



Improving Mammography Screening Among the Medically Underserved

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BACKGROUND: We evaluated the effectiveness and cost-effectiveness of alternative interventions designed to promote mammography in safety-net settings.

METHODS: A three-arm, quasi-experimental evaluation was conducted among eight federally qualified health clinics in predominately rural Louisiana. Mammography screening efforts included: 1) enhanced care, 2) health literacy-informed education of patients, and 3) education plus nurse support. Outcomes included mammography screening completion within 6 months and incremental cost-effectiveness.

RESULTS: Overall, 1,181 female patients ages 40 and over who were eligible for routine mammography were recruited. Baseline screening rates were < 10 %. Post intervention screening rates were 55.7 % with enhanced care, 51.8 % with health literacy-informed education and 65.8 % with education and nurse support. After adjusting for race, marital status, self-efficacy and literacy, patients receiving health-literacy informed education were not more likely to complete mammographic screening than those receiving enhanced care; those additionally receiving nurse support were 1.37-fold more likely to complete mammographic screening than those receiving the brief education (95 % Confidence Interval 1.08–1.74, $p=0.01$). The incremental cost per additional women screened was \$2,457 for literacy-informed education with nurse support over literacy-informed education alone.

CONCLUSIONS: Mammography rates were increased substantially over existing baseline rates in all three arms with the educational initiative, with nurse support and follow-up being the most effective option. However, it is not likely to be cost-effective or affordable in resource-limited clinics.

KEY WORDS: cancer screening; mammography; community clinics; health literacy; underserved populations.

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INTRODUCTION

Breast cancer screening in safety-net settings remains underutilized in the United States. Breast cancer is the second leading cause of cancer-related death among women in the United States.¹ National efforts to reduce breast cancer-related mortality have emphasized early detection through mammography.¹ While mammography rates have increased dramatically over the last 30 years, they remain persistently lower among disadvantaged populations, including low-income women, those with no health insurance, lower health literacy,^{2,3} fewer years of education, and racial/ethnic minorities.^{4–15} Reducing these disparities in mammography screening is a national public health priority.¹⁶

Numerous studies have identified patient and system barriers that impact breast cancer screening rates among disadvantaged populations. These include: poorer knowledge about screening, fear of finding cancer, lack of motivation, embarrassment, inadequate transportation, lack of health insurance, lack of physician screening recommendation, and poor availability of screening facilities.^{1,5,17–27} Limited health literacy is another barrier that has been linked to lower levels of breast cancer knowledge, attitudes on breast cancer screening, understanding of screening benefits, lower self-efficacy and a lesser likelihood of completing screening mammography.^{2,3,13,27–29} To help address this problem, the Department of Health and Human Services “National Action Plan to Improve Health Literacy”³⁰ has called for the development and dissemination of health information and services that are accurate, accessible, understandable and actionable. However, few health literacy interventions have evaluated mammography in safety net settings.³¹

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Our team developed and evaluated an intervention for a population at higher risk for not undergoing mammography: patients cared for in rural and inner-city Federally Qualified Health Centers (FQHCs). FQHCs are government-supported clinics that are required to provide services to patients regardless of insurance status. Strategically located in areas designated as medically underserved, FQHCs provide care to over 20 million individuals in the U.S.³² Identifying practices that can improve mammography rates in community clinics disproportionately caring for vulnerable populations has the potential to advance public health preventive practices and potentially reduce screening disparities among disproportionately affected groups.

The purpose of this quasi-experimental study was to evaluate the effectiveness and cost-effectiveness of three alternative strategies designed to improve mammography screening rates: 1) enhanced care that provided assurance that patients received a screening recommendation and had access to mammography; 2) the use of literacy-informed educational materials with accompanying ‘teach back’ to confirm comprehension;³³ or 3) utilization of this education strategy with support and follow-up by a nurse. Given the resource-constrained FQHCs environment, we evaluated not only the effectiveness of our interventions, but also cost-effectiveness of the interventions.

