07–33.49). Women who had recent mammograms but were off-schedule received modified counseling in which counselors asked women to think about what delayed their mammograms, helped them get mammograms, and could have helped them be screened sooner. Modified counseling ended with a reminder of when they were due for their next mammograms (mean 5.20 minutes; range 2.01–15.50).

Telephone counselors participated in an intensive training program that included education about screening mammography and motivational interviewing techniques,[45] mock calls using the computer-assisted telephone counseling program, and weekly ongoing training. Training was led by PhD-level clinical psychologists and health educators. Quality assurance was conducted for ~10% of telephone counseling calls and addressed issues as needed with counselors.

Intervention Delivery—Researchers received monthly mammography claims information to determine women's adherence status and intervention delivery. Delivery of reminders occurred 2 to 3 months prior to women's mammography due dates. Women overdue for annual screening were sent mailed priming letters about 3 months past participants' due dates. Telephone counseling call attempts began 10 days later. Delivery of subsequent interventions over the 4-year study was timed from participants' most recent mammograms. Thus, participants continued to receive yearly mammography reminders 2–3 months before they were

due for their next mammograms, based on an annual screening recommendation,[46] followed by supplemental interventions if they became overdue in any year.

Study Interviews

Participants completed 30-minute baseline telephone interviews during study recruitment and consent. Baseline interviews included questions about sociodemographics, mammography history, general health information, and mammography-specific psychosocial correlates. Telephone interviewers recontacted women at 12, 24, 36, and 42 months post–baseline survey. Nonparticipation in any follow-up interview did not preclude women from being contacted for subsequent interviews. The interviews at 12, 24, and 36 months were similar to baseline interviews; interviews at 42 months were abbreviated for budgetary reasons and included only items assessing outcomes and major variables of interest. Data were collected from 2004 to 2009.

Interviewers asked women to confirm dates of their most recent and prior mammograms, based on claims data. Women who reported a breast cancer diagnosis (n=63) received abbreviated interviews but did not continue to receive interventions. Women who withdrew from the study were not contacted for follow-up interviews (n=128). Recommended procedures were used for study retention, including multiple call attempts during participants' requested days/times of the week, small study incentives (postage stamps), and thank you letters.

Measures

Outcome

The outcome, mammography non-adherence, was defined as the cumulative number of days non-adherent for each woman during the 4-year study period. Women became non-adherent when 365 days had elapsed since their last screening. This outcome was based on American Cancer Society recommendations at the time of the study which suggested women aged ≥40 years should have mammograms annually. Mammograms occurring within 6 months of the previous one were likely diagnostic or follow-up visits and removed from outcome calculation. 47 Once non-adherent, a calculated variable counted number of days until receipt of a subsequent mammogram. That is, each day beyond 365 contributed 1 day of non-adherence; counting ceased when women received subsequent mammograms but resumed again if women did not receive their next mammograms within 365 days. Values for cumulative days of non-adherence could range from 0 to 1,098.

The outcome was assessed through self-report and health claims data. Women who completed follow-up interviews were asked to confirm dates of both their recent and prior mammograms obtained from claims data. If a discrepancy between self-report and claims data occurred, self-reports were used, because it often took several months for mammograms to appear in claims records. Previous research confirms that self-reports are valid measures of recent mammography use, especially for women in healthcare organizations and over short recall periods.[48, 49]

Independent Variables

Independent variables were based on intervention strategies.

Costs

Costs of PRISM interventions were estimated assuming fully scaled dissemination within a large health organization. Intervention costs included production expenses (e.g., postage, printing, envelopes) and personnel time spent producing and delivering interventions and supervising and training staff. Estimates excluded research and development costs that would

not be incurred during replication and an indirect cost level of 50% was assumed for facilities and infrastructure costs. For telephone counseling, an average call length of 13 minutes was assumed with 10 call attempts per completed call.

