Over the past 10 years, breast cancer screening has increased greatly among women in the United States. Among women ages 50 and older, more than 56% reported having received a clinical breast exam and mammogram (X-ray images of the breast) in the 2 years preceding the 1994 National Health Interview Survey (NHIS), compared with 25% in 1987 (U.S. Department of Health and Human Services [DHHS], 1990). Mammography rates doubled or tripled for most ethnic groups over that period.

In the past decade, the progress that has been made in breast cancer screening is striking. Although it may be impossible to demonstrate a causal relationship, the increase in screening rates surely is a result of a concerted effort by researchers, clinicians, and practitioners. The investments made by the National Institutes of Health (NIH), the Centers for Disease Control and Prevention, the American Cancer Society, and other organizations to conduct research, promote screening, and deliver services have played an important role in the increase in breast cancer screening.

In this review, we examine briefly, and with more emphasis on breadth
than depth, the efforts undertaken and chronicled in a decade of published research on breast cancer screening, with an emphasis on mammography use. First, we provide a brief summary of the barriers to mammography use. Then we focus on intervention research, highlighting the behavioral and social sciences theories that have informed interventions. We end with a discussion of the findings and issues. This broad overview is designed to allow researchers and practitioners the opportunity to examine systematically the body of published intervention research in terms of types of interventions, where they were implemented, efforts at translation, and related information. By doing so, we provide a look at where we have been and what opportunities exist for new research. Some excellent meta-analyses are available for readers who want more detailed quantitative data on study and intervention outcomes (Snell & Buck, 1996; Wagner, 1998).

Mammography is the focus of our review of intervention research for several reasons. First, mammography has a particularly solid research base and a history of successful interventions (Rimer, 1994). Much of the research is grounded in the behavioral and social sciences. These interventions have provided the basis for a dramatic increase in the use of mammography over the past decade. Second, practitioners and those in the public health sector need to know where research interventions already have occurred and what types of interventions have been implemented and their impact, to determine where and what kinds of new interventions are needed. Third, research designed to increase adherence to regular mammography has helped increase its use dramatically over the past decade. It is also one of the best examples of the behavioral and social sciences' valuable contributions to health. Behavioral and social scientists have been on the front line of this research by identifying the barriers to mammography use and then developing theory-informed interventions to overcome these barriers. In compiling this review, we aimed to answer the following questions:

- How much research occurred in the past decade?
- Where did the research occur?
- What types of interventions were conducted?
- What behavioral and social sciences theories informed the results?
- Who did the interventions target?
- What can be said about the results of the interventions?
- How have the results been disseminated?

BACKGROUND

This review is limited to breast cancer screening interventions that were conducted in the United States and published from 1988 through
Our major interest was in research designed to encourage use of mammography. The search procedure for identifying articles and abstracting information has been reported previously (Meissner et al., 1998). Briefly, in the detailed section on intervention research, we included articles published from 1987 to 1998 that reported outcomes of interventions designed to increase utilization of mammography in asymptomatic populations. Needs assessments, pilot or feasibility studies for an intervention, and reports of preliminary findings without measures of intervention impact were excluded. Additionally, only reports of intervention studies that used experimental or quasi-experimental research designs were included. These studies are the foundation of evidence-based decision making in cancer control. We identified 51 studies meeting these criteria. In addition to the 51 studies reporting outcomes, we also examined selected articles that described barriers to mammography use. For the examination of barriers, we did not exclude descriptive research.

Rimer's (1994) typology was used to categorize seven mammography intervention strategies: (a) individual directed, (b) system or provider directed, (c) community education, (d) access enhancing, (e) media campaign, (f) social network, and (g) policy level. Some programs used multiple strategies, and we highlight these as well. We discuss these categories in more detail later in the chapter.

The mammography research trials have included many target groups, including older women, rural women, and ethnic minorities. We used five different Healthy People 2000 (Healthy People 2000 progress review, 1998; DHHS, 1990) special population targets (slightly modified) for cancer screening (or, in the case of age, modified) to define the following underserved populations: Hispanic, Black, and Native American racial and ethnic groups; those with an annual family income of less than $10,000; those with less than high school education; and those ages 65 and older. We also examined whether investigators reported any cost analysis or efforts to institutionalize their interventions.

