Effectiveness of Interventions to Increase Papanicolaou Smear Use

K. Robin Yabroff, PhD, MBA, Patricia Mangan, and Jeanne Mandelblatt, MD, MPH

Background: **Many women fail to adhere to Papanicolaou smear screening guidelines. Although many interventions have been developed to increase screening, the effectiveness of different types of interventions is unclear.**

Methods: **We performed a systematic review of interventions to increase Papanicolaou smear use published between 1980 and April 2001 and included concurrently or randomized controlled studies with defined outcomes. Interventions were classified as targeted to patients, providers, patients and providers, or health care systems and as behavioral, cognitive, sociologic, or a combination based on the expected action of the intervention. Effect sizes and 95% confidence intervals were calculated for each intervention.**

Results: **Forty-six studies with 63 separate interventions were included. Most interventions increased Papanicolaou smear use, although in many cases the increase was not statistically significant. Behavioral interventions targeted to patients (eg, mailed or telephone reminders) increased Papanicolaou smear use by up to 18.8%; cognitive and sociologic interventions were only marginally effective, although a single culturally specific, sociologic intervention using a lay health worker increased use by 18.0% (95% confidence interval [CI]: 7.6, 28.4). Provider-targeted interventions were heterogeneous. Interventions that targeted both patients and providers did not appear to be any more effective than interventions targeted to either patients or providers alone. One of the most effective interventions, which introduced a system change by integrating a nurse-practitioner and offered same-day screening, increased screening by 32.7% (95% CI: 20.5, 44.9).**

Conclusions: **Overall, most interventions increased Papanicolaou smear use, although there was tremendous variability in their effectiveness. Selection of intervention strategies will depend on provider and patient population characteristics and feasibility of implementation. (J Am Board Fam Pract 2003; 16:188–203.)**

Screening with regular Papanicolaou smears can decrease not only cervical cancer mortality but also the incidence of invasive disease.[1,2] Despite increases in recent Papanicolaou smear use during the past two decades,[3,4] with national estimates of approximately 80% within the past 3 years,[4] some women still fail to adhere to recommended Papanicolaou smear screening guidelines,[3–26] are found to have advanced disease, and die of invasive cervical cancer.[27–29] Thus, the potential benefits of routine screening are not being fully realized. Increasing the provision of Papanicolaou smear counseling by primary care providers and, ultimately, routine Papanicolaou smear use are important components of current *Healthy People 2010* goals for reducing cervical cancer mortality.[30]

Physician recommendation is one of the strongest predictors of screening use,[13,17,31–37] but in many cases, women report that their provider did not recommend Papanicolaou smears.[5,7,18,38–45] Explanations for this behavior include lack of time, busy schedules and forgetfulness,[46,47] beliefs about

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From the Cancer Control Program (KRY, PM, JM), Lombardi Cancer Center, and Department of Oncology (KRY, PM, JM), Georgetown University Medical Center, Washington, DC. Address reprint requests to Robin Yabroff, PhD, MBA, Health Services and Economics Branch, Applied Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, Executive Plaza North, Room 4005, 6130 Executive Blvd., MSC 7344, Bethesda, MD 20892-7344.

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screening efficacy in the absence of symptoms or concern about proficiency,[31,48] or confusion about conflicting professional recommendations.[46] In the absence of a physician recommendation, patients might assume that screening is unnecessary.

Women who do not receive regular Papanicolaou smears are more likely to be older,[5–26,49–52] uninsured or underinsured,* lack a usual source of care or regular provider,† and have lower educational attainment or lower household income.‡ Among immigrant women, those who do not speak English or have lower levels of acculturation are also less likely to receive regular Papanicolaou smears.[16,22,23,52,58,64,65]

Additionally, women might not know about the potential benefits of screening, believe it to be unnecessary in the absence of symptoms,§ fear a potential cancer diagnosis, or believe that cancer cannot be cured.‖ Women might also be concerned about inconvenience, discomfort, embarrassment, or pain associated with the test itself.[7,25,42–45,52,69] Concerns about modesty or cultural restrictions on gynecological examinations by male physicians could exacerbate other barriers to screening.[22,25,43,66,72–74] Finally, women might know about the need for Papanicolaou smears but have put off receiving a test because of convenience, time constraints, or forgetfulness.[5,25,38,40,44,59,69]

During the past two decades, results from numerous interventions to increase Papanicolaou smear use have been reported.[75,76] These interventions focus on increasing rates of provider recommendation, reducing patient barriers to screening, or both. Two reviews provided descriptive information about interventions published before 1998 and whether they were effective[75,76] but did not provide details about the magnitude of effectiveness. Because of the large numbers of interventions, particularly in the past several years, and differences in study design, populations, and intervention content, it is difficult to know which interventions are most effective in increasing Papanicolaou smear use. This systematic review of the published literature was conducted to update previous reviews[74,75] and provide information on the effectiveness of controlled interventions to increase Papanicolaou smear use.