Sample Size

Power analyses indicated a target sample size of about 3545 participants to achieve 80% power to detect a 6% difference in effect among intervention arms, with alpha of 0.05 and two-tailed tests. Sample size was adjusted for estimated attrition over the 4-year study as well as multiple testing in comparisons of study groups. This sample size was sufficient to detect potentially small effects between study groups. The adherence level was higher than expected; thus, fewer participants received supplemental interventions.

Data Analysis

Analyses were intent-to-treat and included all women randomized to interventions except those diagnosed with breast cancer (*n*=63) and women who died during the study (*n*=29). The final analytic sample included 3455 participants. For study withdrawals (*n*=128), mammography dates were imputed based on the average length of time between mammograms prior to leaving the study.

Bootstrapping procedures were used with case resampling to assess differences in mean number of days' non-adherent among intervention strategies.[50] Bootstrapping procedures adjusted for multiple comparisons. In brief, bootstrapping is a nonparametric procedure that does not assume normal distribution of data. Bootstrapping procedures resampled data 10,000 times and computed p-values for each sample. From those sample p-values, an adjusted p-value was calculated.

To assess intervention efficiency, it was first examined whether there were any significant differences in cumulative number of days non-adherent for women randomized to each of the study reminder conditions. Next, it was checked whether there were significant differences in cumulative days non-adherent for women randomized to receive EUCR compared to supplemental interventions and among supplemental interventions. Analyses were conducted in 2009 using the MULTTEST procedure in SAS 9.2 statistical software.

Results

Sample characteristics

Sample characteristics are reported in Table 2. Most were white, aged ≥50 years, college-educated, married or living as married, did not report financial hardship, and described their health as good or excellent. Women who withdrew (*n*=128) did not differ significantly by study condition or sociodemographic characteristics.

Intervention Efficacy

To determine which reminder type was most effective for reducing days non-adherent (Research Question 1), average days non-adherent were compared among reminder-only conditions (that is, among women not randomized to receive any supplemental interventions). Differences in mean days non-adherent over the study were not significant among reminder conditions and ranged from 15.73 to 24.13 days (Table 3).

To determine the extent to which supplemental interventions reduced days non-adherent beyond reminders only (Research Question 2), average days non-adherent were compared among women randomized to receive EUCRs to women randomized to receive any of the three supplemental intervention conditions (BarriCall, BarriConCall+, BarriConCall−). Women

randomized to receive any form of supplemental intervention had significantly fewer mean days non-adherent (183.40) than women receiving EUCRs only (221.95; *p-value*=0.0003). Absolute difference in mean days non-adherent for these groups was 38.55.

It was then examined which supplemental intervention strategy was most effective in reducing days non-adherent (Research Question 3). Because there were no significant differences among the three reminder conditions (Research Question 1), collapsed supplemental conditions were collapsed into three groups (BarriCall, BarriConCall+, BarriConCall−). First, the BarriConCall + and BarriConCall− conditions were compared. Finding no significant differences, these conditions were collapsed into one group (BarriConCall+/−). The EUCR were then compared to two types of supplemental intervention conditions (BarriCall and BarriConCall+/−). Both types of supplemental interventions significantly reduced average days non-adherent compared to EUCR (mean differences 39.56 and 38.05 days respectively; *p-values* 0.0042 and 0.0008 respectively). BarriCall and BarriConCall+/− conditions performed equally well in reducing days non-adherent (*p-value*=0.98) (Table 4).

Cost Analyses—Previously, the cost of reminder conditions per intended recipient was reported as $0.86 for EUCR, $0.35 for ATR, and $1.34 for ELR.[37] A universal cost was estimated for supplemental interventions (priming letters + telephone counseling), regardless of study condition; cost of delivery was not affected by study condition. Assuming delivery to 500,000 women per year, the estimated cost per intended recipient is $2.76 for priming letters and $16.65 for telephone counseling. Total cost of delivering the complete supplemental intervention one time to one woman is estimated at $19.41.