**BARRIERS TO MAMMOGRAPHY**

The first studies of mammography use focused on identifying the barriers to use (Howard, 1987). This work was, and continues to be, important, although the emphasis should evolve to focus on specific groups who are currently underusers. Interventions must overcome women's individual barriers to mammography to be effective. Fox, Roetzheim, and Velt (1997) reviewed the following barriers to mammography: sociodemographic characteristics, factors related to patient—doctor communication, knowledge gaps, physicians or patients' knowledge or attitudes about some aspect of breast cancer screening, and insufficient clinical or community support for
education and reminders about screening. Other studies have shown that previous use of the test, number of persons in the household, race, age, income, level of education, and health insurance are important predictors of use (Breen, Kessler, & Brown, 1996; Gaudette, Ahmayer, Nobrega, & Lee, 1996; Harris et al., 1991; Mah & Bryant, 1997; Mandelblatt et al., 1993; Rakowski, Pearlman, Rimer, & Ehrich, 1995; Rakowski, Rimer, & Bryant, 1993; Rimer et al., 1996).

Researchers have documented general barriers to mammography and barriers in specific subgroups of women, such as poor, immigrant, and some minority groups (Dawson & Thompson, 1990; Gaudette et al., 1996; Harris et al., 1991; Lacey et al., 1993; Mayer et al., 1993; McPhee, Stewart, Brock, Jenkins, & Pham, 1997; Suarez, Roche, Nichols, & Simpson, 1997). Although there are differences among these subgroups of women, certain themes predominate. Being a recent immigrant, not having a regular physician, lacking health insurance, and having lower levels of education have been related negatively to breast and cervical screening (Camirand, Potvin, & Beland, 1995; Carney, Dietrich, & Freeman, 1992; MMWR, 1990). Knowledge barriers are important and, for some groups of women, so are access barriers and concerns about pain and radiation (Rimer, 1994). Lack of health insurance may be a significant barrier, particularly in the United States, where a universal health insurance system does not exist. One of the most important barriers to screening is the lack of physician recommendations (Dawson & Thompson, 1990; Harris et al., 1991; Lane, Caplan, & Grimson, 1996; Marchant & Sutton, 1990). There is some evidence that Black women are less likely than other groups of women to be advised by their doctors to get mammograms (Glanz, Resch, Lerman, & Rimer, 1996), even with similar use of primary care (Burns et al., 1996). Conversely, the most important facilitator of mammography is a physician's recommendation (Dawson & Thompson, 1990; Fox et al., 1997; Paskett et al., 1998; Rimer, Keintz, Kessler, Engstrom, & Rosan, 1989).

The general barriers to mammography have been well documented, and there is substantial consistency from one study to another. At this point, neither science nor practice will benefit from additional studies that attempt to identify barriers to mammography in the general population. Surveillance of general population barriers is needed to monitor trends, however. There also may be a need to identify barriers in specific population groups, particularly those who are not being screened on schedule.

TYPES OF INTERVENTIONS

This review is based on research studies of interventions that are designed to increase mammography use. The interventions evolved from earlier descriptive research that identified the barriers to women's use of
mammography (Dawson & Thompson, 1990). These interventions have made a major contribution to behavioral intervention research over the past decade. Most of the research teams conducting breast cancer screening interventions have included at least one person with a behavioral sciences background, and many interventions have been grounded in behavioral theories and models, as discussed in a section below.

As noted earlier, we used the typology Rimer (1994) created to categorize mammography interventions, which represent the major strategies used for interventions. We defined seven types of interventions and provide representative examples of studies that used them.

1. Individual-directed interventions have included strategies such as mailed letters and reminders and in-person or telephone counseling (Rimer, 1994). Telephone counseling is an extension of the clinical encounter, a face-to-face occurrence that, at its best, is tailored to the needs of the individual patient. The benefits of telephone counseling have been demonstrated for a large number of topics and with a wide range of populations (McBride & Rimer, 1999). These interventions have been shown to double or triple the odds that women will have mammograms (Snell & Buck, 1996; Wagner, 1998) and, in some cases, are cost effective (King, Rimer, Seay, Balshem, & Engstrom, 1994). Telephone counseling, particularly barrier-specific telephone counseling, has significantly increased the proportion of women who get mammograms (Calle, Flanders, Thus, & Martin, 1993; Champion & Huster, 1995; Davis, Lewis, Rimer, & Harvey, 1997; Janz et al., 1997; King et al., 1994). Although most protocols use humans to deliver the interventions, some use computer-controlled, digitized human voices (Friedman, 1998).