*References 5,6,13,16,17,19,23,24,26,42,43,45,51,53–55.
†References 17,18,22,32,34,36,40,41,45,54,56,57.
‡References 5,6,8,14–16,18–20,22,23,40,41,49–51, 54,58–63.
§References 5,7,13,16,38,40,42–44,51,59,65–69.
‖References 7,11,12,40,42–44,65–67,69–71.

Methods

Study Selection

We used the Ovid search mechanism for MEDLINE to select English language articles published between 1980 and April 2001 on interventions to increase Papanicolaou smear use. The start date of 1980 was chosen because the National Institutes of Health Consensus Conference endorsed routine Papanicolaou smear screening and began to publicize their screening guidelines in that year.[77] The search strategy used the subject terms "health behavior," "patient compliance," "patient acceptance of health care," "attitude to health," "health education," or "health promotion" (N = 75,985) with the subject terms "Papanicolaou smear" or "cervical neoplasms/prevention and control" (N = 1,871). The combination yielded 467 studies. Study abstracts were reviewed for evidence of random or concurrent assignment of subjects to an intervention or control group, prospective follow-up, and Papanicolaou smear use or recommendation as an outcome. Pre-post designs without control groups were excluded because secular trends to increased Papanicolaou smear use in the past two decades[3,4] would limit the interpretation of intervention effectiveness. Non-US studies were excluded because differences across systems of care might limit the generalizability of outcomes.

From the review of abstracts, 66 studies were potentially eligible for inclusion. Of this number, 14 were eliminated because they lacked concurrent or randomly assigned control groups and 27 were eliminated because the outcome was not receipt or recommendation of Papanicolaou smear and were non-US studies. Physician-targeted interventions with a documented outcome of recommendation of Papanicolaou smear use were not excluded because these interventions were designed to improve this behavior. Nine interventions were excluded because they were designed to improve follow-up after abnormal Papanicolaou smears, which left 16 studies as a result of the search.[78–90] Because electronic searches might not identify all relevant studies,[91] reference lists and published reviews of interventions[70,75,76] were reviewed, and a hand search of the journals *Preventive Medicine* and *American Jour-*

nal of Preventive Medicine for 1999 through April 2001 was conducted to find other eligible studies. Thirty additional studies were found,[92–124] and 46 studies are included in this article.

Data Abstraction

Data were abstracted from studies using a standardized abstraction format to describe the intervention target (ie, patient, physician, patient and physician, or health care system), type of intervention, intervention content, means of determining receipt of Papanicolaou smear (eg, self-report, chart), characteristics of the patient population, and intervention effectiveness. In randomized trials where the sample size was not reported for each arm, the sample was divided by the number of study arms to estimate the number of women in each arm.

Each intervention within a study was abstracted separately. Within studies, interventions were classified based on the underlying mechanism of an intervention to increase Papanicolaou smear use using a previously developed classification scheme.[125] Interventions were classified as behavioral, cognitive, sociologic, or a combination of the three. Behavioral interventions change stimuli associated with Papanicolaou smear use (eg, reminders). Cognitive interventions provide new information, educate women about Papanicolaou smears, and clarify any existing misperceptions. Cognitive interventions were categorized further as individually tailored or based on theory (eg, health belief model) and as using generic educational materials. Cognitive interventions were also classified based on the method of delivery—interactively (eg, by telephone or in person) or statically (eg, by letter or pamphlet). Sociologic interventions use social norms or peers to increase Papanicolaou smear use (eg, lay health workers, peer counselors).

Interventions were classified further based on the content of the intervention (eg, telephone reminder) and type of control group to which the intervention was compared. Studies that included a lower level intervention to increase Papanicolaou smear use as the control group (eg, postcard reminder) were considered to have active controls. Studies in which the control group did not receive any specific strategies to increase Papanicolaou smear use were classified as having usual-care controls. In studies with combined interventions in which the same strategy was applied to intervention and control groups (active controls), the intervention was categorized by the difference between intervention and control groups.