Discussion

To our knowledge, PRISM is the first adaptively designed intervention study to assess a combination of minimal and more-intensive strategies on *sustained* mammography adherence over multiple screening opportunities. Results indicate that reminders followed by priming letters and barriers-specific telephone counseling for women who became off-schedule produced the fewest cumulative days non-adherent. Differences among study conditions were modest; inclusion of any supplemental interventions increased cost per dose by $19.41.

This study supports previous literature showing effectiveness of simple mammography reminders[15] and extends these finding to longer-term outcomes. On average, when women received reminders alone, there were averages of 198 to 222 days non-adherent per woman over the 4-year study. These numbers translate to an average of about 50 to 60 days non-adherent per woman-year of the study, suggesting that most women in PRISM received regular, on-schedule mammograms after delivery of reminders. However, since PRISM did not include a no-intervention control group, it is not possible to determine how much of these effects are due to reminder efficacy. While all reminder types were equally effective, ATRs cost less to deliver than printed materials.[37] Many health plans and other medical organizations already use automated telephone reminders over traditional mailed reminders as a less costly but equally effective option for promoting regular mammography. Other organizations may want to consider this approach.

Providing supplemental interventions facilitated a return to adherence among women who were off-schedule. Women randomized to receive priming letters and telephone counseling, in addition to reminders, had fewer average days non-adherent compared to women who received EUCR. Many studies support telephone counseling as an effective strategy to promote mammography adherence.[12, 15, 29, 51, 52] PRISM extends these findings in several ways. First, results showed that addition of a more-intensive, tailored counseling component for women

who became off-schedule was an effective strategy to reduce days non-adherent over *multiple* years. Past studies on telephone counseling focused on short-term outcomes.[12, 52]

Results also indicate that telephone counseling addressing women's barriers to getting mammograms may be the minimal component necessary for tailored counseling calls. While this finding suggests that enhancements to the barriers strategy did not add value, it is also plausible that if the consequences interventions had been stronger or designed differently, there might have been greater effects. Alternatively, barriers may account for the largest variation in non-adherence. Once barriers are addressed, the incremental benefit of adding additional counseling components may be small. Given current attention to issues of comparative effectiveness, understanding when additional intervention components add value and when they do not is critical to improving the U.S. healthcare system.

While overall differences in average days non-adherent between intervention groups were modest, it is likely that study effects would have been greater if there had not been a usual care condition enhanced with information (e.g., mammography guidelines, insurance coverage information). At the time of the study, the State Health Plan did not have a mammography reminder system. The PRISM-enhanced usual care reminder likely contained information beyond what many reminder systems typically use and could have attenuated differences between groups.

Findings also should be viewed in the context of long-term screening behavior. Modest savings in days non-adherent for the study period may add up over potential decades of regular screening, depending on the durability of intervention effects over time. While supplemental interventions contributed to 39 fewer days non-adherent over the 4-year study compared to EUCRs, this would translate to nearly 200 days of avoided non-adherence over 2 decades of screening and to nearly 300 days over 3 decades of screening. Some studies suggest that even relatively short delays of 6–12 months between screenings might contribute to some of the nation's breast cancer morbidity and mortality.[53–55] Intervention strategies that result in modest savings in screening delays may have larger impacts on breast cancer mortality over time. However, it still is not clear just how many days would make a clinical difference. There will not be one answer since this is a multifactorial issue.

This study has several strengths, including an adaptive design which allowed the allocation of more-intensive and costly interventions for only those women most likely to benefit, based on their adherence status. Other study strengths include use of mammography claims data verified through self-reports to determine adherence, which likely enhanced accuracy of calculating mammography use.

This study also has some limitations. PRISM's design required that all women have health insurance coverage and recent mammograms prior to study entry. Results should not be generalized beyond these groups. Overall, women were well-educated, and numbers of black women and other racial and ethnic minorities were modest. Most likely, this was a function of eligibility criteria, but it is not possible to be certain. Assuring external validity with regard to more diverse socioeconomic and racial/ethnic backgrounds should be a focus of future research.