More recently, tailored letters and other print materials have been used to deliver personalized messages, and they have shown promising results (Drossaert, Boer, & Seydel, 1996; Rakowski, 1999; Rimer et al., 1999; Skinner, Strecher, & Hospers, 1994). Rakowski et al. (1998) found significant increases in mammography use when interventions were both tailored and matched to a woman’s stage of readiness to adopt mammography.

The individual-directed interventions have been informed by such models as the theory of reasoned action, the health belief model (HBM), and the stages of change model (see chapters 1–4 in Glanz, Lewis, & Rimer, 1997).

2. System-directed or provider-directed interventions have been based on the assumption that providers may fail to recom-
mend mammography, not because of a lack of support or commitment, but because they forget. Thus, strategies such as computerized and manual-prompting systems are designed to cue, reinforce, and remind health providers. Systemwide interventions can alter the practice environment to make it more supportive of cancer screening (Burack et al., 1994). The provider-directed strategies have been informed by a number of theories, including the HBM, social learning theory (SLT) and, recently, the stages of change model (Rakowski, 1999).

3. Community education focuses on mammography within the community where women live. In Flynn et al.'s (1997) highly successful intervention study among rural women, a combination of community interventions, including a mobile van and reduced-cost mammograms, resulted in about a 10% difference reported in recent mammography use between the control and comparison communities.

4. Access-enhancing strategies are designed to reduce the impediments to mammography. Such interventions include attempts to lower the costs of mammograms and to make mammograms more accessible, for example, through the use of mobile vans as reported by Rimer et al. (1992). Some of these approaches have been based on the HBM (Strecher & Rosenstock, 1997) and the recognition that women's access barriers may keep them from getting mammograms.

Several studies have reported the efficacy of vouchers and other mechanisms to reduce or remove the cost barrier to screening, increase access, or both. The results are encouraging. When vouchers for free mammograms were added to the usual health instruction in migrant health clinics, women who received the vouchers were found to be 47 times more likely to have had mammograms than women in the control group (Skaer, Robison, Sclar, & Harding, 1996). In an inner-city public hospital clinic, Kiefe, McKay, Halevy, and Brody, (1994) used vouchers to increase mammography use and found that they resulted in about a sevenfold increase in use. Stoner et al. (1998) concluded that a vouchering program, with limited resources, may be more efficient if it focuses on women who are currently out of compliance and women who are financially vulnerable, rather than women who are already getting screened routinely.

5. Media campaigns rely on the use of mass media, alone or in combination with other strategies, to increase mammography use (Rimer, 1994). Mayer et al. (1992) showed that mass
media could increase awareness and heighten intentions about mammography. The A Su Salud project (Ramirez & McAlister, 1988) used more specialized, local media to reach ethnic minorities with messages about mammography. The media campaigns have been based on several theoretical models. To date, SLT (Bandura, 1995) has been the most widely used model.

6. Social network interventions have included the use of peer and lay health advisors who, based on SLT, model the desired behavior while also seeking to overcome women's barriers. Peer leaders and community organization techniques can change social norms regarding breast cancer screening (Eng, 1993; Israel, 1985). For example, the Save Our Sisters Program was designed to increase breast cancer screening among low-income Black women in North Carolina by using Black women to reach others from their community (Eng, 1993). In the A Su Salud program, volunteers reinforced media campaigns (Amezcua, McAlister, Ramirez, & Espinoza, 1990; Ramirez & McAlister, 1988). Senior health advocates were used in Chicago to reach older, low-income women (List, Lacey, Hopkins, & Burton, 1994). Peer leaders may be an important vehicle for reaching underserved women.

Recently, results of several studies were published that assessed the effectiveness of peer- or lay-led interventions. These strategies have shown mixed results (Suarez, Roche, Pulley, et al., 1997; Sung et al., 1997).