METHODS

Study Design and Sample

A three-arm, quasi-experimental (i.e. based on randomization of sites, but not patients within sites) comparative effectiveness evaluation was conducted among three Louisiana FQHC networks between May 2008 and August 2011. Louisiana ranks third among states in breast cancer death rates.³⁴

The study team determined that randomizing patients within an FQHC network was not an optimal study design, as was case in our prior studies of screening for colorectal cancer,^{35,36} because of the diffuse nature of interventions and concern of contamination among patients who belonged in a network FQHC that shared providers and staff. The target population was the five FQHC networks in predominantly rural north Louisiana. Three networks participated in this study; the other two were involved in cancer screening programs. The study statistician used computer-generated random numbers to allocate each network to an arm. Each participating FQHC parent network was affiliated with multiple clinics, which were assigned to the same study arm as their parent network. This resulted in two clinics in the enhanced care arm, two in the education arm, and three in the nurse support arm. After the first year of the study, one additional clinic was enrolled

in the enhanced care arm due to limited patient recruitment in this arm. The three parent networks each served between 1,162 and 2,386 female patients aged 40 and over.

The eight study clinics were located in eight towns in seven parishes across the state. Six clinics were located in rural towns, with populations ranging from 450 to 13,000; and two clinics were in low-income areas of cities with populations of 63,000 and 199,000, respectively. Clinic personnel included on average one to two physicians, two nurse practitioners, one registered nurse, and one to three licensed practical nurses (LPNs), a medical technician and a receptionist. Baseline rates of screening mammograms at each clinic ranged from 5 to 9 %.

Due to ethical concerns and to ensure all patients had access to mammography, the grant provided free mammograms to those without insurance. The parent FQHCs were randomized to one of three arms: 1) enhanced care; 2) a literacy informed educational intervention; or 3) nurse support.

Participants

Patients were recruited through a multi-step process. First, while taking patient vital signs, a medical assistant at each clinic identified potentially eligible female patients by age (≥ 40 years old) and asked if they would be willing to talk to a research assistant (RA) on site about participating in a cancer screening study prior to their physician encounter. Those interested met with the RA, who screened them for further eligibility: 1) English-speaking, 2) current clinic patient, 3) not requiring screening at an earlier age according to American Cancer Society (ACS) guidelines,¹ 4) not up-to-date with United States Preventive Services Task Force³⁷ screening mammography recommendations (i.e. mammogram every other year), and 5) not having an acute medical concern. In all, 1,236 patients were identified, 36 (3 %) refused to participate and 19 (2 %) were found to be ineligible (see Fig. 1). This left 1,181 enrolled patients with a determined cooperation rate of 96 %. All patients were consented prior to data collection. The Louisiana State University Health Sciences Center–Shreveport Institutional Review Board approved the study. Each patient received \$10 for their participation in the baseline survey.

Structured Survey

The study interview included demographic, breast cancer and screening mammography items from validated questionnaires³⁸ used previously by the authors and conceptually guided by the Health Belief Model (HBM)^{39–42} and Social Cognitive Theory (SCT).^{41,42} A detailed description of the survey, which was written on a fourth-grade level and administered orally, has been reported previously.⁴³ Litera-

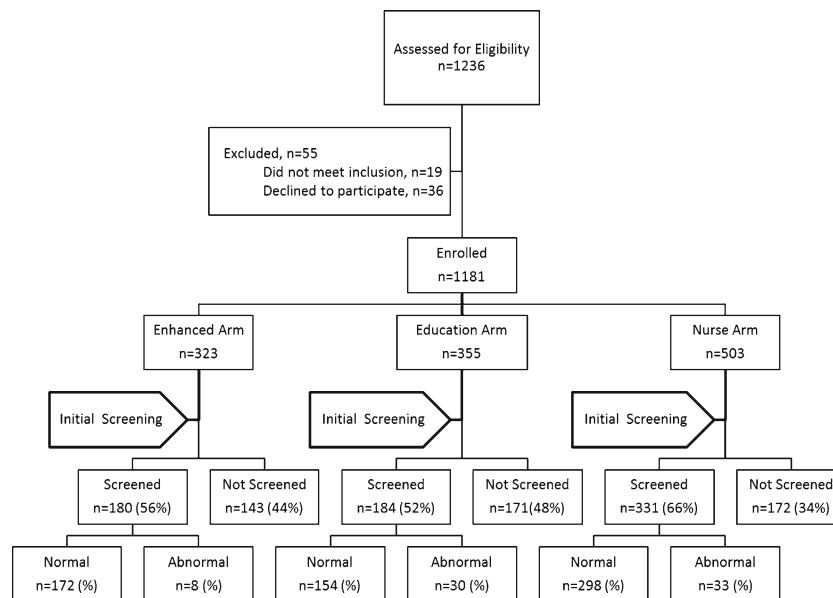


Figure 1. Flowchart of initial screening.