While the incremental benefit of supplemental interventions added to a reminder system were assessed, the design does not permit the disentangling of effects of mailed priming letters from telephone counseling calls. These two strategies were implemented as a complementary, bundled intervention. Adding only supplemental mailed mammography promotion materials to a reminder system may not be an effective strategy to facilitate a return to adherence.[13, 33, 34] In contrast, other studies support telephone counseling as a stand alone strategy to promote

mammography adherence.[56, 57] It is reasonable to consider that telephone counseling alone would have added benefit beyond annual reminders.

Interventions were designed with potential dissemination in mind and conducted the study with a defined population of health plan members. While it is hypothesized that findings would be similar if disseminated within an entire health plan, future effectiveness trials should test this assumption with both adherent and non-adherent women. It is plausible that having been screened recently, coupled with participating in a 4-year study with annual study interviews, may have motivated some women to have mammograms.[58] Future studies should assess intervention reach, implementation, and effectiveness in non-research settings.[59, 60]

While it appears that the minimal intervention needed for sustained mammography use is a combination of a reminder followed by a priming letter and barrier-specific telephone counseling for women who become off-schedule, additional costs associated with supplemental interventions ($19.41 per dose) should be considered by any organization deciding which interventions to use. Although it was not possible in the current study to evaluate cost effectiveness of supplemental interventions, such cost analyses should be a core component in future research.

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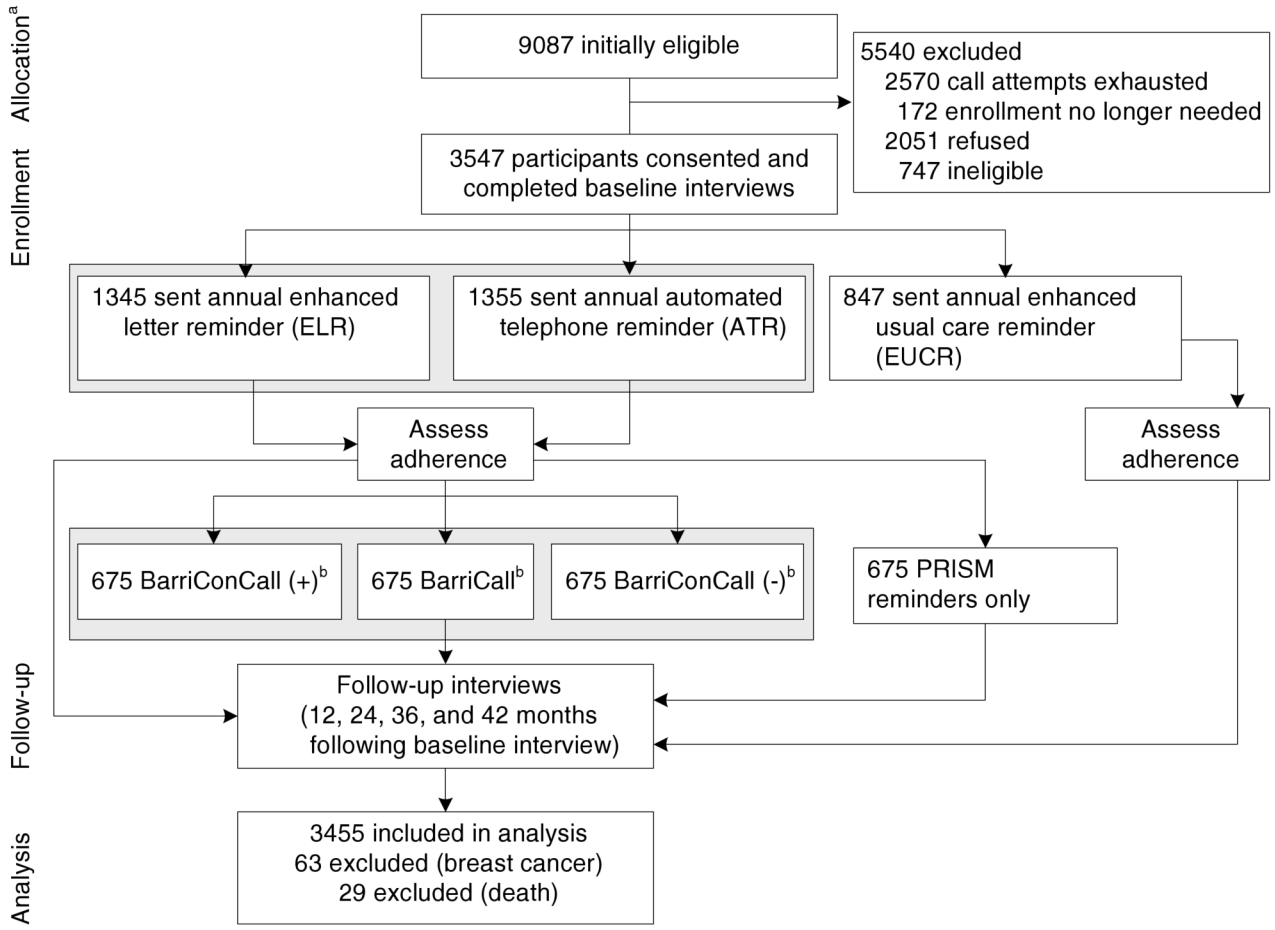