7. Policy level interventions, such as changes in payment for mammography under Medicare, can be an important part of a strategy to overcome cost barriers. There is some evidence that, although these interventions are important and sometimes even necessary for behavior change, they are not sufficient (Rimer et al., 1992).

Multistrategy interventions have been used by a number of investigators. They include continuing medical education and prompting systems; cost reductions; access-enhancing interventions; and interventions aimed at physicians and other providers, individual women, the community, or a combination thereof (Costanza et al., 1992; Fletcher et al., 1993; Trock et al., 1993; Zapka, Chasan, Barth, Mas, & Costanza, 1992; Zapka, Costanza, et al., 1993). In many cases, a combination of interventions is better than one, because multiple levels of intervention can be used to target different groups who can facilitate and reinforce the behavior (e.g., women, providers, and the health care systems).

Generally, more interventions are better than fewer interventions.
(Snell & Buck, 1996). Several authors have shown that multistrategy interventions were effective in increasing mammography use within community health centers (Ansell et al., 1994; Rimer, 1994; Zapka et al., 1992). As Fox et al. (1997) concluded, well-structured interventions have increased screening rates in an impressive variety of patient care settings and for patients of varied ethnicities and socioeconomic status. Most of the successful programs around the world have used mailed letters or reminders, targeted outreach, free or reduced-price screening, inreach techniques to facilitate mammograms among women already enrolled at a health care facility, professional education, or some subset of these interventions.

CHARACTERISTICS OF THE MAMMOGRAPHY LITERATURE

In the following sections, we discuss several key features of mammography intervention studies. These include factors such as where the research was conducted, what types of interventions were used and their frequency in the literature, target populations, year of publication, and whether or not there was any discussion of cost effectiveness or attempts to disseminate the intervention. This information provides a picture of the intervention research landscape at the time this analysis was performed.

Location of Interventions

Figure 9.1 shows the interventions that were reported in more than one third of the United States, largely in densely populated states and localities. Many publications reported the state's name only with no other detail. There was one national study, which is not reflected in the map (Anderson, Duffy, Hallett, & Marcus, 1992). Two studies (Grady, Lemkau, Lee, & Caddell, 1997; King et al., 1998) that were implemented in two states are recorded in both states in Figure 9.1.

Frequency of Intervention Types and Target Populations

Rimer's (1994) seven intervention categories were used to group the reported intervention strategies in Table 9.1. We indicated where multiple strategies were used. Table 9.2 shows the study locations and the number of studies targeting underserved populations. It also summarizes interventions according to the combination of strategies used because many studies used more than one approach. Of the 51 studies, 19 targeted underserved populations. Individual-directed strategies, alone or in combination with system- or provider-directed interventions, were used most frequently to target underserved populations.
Figure 9.1. Where mammography screening interventions were reported (1988–1998). One national study is not reflected in this map. Two studies were implemented in two states.
TABLE 9.1

<table>
<thead>
<tr>
<th>Intervention type</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual directed</td>
<td>27</td>
</tr>
<tr>
<td>System or provider directed</td>
<td>26</td>
</tr>
<tr>
<td>Community education</td>
<td>10</td>
</tr>
<tr>
<td>Access enhancing</td>
<td>8</td>
</tr>
<tr>
<td>Media campaign</td>
<td>4</td>
</tr>
<tr>
<td>Social network</td>
<td>4</td>
</tr>
<tr>
<td>Policy level</td>
<td>0</td>
</tr>
</tbody>
</table>

Note. Multiple intervention types were reported for some studies.

Year of Publication

Scientific information is disseminated through peer-reviewed publications, among other routes. Figure 9.2 displays a time line of the chronological order of publications from studies that reported when the interventions occurred. Fifteen studies reported no intervention dates. The first published mammography screening interventions were conducted in the mid-1980s. The most recently reported study began in 1994. The time line also shows the publication date for each study and the dates of duration; publication occurs about 2.9 years after study completion. The time line therefore represents the accumulated published knowledge about breast cancer interventions for the past decade and indicates that, on average, almost 3 years elapse before a study becomes part of the scientific literature.