cy was assessed using the Rapid Estimate of Adult Literacy in Medicine (REALM).⁴⁴ The REALM is highly correlated with the Test of Functional Health Literacy in Adults (TOFHLA), and is an indicator of functional health literacy. Raw REALM scores (0–66) can be converted into reading grade levels that correlate with literacy skills. Raw scores of ≤ 60 indicate a reading grade level of eighth grade or below, or limited literacy; scores > 61 indicate at least a ninth-grade reading level or adequate literacy.

Clinic In-Service and Training of Research Assistants and Nurses

Staff and providers in each clinic attended a 2-hour in-service on mammography screening guidelines and an orientation to the study during a quarterly clinic meeting. RA training in the enhanced care arm included practice interviewing patients and administering the survey and literacy test. Each clinic RA (who was a part-time clinic staff member) was given a script for recommending screening. For the educational strategy, RAs were given additional training in using health literacy techniques.^{32,33} For the nurse support arm, the nurse training also included motivational interviewing techniques,⁴⁵ use of a tracking system, and a protocol for contacting patients and assisting them with navigation if a test was positive.

The Three Study Arms

Enhanced Care Arm. At enrollment, after completing the structured interview, the RA gave patients a recommendation to get a mammogram, and suggested they talk with their

primary care provider about screening during their visit that day. Before patients left the clinic, the clinic nurse scheduled the mammograms at the closest community hospital with which the clinic had a contract, or the closest state public hospital. Mammography was provided at no cost to those who lacked adequate insurance. Regular clinic protocol was followed for abnormal mammogram results and if there was a need for diagnostic testing.

Health-Literacy Informed Education Arm. At enrollment, after completing the structure interview, the RA followed the enhanced care protocol and additionally provided brief education using health literacy best practices, such as using plain language and teach back to confirm understanding.^{29,37} As in the enhanced care arm, the clinic nurse scheduled mammograms before patients left the clinic. The education included the RA using a pamphlet and brief video as teaching tools. The materials were created by the authors, a video production team, and input from focus groups of FQHC patients and clinic providers. The video captured actual FQHC patients discussing barriers and facilitators to screening. It showed women encouraging each other to get screened, a physician recommending screening, and one woman getting a mammogram. The pamphlet, written on a fifth-grade level, highlighted risk factors for breast cancer, benefits of regular mammography and a brief explanation and illustration of the test. It included culturally appropriate pictures, text and testimonials to convey empowering messages to encourage mammography. Iterative cognitive interviews of FQHC patients ensured appeal and cultural and literacy appropriateness of the text and pictures.

Both materials incorporated evidence-based practices for the design of multimedia tools, guided by the theory of

health learning capacity.⁴⁶ The Health Belief Model and Social Cognitive Theory guided the inclusion and framing of content to address the salience of mammogram screening and the need to take action.^{41,42} The strategies were targeted at overcoming patient barriers to mammography, such as access to tests, limited knowledge, negative beliefs, poor self-efficacy and lack of motivation.^{5,17–27} Regular clinic protocol was followed for abnormal mammogram results.

Nurse Support Arm. At enrollment after the structured interview by the RA, the registered nurse gave participants the educational intervention, brief counseling and a screening recommendation, and the suggestion to talk to their primary care provider about screening. This nurse scheduled the mammogram, and followed up with patients to remind them of their mammogram appointment and ensure that they knew how to locate the clinic. This strategy was designed to extend the educational intervention by adding an ongoing supportive relationship and follow-up reminder calls to help identify and problem-solve barriers and motivate patients to complete mammography. If the patient missed her appointment, the nurse called to reschedule. If the patient had obtained the mammogram, the nurse entered the results in the tracking system and clinic chart. If results were negative, the nurse sent a letter informing patients that their mammogram was normal. If results were positive, the nurse called the patient to discuss results and facilitate scheduling of an appointment for a diagnostic mammogram.