Figure 1. PRISM study design

[a] Random allocation to study arms occurred *prior* to participant contact and recruitment. Larger numbers for ATR and ELR were planned for analysis of supplemental interventions. Equal proportions of participants were allocated to supplemental interventions.

[b] Supplemental intervention for non-adherent women in any year.

PRISM, Personally Relevant Information on Screening Mammography

Table 1

PRISM study intervention strategies

Reminder intervention	Supplemental interventions	Study condition	*n* (%)
Reminder-only conditions			
Enhanced usual care reminder	None	EUCR	823 (23.8)
Automated telephone reminder	None	ATR	318 (9.2)
Enhanced letter reminder	None	ELR	337 (9.8)
Supplemental intervention conditions			
Automated telephone reminder	Barriers-only priming letter and telephone counseling	ATR + BarriCall	338 (9.8)
Automated telephone reminder	Barriers + positive consequences priming letter and telephone counseling	ATR + BarriConCall+	335 (9.7)
Automated telephone reminder	Barriers + negative consequences priming letter and telephone counseling	ATR + BarriConCall−	328 (9.5)
Enhanced letter reminder	Barriers-only priming letter and telephone counseling	ELR + BarriCall	318 (9.2)
Enhanced letter reminder	Barriers + positive consequences priming letter and telephone counseling	ELR + BarriConCall+	327 (9.5)
Enhanced letter reminder	Barriers + negative consequences priming letter and telephone counseling	ELR + BarriConCall−	331 (9.6)