Cost Effectiveness and Institutionalization

Information about cost effectiveness and the process of institutionalization is critical to ensure that research results are disseminated into public practice. Documentation of costs is particularly important in a managed care environment in which costs may be scrutinized as closely as is efficacy. Although only seven studies reported either costs or cost effectiveness, recent intervention studies are more likely to include some measure of costs. None of the publications included a discussion of institutionalization. It is possible that such discussion was delayed for other articles.

THEORIES USED TO INFORM RESEARCH

A major contribution to the study of mammography by the behavioral and social sciences has been the application of theory to inform both research and practice (Glanz et al., 1997). This is a critical contribution,
### TABLE 9.2

Populations Targeted and Location of Types of Intervention Reported

<table>
<thead>
<tr>
<th>Intervention type</th>
<th>No. of studies</th>
<th>No. of targeting underserved</th>
<th>Study locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access enhancing</td>
<td>2</td>
<td>2</td>
<td>MN, WA</td>
</tr>
<tr>
<td>Individual directed</td>
<td>15</td>
<td>4</td>
<td>CT, NH, NY, MI, CA, WA, GA, NC, PA, TX, IN</td>
</tr>
<tr>
<td>Community education</td>
<td>2</td>
<td></td>
<td>CT, AZ</td>
</tr>
<tr>
<td>Individual directed, community education</td>
<td>1</td>
<td>1</td>
<td>TX</td>
</tr>
<tr>
<td>Individual directed, system or provider directed</td>
<td>1</td>
<td>0</td>
<td>CA</td>
</tr>
<tr>
<td>Individual directed, system or provider directed, access enhancing</td>
<td>1</td>
<td>1</td>
<td>IL</td>
</tr>
<tr>
<td>Individual directed, system or provider directed, access enhancing, community education</td>
<td>1</td>
<td>1</td>
<td>NY</td>
</tr>
<tr>
<td>Individual directed, system/provider directed, community education</td>
<td>1</td>
<td>0</td>
<td>WA</td>
</tr>
<tr>
<td>Media campaign, individual directed, social network</td>
<td>1</td>
<td>1</td>
<td>TX</td>
</tr>
<tr>
<td>Media campaign, social network, community education</td>
<td>1</td>
<td>1</td>
<td>TX</td>
</tr>
<tr>
<td>Media campaign, system/provider directed, access enhancing, community education</td>
<td>1</td>
<td>1</td>
<td>NC</td>
</tr>
<tr>
<td>Media campaign, system/provider directed, community education</td>
<td>1</td>
<td>0</td>
<td>MA</td>
</tr>
<tr>
<td>Social network, community education</td>
<td>1</td>
<td>1</td>
<td>CA</td>
</tr>
<tr>
<td>Social network, community education, access enhancing</td>
<td>1</td>
<td>1</td>
<td>NC, PA</td>
</tr>
<tr>
<td>System or provider directed</td>
<td>14</td>
<td>1</td>
<td>OH, CO, WA, FL, PA, NY, VA, MI, IN, CA, MA</td>
</tr>
<tr>
<td>System or provider directed, access enhancing</td>
<td>1</td>
<td>1</td>
<td>MI</td>
</tr>
</tbody>
</table>