Outcomes

Eligible patient mammogram completion at six months post enrollment was the primary outcome measure, as documented by the clinic nurse (enhanced care and education arms) or the nurse (nurse support arm) when mammography results were returned to the clinic.

Statistical Analysis

Mammography completion rates were defined as the percentage of mammogram results returned to the clinic. To examine whether patients in the study arms differed on baseline age and the self-efficacy and barrier indices, analysis of variance was used. Chi-square tests were performed to compare categorical factors across study arms. Screening ratios were defined as the ratio of mammogram completion rates between two groups. Screening ratios and pairwise tests for mammogram were calculated using logistic regression, which accounted for clustering by clinic.

Factors found to be significantly different between arms (race, marital status, literacy level, self-efficacy) were included in a multivariate analysis.

Cost and Cost Effectiveness Analysis

Cost data were collected from purchase orders, receipts, and questioning research staff. Incremental costs and additional number of persons screened were calculated for the education arm over the enhanced care arm. Costs included a video (\$5,000), pamphlets (\$2,000) and research assistant (\$1,098). Costs for the nurse arm over the education arm included 65 % of two registered nurses (\$172,705). Comparison arm costs and number screened were normalized to the reference arm to account for differences in sample size. The incremental cost effectiveness (ICER) was calculated as the total incremental cost of a comparison arm relative to the reference arm divided by the total number of additional persons screened, as was done in our prior studies of cost-effectiveness of cancer screening interventions.³⁶

RESULTS

Baseline participant characteristics, stratified by study arm, are presented in Table 1. While almost all (88 %) reported seeing a doctor in the past 12 months, none reported receiving a mammogram in the last 2 years, despite a high reported recommendation rate (82 %) and screening history (77 %). There were significant differences across groups for race/ethnicity, marital status, and literacy.

The overall mammogram completion rate was 59.9 %, 55.7 % in the enhanced care arm, 51.8 % in the education arm and 65.8 % in the nurse support arm ($p=0.037$). Adjusting for race, marital status, literacy and self-efficacy, participants in the education arm were 0.87 times more likely to be screened (95 % CI 0.62–1.22, $p=0.42$) compared to participants in the enhanced care arm (Table 2). Those in the nurse support arm were 1.19 times more likely to be screened (95 % CI 0.85–1.65, $p=0.31$) compared to those in the enhanced care arm and 1.37 times more likely to be screened (95 % CI 1.08–1.74, $p<0.0001$) compared to those in the education arm.

Table 3 presents the differences in mammography completion rates among study arms for each of the two literacy groups. There were significant differences across arms for the adequate literacy group, but not for the limited literacy group; among those with adequate literacy screening, completion rates were highest in the nurse support arm. An interaction term for study arm and literacy level was entered into the final model and was statistically significant