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Table 2

Characteristics of analytic sample by collapsed intervention strategies

Characteristic	Collapsed intervention strategies: Supplemental Interventions (*n* = 1,977) *n* (%)	ATR/ELR Reminders (*n* = 655) *n* (%)	Enhanced Usual Care Reminders (*n* = 823) *n* (%)	Analytic Sample (*n* = 3,455) *n* (%)	*p-value*
Race					0.18
White	173 (87.2)	577 (88.1)	736 (89.4)	3036 (87.9)	
Black	220 (11.1)	67 (10.2)	80 (9.7)	367 (10.6)	
Asian	9 (0.5)	2 (0.3)	—	11 (0.3)	
Native Hawaiian	—	1 (0.2)	—	1 (0.03)	
American Indian	22 (1.1)	6 (0.9)	4 (0.5)	32 (0.9)	
Self-reported other or refused to report	3 (0.2)	2 (0.3)	3 (0.4)	8 (0.2)	
Age (years)					0.75
40–49	426 (21.6)	132 (20.2)	174 (21.1)	732 (21.2)	
50–74	1551 (78.5)	523 (79.9)	649 (78.9)	2723 (78.8)	
Education					0.62
High school or less	331 (16.8)	111 (17.0)	127 (15.4)	569 (16.5)	
Some college or technical school	397 (20.1)	137 (20.9)	186 (22.6)	720 (20.9)	
College degree or more	1247 (63.1)	407 (62.1)	510 (62.0)	2164 (62.7)	
Marital Status					0.81
Married or living as married	1585 (80.2)	532 (81.2)	664 (80.9)	2781 (80.5)	
Not married	392 (19.8)	123 (18.8)	157 (19.1)	672 (19.5)	
Work for pay					0.31
Yes	1545 (78.2)	513 (78.3)	664 (80.7)	2722 (78.8)	
No	432 (21.9)	142 (21.7)	159 (19.3)	733 (21.2)	
Perceived financial status					0.10
No hardship	1268 (64.7)	393 (60.1)	522 (64.0)	2183 (63.7)	
Financial hardship	691 (35.3)	261 (39.9)	293 (36.0)	1245 (36.3)	
Health Status					0.27
Excellent	741 (37.5)	232 (35.5)	298 (36.3)	1271 (36.8)	
Good	1072 (54.3)	352 (53.9)	441 (53.7)	1865 (54.1)	

Characteristic	Collapsed intervention strategies: Supplemental Interventions (*n* = 1,977) *n* (%)	ATR/ELR Reminders (*n* = 655) *n* (%)	Enhanced Usual Care Reminders (*n* = 823) *n* (%)	Analytic Sample (*n* = 3,455) *n* (%)	*p-value*
Fair	149 (7.5)	62 (9.5)	69 (8.4)	280 (8.1)	
Poor	14 (0.7)	7 (1.1)	13 (1.6)	34 (1.0)	
Number of People in Household					0.20
No Others	224 (11.3)	58 (8.9)	100 (12.2)	382 (11.1)	
One person	1056 (53.4)	344 (52.5)	428 (52.0)	1828 (52.9)	
Two people	349 (17.7)	146 (22.3)	146 (17.7)	641 (18.6)	
Three people	241 (12.2)	75 (11.5)	102 (12.4)	418 (12.1)	
Four or more	107 (5.4)	32 (4.9)	47 (5.7)	186 (5.4)	

Table 3

Comparison of reminder strategies

Study condition comparisons	*n*	Days non-adherent (M [SD])	Difference in days	*p-value*
ELR and EUCR			24.13	0.20
Enhanced letter reminder	337	197.82 (234.57)		
Enhanced usual care reminder	823	221.95 (258.38)		
ATR and EUCR			15.73	0.51
Automated telephone reminder	318	206.22 (244.05)		
Enhanced usual care reminder	823	221.95 (258.38)		

Table 4
Comparison of supplemental strategies

Study condition comparisons	*n*	Days non-adherent (M [SD])	Difference in days	*p-value*
Supplemental interventions and EUCR			38.55	**0.0003**
Any supplemental intervention	1977	183.40 (217.35)		
Enhanced usual care reminder	823	221.95 (258.38)		
BarriConCall + and BarriConCall −			5.38	0.9661
BarriConCall +	662	181.22 (209.11)		
BarriConCall −	659	186.60 (221.68)		
BarriCall and EUCR			39.56	**0.0042**
Barriers-only priming letter and telephone counseling	656	182.39 (221.37)		
Enhanced usual care reminder	823	221.95 (258.38)		
BarriConCall +/− and EUCR			38.05	**0.0008**
Barriers plus positive/negative consequences priming letter and telephone counseling	1321	183.90 (215.40)		
Enhanced usual care reminder	823	221.95 (258.38)		
BarriConCall (+/−) and BarriCall			1.51	0.9871
Barriers plus positive/negative consequences priming letter and telephone counseling	1321	183.90 (215.40)		
Barriers-only priming letter and telephone counseling	656	182.39 (221.37)		