because theory-informed interventions are more likely to be effective. As shown in Table 9.3, a variety of theoretical models have been used in the study of mammography. Some investigators have used different models for different levels of planning and evaluation. This review does not permit an analysis of the utility of the models, and 28 articles did not report any theory. In the literature reported here, the most frequently used theories and models were the HBM, the transtheoretical model, SLT, the theory of reasoned action, prospect theory, and the PRECEDE–PROCEED model.
Figure 9.2. Study duration and publication dates for breast cancer intervention studies. Average publishing time was 2.5 years.
<table>
<thead>
<tr>
<th>Intervention type</th>
<th>HBM</th>
<th>Trans</th>
<th>Social</th>
<th>Reason</th>
<th>Pros/mess</th>
<th>PRECEDE</th>
<th>Diffusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual directed</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>System/provider directed</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Community education</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Access enhancing</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Media campaign</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Social network</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Note. Multiple intervention types and multiple theories were reported for some studies. Dual-task performance theory was cited in one study (Litzelman, Dittus, Miller, & Tierney, 1993) and is not reflected in the table. HBM = health belief model. Trans = transtheoretical model/stages of change. Social = social learning theory. Reason = theory of reasoned action. Pros/mess = prospect and message framing theories. PRECEDE = PRECEDE framework. Diffusion = diffusion of innovations.
In the past few years, researchers have expanded the theoretical basis on which interventions were developed. Rakowski, Fulton, and Feldman (1993) were among the first to extend the transtheoretical or stages of change model to the study of mammography, which is now one of the most widely used because of its application in designing stage and stage-matched interventions (Green & Kreuter, 1989; Rakowski, Fulton, & Feldman; Rakowski et al., 1998; Skinner et al., 1994). Other models, such as Wein-stein's (1989) precaution adoption model, are appropriate when response to a risk is a major concern. The best approach to theory is probably an ecological one that uses different theories for different levels of intervention (McLeroy, Steckler, Goodman, & Burdine, 1991).

An examination of Table 9.3 suggests that the theories have been selected in a deliberative manner. For example, although individual-directed interventions have used all the theories, community education interventions have relied more appropriately on SLT and the PRECEDE–PROCEED model (Morisky, Fox, Murata, & Stein, 1989). Social network interventions have been based most often on SLT, again with some logic. At a macro level, there does not seem to be any real mismatch between theories and intervention types. There are a large number of reports that omit any mention of theory, however. Although the social psychological theories used to date are valid and appropriate for many problems and populations, it is appropriate to broaden the theoretical basis as the focus of interventions shifts. For example, theories of organizational change may be useful for studying provider behavior. Similarly, diffusion theories may be helpful in examining the trajectory of mammography behavior at a given point in time (see Glanz et al., 1997, for a fuller discussion of these theories). In addition, theories from other disciplines, such as marketing, sociology, and economics, also may be informative in applying tested intervention strategies to public health practice.

**DISCUSSION**

Our review of a decade of social and behavioral interventions to improve mammography suggests opportunities for future research. Mammography intervention research has not been distributed evenly or widely across the United States. No published intervention research was reported in 31 states. There are vast areas where no research has been conducted, which should provide a rationale to encourage partnerships between researchers and health care delivery units from different areas. Such research is needed to establish the external validity of interventions. In addition, only about one third of the reported intervention studies focused on underserved populations. This reflects a critical problem, because underuse of mammography increasingly is concentrated in these groups. Moreover, re-
searchers are starting to experience ceiling effects in research that is conducted among more mainstream groups.

Most mammography interventions that were reviewed for this chapter drew from several strategies and their combinations: individual-directed, system- or provider-directed, community education, and access-enhancing interventions. There is now strong documentation suggesting the efficacy of patient reminders, letters, and other provider-directed and patient-directed interventions (Stoner et al., 1998). As intervention research increasingly targets underserved populations, researchers should draw on a wider range of research strategies or different combinations of research strategies, and should focus on populations and geographic areas where intervention research is lacking.

Over the last decade of the 20th century, thousands of women were enrolled in studies designed to increase mammography use. Rates increased dramatically from 1987 through 1996. Yet, there remain many unanswered questions. For example, how intensive or extensive must interventions be to promote mammography (or other cancer screening) effectively and to ensure routine use over time? How can intervention effects be sustained and measured? Here, reports have been mixed (Burack & Gimotty, 1997; Foley, D'Amico, & Merenstein, 1995; Mandelblatt & Kanetsky, 1995), but there are no widely replicated strategies for assuring maintenance. Nonetheless, there is substantial evidence that many women will respond to simple prompts, such as letter reminders (King et al., 1994; Snell & Buck, 1996; Taplin, Anderman, Grothaus, Curry, & Montano, 1994; Wagner, 1998). Reminders should become usual care. In addition, more attention should be paid to maintenance of mammography. Interventions that are effective in motivating initial use or encouraging mammography among nonadherent women may be different from those that are needed to sustain the behavior over time. The preponderance of research has focused on initial mammography use rather than maintenance of mammography over time.