Table 1. Characteristics of Study Sample at Baseline, Stratified by Study Arm

Characteristic	All patients (n=1181)	Study arm			p value
		Enhanced care (n=323)	Education (n=355)	Nurse (n=503)	
Age, mean (sd)	53.3 (9.0)	53.2 (8.9)	52.9 (8.1)	53.7 (9.5)	0.66
Self-Efficacy Index*, mean (sd)	28.2 (2.4)	27.8 (2.5)	29.0 (2.7)	27.8 (1.9)	0.007
Barrier Index*, MEAN (sd)	14.3 (3.0)	14.4 (3.1)	14.4 (3.2)	14.1 (2.8)	0.60
	N (%)	N (%)	N (%)	N (%)	
Age categories					
40–49	437 (37)	113 (35)	131 (37)	193 (38)	0.44
50–59	475 (40)	143 (44)	146 (41)	186 (37)	
60–69	203 (17)	50 (15)	65 (18)	88 (17)	
70+	66 (6)	17 (5)	13 (4)	36 (7)	
Years of education					
Less than high school	346 (29)	103 (32)	107 (30)	136 (27)	0.22
High school grad	544 (46)	135 (42)	175 (49)	234 (46)	
Some college	214 (18)	62 (19)	54 (15)	98 (19)	
≥ College graduate	77 (7)	23 (7)	19 (5)	35 (7)	
Race					
African-American	766 (65)	208 (64)	164 (46)	394 (78)	< 0.001
Caucasian/Hispanic	416 (35)	115 (36)	191 (54)	109 (22)	
Marital status					
Single	370 (31)	85 (26)	87 (24)	198 (39)	0.04
Married	369 (31)	106 (33)	145 (41)	118 (23)	
Separated	93 (8)	29 (9)	29 (8)	35 (7)	
Divorced	207 (18)	54 (17)	63 (18)	90 (18)	
Widowed	142 (12)	49 (15)	31 (9)	62 (12)	
Marital status					
Married	369 (31)	106 (33)	145 (41)	118 (23)	< 0.001
Not married	812 (69)	217 (67)	210 (59)	385 (77)	
Literacy level					
Limited: < 9 th grade	536 (45)	173 (54)	105 (30)	258 (51)	0.01
Adequate: ≥ 9 th grade	645 (55)	150 (46)	250 (70)	245 (49)	
Seen doctor in past 12 months	1041 (88)	284 (88)	322 (91)	435 (86)	0.13
Prior recommendation	922 (82)	249 (80)	307 (86)	366 (80)	0.40
Ever had a mammogram	850 (77)	233 (75)	260 (73)	357 (78)	0.34
Want to know if had cancer	1034 (92)	288 (93)	326 (92)	420 (92)	0.77

*The Self-Efficacy Index ranges from 17 to 35, where low numbers mean low self-efficacy and high numbers mean high self-efficacy. The Barrier Index ranges from 6 to 26, where low numbers indicate a low barrier level to obtaining a mammogram and high numbers indicate a high barrier level.

($p < 0.0001$), indicating significantly different levels of effectiveness for the two literacy categories.

The incremental cost effectiveness of the health literacy informed education, with or without nurse support is presented in Table 4. After adjustment for sample size, more people were screened in the enhanced care arm than in the education arm. Therefore, an incremental cost-effectiveness ratio was not calculated for education over enhanced care. The incremental cost of the nurse support intervention

per additional person screened compared with the education arm was \$2,457.

DISCUSSION

Among urban and rural southern FQHC patients, our study documented extremely low baseline screening mammography rates. Our results indicate that mammography rates

Table 2. Primary Outcome Measure—Mammogram (Screened) Within 12 Months

	All patients (n=1181)	Study arm			p value
		Enhanced care (n=323)	Education (n=355)	Nurse (n=503)	
	N (%)	N (%)	N (%)	N (%)	
Mammogram (screened)	695 (59.9)	180 (55.7)	184 (51.8)	331 (65.8)	0.037
No mammogram	486 (41.1)	143 (44.3)	171 (48.2)	172 (34.2)	
Screening ratio		1.00	0.87	1.19	
95 % Confidence Interval			(0.62–1.22)	(0.85–1.65)	
p value			0.42	0.31	
Screening ratio		–	1.00	1.37	
95 % Confidence Interval				(1.08–1.74)	
p value				0.01	

Multivariate analyses controlling for race (African American vs. Caucasian and Hispanic), marital status (married vs. not married), literacy (two categories) and self-efficacy

Table 3. Primary Outcome Measure—Mammogram (Screened) Within 12 months, by Literacy Level

	All patients N (%)	Study arm			p value
		Enhanced care N (%)	Education N (%)	Nurse N (%)	
Limited literacy	N=536	N=173	N=105	N=258	0.17
Mammogram (screened)	309 (58)	102 (59.0)	58 (55.2)	149 (57.7)	
No mammogram	227 (42)	71 (41.0)	47 (44.8)	109 (42.3)	
Adequate literacy	N=645	N=150	N=250	N=245	0.039*
Mammogram (screened)	386 (60)	78 (52.0)	126 (50.4)	182 (74.3)	
No mammogram	259 (40)	72 (48.0)	124 (49.6)	63 (25.7)	

Multivariate analyses controlling for race (African American vs. Caucasian and Hispanic), marital status (married vs. not married), literacy (two categories) and self-efficacy

*p=0.016, Nurse versus Education

increased substantially over baseline in the three study strategies, although the nurse support arm was clinically and statistically superior to the other two arms. Of interest, we found giving low-income women a recommendation and scheduling a mammogram that required no out-of-pocket cost increased screening rates dramatically; however, additionally providing literacy and culturally appropriate education did not result in improvement in mammography rates over enhanced care. The addition of the nurse support and telephone follow-up significantly increased mammogram screening completion, but this arm was at substantially greater cost per patient.