Data Analysis

Effect sizes and 95% confidence intervals (CI) were calculated for each intervention. For randomized studies, intervention effectiveness was calculated as the difference in Papanicolaou smear use between the intervention and control groups at the first assessment of intervention effectiveness. Variance was calculated for binomial proportions for intervention and control groups. For concurrently controlled studies, the effect size was calculated as the difference between the screening rates before and after the intervention for the intervention group and the control group ($[P_{\text{screened postintervention}} - P_{\text{screened preintervention}}] - [P_{\text{screened postcontrol}} - P_{\text{screened precontrol}}]$). Variance was calculated for the binomial proportions for intervention and control groups both before and after the intervention.

Compliance scores, which measured compliance with recommended screening frequency (number of screenings during a specified period divided by the number of women eligible for screening), were treated as the proportion of women screened for the purposes of this article. In two studies, compliance scores were based on a 3-year frequency of Papanicolaou smear use[108,109] and were greater than 100% because most screening guidelines recommend screening more often than every 3 years. These scores were divided by 3 to create an average annual compliance score.

Within each group of intervention (eg, reminders mailed to patients compared with active controls), the effect size and 95% confidence interval for each intervention was graphed, and graphs were inspected visually for signs of heterogeneity. Because of the variability in patient populations and setting, as well as small numbers of interventions in any single category, we did not perform quantitative analysis.

Results

Of the 46 studies, there were 63 separate interventions; 24 were targeted to patients, 25 to physicians, and 12 to both patients and physicians. Two interventions introduced system changes (Table 1[78–90,92–124]). Most studies were randomized controlled trials (n = 31; 67.4%). Overall, the largest number of interventions, 22, used behavioral strategies; all other categories had 10 or fewer interven-

Table 1. Study Characteristics.

Characteristics	No.	Percent	References
Studies	46	100.0	
Study design			
Randomized controlled trial*	31	67.4	78,83–89,93–95,97,98,101,102–104,106–109,111–113,116,118–121,123,124
Concurrently controlled	15	32.6	79,82,90,92,96,99,100,105,110,114,115,117,122
Type of control			
Usual care	30	65.2	78–84,87–89,92–100,102,107,109,110,112,114,115,117,122–124
Active control	16	34.8	85,86,90,101,103–106,108,111,113,116,118–121
Interventions	63	100.0	
Intervention target			
Patients	24	38.1	78,80–89,94,96,100,102,103,111–113,116,122
Physicians	25	39.7	85,86,90,92,93,95,97,101,104,107,108,111,114,115,118–121,124
Patients and physicians	12	19.0	79,85,98,99,106,109–111,116,121,123,124
System	2	3.2	105,117
Intervention strategy			
Behavioral	22	34.9	85,86,90,92,93,95–97,101,103,104,107,109,111,115,116,118–121,124
Cognitive	5	7.9	97,102,108,113,119
Sociologic	5	7.9	80,83,84,87,100
Behavioral and cognitive	10	15.9	85,94,97–99,106,110,112,114,121
Cognitive and sociologic	3	4.8	78,88,89
Behavioral, cognitive, and sociologic	5	7.9	79,81,82,122,123
Intervention content			
Behavioral strategy			
Postcard or letter reminder	16	25.4	79,85,86,94,103,106,111,112,116,123,124
Telephone reminder	2	3.2	103,86
Health diary	2	3.2	96,99
Chart reminder	22	34.9	85,86,95,98,106,107,108,109,110,111,114,115,116,118,119,121,123,124
Office reminders or poster display	3	4.8	79,99,110
Patient-carried prompt	4	6.3	98,106,109,120
Flow sheet or checklist requiring completion	9	14.3	90,92,93,97,104,106,108,110,116
Mass media reminders	1	1.6	81
Financial incentives	3	4.8	82,101,122
Cognitive strategy			
Educational letter or pamphlet	13	20.6	79,81,82,85,94,99,102,106,113,121,123
Telephone or in-person counseling	3	4.8	79,112,121
Educational mass media	2	3.2	78,79
Educational workshop or presentation	9	14.3	78,79,97,98,106,110,114,123
Audit with feedback	5	7.9	97,106,108,119
Sociologic strategy			
Peer or lay health workers	10	15.9	78,79,80,82,83,84,87,88,100,122
Culturally sensitive videotape	3	4.8	80,81,89
Outcome measurement			
Self-report	15	32.6	78–84,87,88,97,99,100,102,112,113
Chart audit	23	50.0	89,90,92–96,98,101,105–110,114,115,118,120–124
Claims or electronic record	10	21.7	83,85,86,103,104,111,116–119
Patient age-group			
<40 years	14	30.4	82,84–89,93,100,106,111,113,117,121
40–49 years	23	50.0	78,80,82–84,86–89,93,97,100,102,103,106,108,109,111–113,116,117,124
50–59 years	28	60.9	78,80,82–84,87–89,92,93,95–100,103,104,106–109,112,113,115–117,124
60+ years	19	41.3	79,80,84,87,89,93–95,97,98,100,103,104–106,112,113,117,120
Not stated	9	19.6	81,90,101,110,114,118,119,122,123
Patient race			
>20% African American	19	41.3	79,85,87,89,92,98,99,101,104–108,111,113,115,120,122,124
>20% Hispanic, Latina	6	13.0	80,84,89,96,98,106
>20% Asian, Pacific Islander	3	6.5	81,82,100
>20% Native American	2	4.3	88,117
>20% White	12	26.1	78,83,98,102,103,108,109,111,113,115,120,124
Not stated	14	30.4	86,90,93–95,97,110,112,114,116,118,119,121,123
Percentage with health insurance			
<50%	4	8.7	80,84,88,89
50–74%	4	8.7	81,98,111,113
75%+	16	34.8	78,82,83,85,86,92,94,99,101,103,105,106,108,109,112,116
Not stated	22	47.8	79,87,90,93,95–97,100,102,104,107,110,114,115,117–124