How can we diffuse effective strategies for initiation and maintenance at a population level? How can higher technology interventions, such as tailored communications and computer-based prompting systems, be adapted for public health? Some of the most effective interventions may be too complex and costly to be integrated without adaptation into public health practice. What mechanisms are needed to translate research interventions so that they can be used in public health settings? Future cancer control research should aim to promote both initiation of cancer screening and maintenance over time to have a lasting impact on public health. To be effective, mammography interventions may have to be packaged with other screening or risk factor interventions.

Researchers should address the topics of cost, institutionalization, and dissemination in their publications. There was no mention of institution-
alization in the studies that we reviewed. Intervention scientists can help meet the challenges of dissemination by designing studies to evaluate how effective intervention strategies can be used in public health settings. Successful interventions that are never institutionalized represent a long-term loss on research investment. Funding is needed to permit researchers to move research into practice. Clinicians must be provided with useful syntheses and tools that can help them use efficacious interventions, as Scott, Wong, and Rimer (1999) demonstrated. Successful translation of research also demands that, although the public health sector encourages innovative practices, it must base practice on evidence. The lack of cost analyses makes it difficult for health plans and other organizations to determine whether they can adopt a promising strategy.

It has become increasingly clear from research reports that most studies have recruited women who have had prior mammograms. Even researchers who intend to recruit nonadherent women may find that their studies have a disproportionate number of women who have had prior mammograms. This results in both an attenuation of statistical power and a failure to reach the women who could most benefit from intervention. The adherent women should not be ignored, but they are likely to respond to minimal interventions (King et al., 1994). Intensive interventions should be reserved for the women who require them.

One of the greatest challenges for future research will be to reach the women who will benefit most from intervention, especially women who have not adopted mammography—the women referred to in stage models as precontemplators. Among these individuals are those who may have contemplated mammography and decided not to have it and those who are referred to as relapsers, that is, they have had at least one mammogram but are off schedule (Rakowski et al., 1995). Thus, future interventions must focus increasingly on women who are not regular users of the health care system, immigrants, older women, and those with lower levels of education. Strategies such as same-day screening, offered in conjunction with an acute care visit, may increase the likelihood that women will have mammograms (Dolan, McDermott, Morrow, Venta, & Martin, 1999). In addition, several community health center studies have shown the success of combinations of inreach and outreach strategies in promoting mammography (Paskett et al., 1998; Zapka, Costanza, et al., 1993; Zapka, Harris, et al., 1993). The potency of such interventions might be enhanced through the use of tailored print communications (Rimer & Glassman, 1998) and tailored interactive communications (Strecher, Greenwood, & Wang, 1999). Other electronic media, such as culturally sensitive videos played in health center waiting rooms, also have shown promise in reaching underserved women (Yancey, Tanjasiri, Klein, & Tunder, 1995). Increasingly sophisticated techniques are being developed to guide both researchers and investigators in developing theory and evidence-based health
education programs (Bartholomew, Parcel, & Kok, 1998). We recommend that these techniques be adopted.

With national surveys showing that 60% or more women ages 50–65 report having mammograms, researchers need to understand what is keeping nonadherent women from getting them. As the focus on research is narrowed to the women who are not getting regular mammograms, new (or revised) theories and interventions may be needed. An Institute of Medicine (1999) report on quality of cancer care stressed the need to understand barriers in these women. There is much to learn about the people whose health we are trying to influence, including what inhibits their use of mammography and how we, as researchers, can encourage breast cancer screening through culturally sensitive, effective interventions that are consistent with women's lives, economic circumstances, and values. The impact of peer leaders and vouchers, in conjunction with community interventions, may be strengthened by combining them with individual- and provider-directed interventions. This would be a promising direction for the next generation of cancer-screening research conducted among underserved populations.

As researchers attempt to motivate nonadherent women to get mammograms by using multiple strategies grounded in communities, the work will be labor intensive, and the effects may be smaller than those found in the earlier mammography studies. Those studies had much less "noise" with which to contend. A growing number of mammography providers and programs can be found in communities throughout the United States. Some of the nonsignificant results that researchers (Suarez, Roche, Pulley, et al., 1997) have found are undoubtedly a result of the "contamination" of control sites. What is good for public health poses new challenges for research.

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