Prior studies in safety-net clinics cite provider and system barriers, such as low rates of physician recommendation and inadequate insurance, as causes of lower mammography screening rates.^{12,14,47,48} Overcoming these barriers may be a reason for substantial improvement in the enhanced care arm, where non-medical staff gave patients a recommendation and suggestion to talk with their provider

during their routine office visit and mammography was provided at no cost to those who lacked adequate insurance. The literature also cites personal barriers, such as limited knowledge and self-efficacy and faulty beliefs.^{5,17-27} However, in our study, although no patients were up-to-date and three-fourths had previously had a mammogram, the literacy-informed education intervention did not improve mammography completion over enhanced care. This may suggest that the education needs to be aimed at enhancing motivation and emphasizing the importance of regular mammography screening.

In our study, two-thirds of women who received brief education by a nurse with telephone follow-up, along with a free mammogram to those who lacked adequate insurance, completed screening. This is consistent with a meta-analysis that found the most effective programs for women with historically lower rates of mammography incorporated multifaceted-leveraging access-enhancement as well as individually directed strategies.⁴⁹ Previous studies using

Table 4. Cost-Effectiveness Analysis

	Education (comparison arm) vs. EUC (reference arm)	Nurse (comparison arm) vs. Education (reference arm)
Additional people screened in comparison arm		
A Sample size in reference arm	323	355
B Number screened in reference arm	180	184
C Sample size in comparison arm	355	503
D Number screened in comparison arm	184	331
E Number screened in comparison arm normalized to size of reference arm	167.4	233.6
F Additional number screened in comparison arm normalized to size of reference arm = E - B	-12.6	49.6
Incremental costs of comparison arm		
G Personnel	\$1,098	\$172,705
H Non-personnel	\$7,000	\$0
I Total incremental costs	\$8,098	\$172,705
J Total incremental costs normalized to size of reference arm	\$7,368	\$121,889
Incremental cost-effectiveness ratio = row J/row F	*	\$2,457

*Incremental cost-effectiveness ratio of Education vs EUC was not calculated, since after adjusting for different group sample sizes, more people were screened in the EUC arm

personal telephone calls by an outreach specialist or patient navigator with women patients enrolled in privately and publically insured programs found significant improvement in mammography completion.^{47–52} In our study, when the nurses called patients, the most common barrier was being unable to make the appointment, rather than additional decision-making or cancer-related anxiety. Providing telephone follow-up reminders, and if needed, rescheduling assistance for no cost mammograms, may reduce key barriers for mammography completion for low income women. Given the cost of the nurse, other strategies to prompt patients, such as reminder calls and rescheduling help by a less-costly medical assistant, should be investigated. Even though use of a medical assistant would reduce cost by 80 %, this may still be cost-prohibitive among FQHCs. With the recent federal requirement for community health centers to have electronic health records (EHRs), amount of staff time dedicated to identifying and tracking patients could be substantially reduced. None of the FQHCs in this study had an integrated EHR system at the time of this study. Future studies should consider coupling reminder letters generated from the EHR with outreach calls and use of mobile mammography units, particularly in rural areas. FQHC networks could also consider structuring a collaborative outreach program, using a designated medical assistant to provide follow-up reminder calls for patients from multiple clinics.

Our study has limitations. Differences were noted between arms in sociodemographic characteristics, and self-efficacy, but not for the primary outcome of screening rates. Adjustments for key variables were therefore made in statistical analyses. Other limitations relate to generalizability of our results; we included predominantly African American and female patients receiving care from FQHCs in one state. However, this is generally representative of FQHC populations in the southern United States.

Strategies are needed to overcome limited resources for patient reminders, continued outreach, and scheduling assistance in FQHCs.³⁰ Future research should explore leveraging less expensive clinic staff, distributing the workload over multiple clinics, and using EHR technology and possibly automated phone calls or text messages to offset some of the costs that may likely be necessary to maintain the success of a screening program that requires regular follow-up.

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