Table 1. Continued.

Characteristics	No.	Percent	References
Previous Papanicolaou smear use			
0–24%	3	6.5	78,103,121
25–49%	10	21.7	82–85,88,90,98,102,111,117
50–74%	6	13.0	79,81,87,92,106,114
75%+	1	2.2	78
Not stated	29	63.0	80,83,86,89,93–97,99–101,103,104,105,107–110,112,113,115, 116,118–120,122–124
Time for assessment			
<3 months	1	2.2	90
3–6 months	12	26.1	84,89,94–96,99,102,104,114–116,121
6–12 months	13	28.3	86,93,103,105,108,111,117,119,120,122,124
12+ months	20	43.4	78–83,85,87,88,92,97,98,100,101,106,107,110,113,118,123
Not stated	1	2.2	112

*May add to more than 100%, because many interventions used multiple components.

tions each. Most studies included women in the 50- to 59-year age-group (60.9%), and approximately 30% of the studies included women younger than 40 years. Many studies (41.3%) included a sizable portion (>20%) of minority women. About one half of the studies reported health insurance status of the patient population. Among this group, most were conducted in samples where at least 75% of the patient population had health insurance. Finally, the period of assessment following intervention delivery was most frequently 12 or more months, although many studies also reported assessments of 3 to 6 and 6 to 12 months.

The types of interventions changed during the past two decades. In general, most interventions conducted in the 1980s and early 1990s were compared with usual-care controls, whereas those conducted in the 1990s were mainly compared with active controls. Additionally, interventions conducted in the late 1990s generally included multiple different components and targeted patients and providers, whereas those conducted in earlier years focused on single components and targeted patients or providers. For example, in an intervention published in 1999, Paskett and colleagues[79] reported the combined effectiveness of an intervention that targeted both patients and providers and used letter reminders, office reminders, multiple educational strategies, mass media, and lay health workers. Earlier interventions evaluated provider reminders alone.[119]

Patient-Targeted Interventions

The 24 patient-targeted interventions are listed in Table 2.¶

¶References 78,80–89,94,96,100,102,103,111–113,116,122.

Behavioral Interventions

Compared with usual care, the single behavioral intervention was very effective and increased Papanicolaou smear use by 24.4% (95% CI: 11.1, 37.7).[96] Among the five interventions that were compared with active controls, one intervention was associated with decreased rates of Papanicolaou smear use (−8.6%; 95% CI: −13.1, −4.1).[111] Compared with active controls, the other four behavioral strategies were effective, and improvements in Papanicolaou smear use ranged from 10.1% to 18.8%.[86,103,116] The telephone reminder was associated with the largest increase in Papanicolaou smear use and was from a single study in which multiple interventions were tested separately.[86]

Cognitive Interventions

All four cognitive interventions were theory based and compared with active controls. The three delivered statically by letter did not improve Papanicolaou smear use, but the fourth, delivered interactively by telephone, led to an increase in Papanicolaou smear use of 8%, although this finding was not statistically significant (95% CI: −1.4, 17.4).[113]

Two of the three behavioral and cognitive interventions utilized mailed generic educational information and reminders and were not associated with significant improvements in Papanicolaou smear use.[85,94] The third, which incorporated a telephone call from a health educator with the reminder in the intervention group, reported a 13.5% increase in Papanicolaou smear use (95% CI: 7.6,19.4).

Table 2. Patient-Targeted Interventions to Increase Papanicolaou Smear Use.

Intervention	Author, Year	Intervention Content	Sample Size (No.)		Number (%) Screened		Effect Size	95% CI
			Intervention	Control	Intervention	Control		
Behavioral, usual-care controls	Dickey & Petiti, 1992[96]*	Health diary reminder	142	73	111 (78.2)	39 (53.4)	24.4	11.1, 37.7
Behavioral, active controls	Ornstein et al, 1991[111]	Letter reminder	1,054	843	394 (37.4)	388 (46.0)	−8.6	−13.1, −4.1
	Lantz et al, 1995[103]	Letter, telephone reminders	236	238	45 (19.1)	14 (5.9)	13.2	7.4, 19.0
	Somkin et al, 1997[116]	Letter reminder	1,188	1,188	230 (19.4)	108 (9.1)	10.4	7.6, 13.2
	Binstock et al, 1997[86]	Phone reminder	1,526	1,526	536 (35.1)	249 (16.3)	18.8	15.8, 21.8
	Binstock et al, 1997[86]	Letter reminder	1,526	1,526	403 (26.4)	249 (16.3)	10.1	7.2, 13.0
Cognitive theory-based, active controls, static delivery	Kreuter & Strecher, 1996[102]	Educational letter	48	32	30 (62.5)	21 (65.6)	−3.0	−24.4, 18.4
	Kreuter & Strecher, 1996[102]	Educational letter	46	32	24 (52.2)	21 (65.6)	−14.0	−35.9, 7.9
	Rimer et al, 1999[113]	Educational letter	206	206	107 (52.0)	115 (56.0)	−4.0	−13.6, 5.6
Cognitive theory-based, active controls, interactive	Rimer et al, 1999[113]	Telephone counseling	206	206	132 (64.0)	115 (56.0)	8.0	−1.4, 17.4
Behavioral and cognitive (generic)	Clementz et al, 1990[94]	Letter reminder, educational pamphlet	102	76	21 (20.6)	23 (30.3)	−9.7	−22.7, 3.3
	Reding et al, 1997[112]	Letter reminder, telephone education	233	240	45 (19.2)	14 (5.8)	13.5	7.6, 19.4
	Burack et al, 1998[85]	Letter reminder, educational pamphlet	964	964	280 (29.0)	270 (28.0)	1.0	−3.0, 5.0
Sociologic	Yancey et al, 1995[89]	Culturally sensitive video	868	876	168 (19.4)	120 (13.7)	5.7	2.2, 9.2
	Suarez et al, 1997[80]	Lay health worker, culturally sensitive video	Pre: 450 Post: 450	Pre: 473 Post: 473	Pre: 205 (45.6) Post: 231 (51.3)	Pre: 237 (50.1) Post: 268 (56.7)	−0.7	−9.8, 8.4
	Sung et al, 1997[87]	Lay health worker	163	158	96 (58.7)	98 (62.1)	−3.4	−14.1, 7.3
	Margolis et al, 1998[83]	Lay health worker	501	466	352 (70.3)	293 (62.9)	7.4	1.5, 13.3
	Navarro et al, 1998[84]	Lay health worker	199	162	130 (65.3)	99 (61.1)	4.2	−5.8, 14.2
	Gotay et al, 2000[100]	Lay health worker	Pre: 318 Post: 318	Pre: 360 Post: 360	Pre: 188 (59.0) Post: 213 (67.0)	Pre: 277 (63.0) Post: 232 (64.0)	7.0	−3.3, 17.3
Sociologic and cognitive, usual-care controls	Dignan et al, 1996[88]	Lay health worker	385	430	282 (73.2)	275 (64.0)	9.2	2.9, 15.5
	Allen et al, 2001[78]	Lay health worker, mass media, workshop	1,374	1,288	1,116 (81.2)	1,011 (78.5)	2.7	−0.3, 5.7
Sociologic, behavioral, and cognitive, usual-care controls	Whitman et al, 1994[122]	Lay health worker, financial incentives, workshop	Pre: 284 Post: 283	Pre: 189 Post: 175	Pre: 34 (12.0) Post: 74 (26.0)	Pre: 74 (39.0) Post: 30 (17.0)	36.0	25.1, 46.9
	Bird et al, 1998[82]	Lay health worker, financial incentives, educational pamphlet	Pre: 306 Post: 346	Pre: 339 Post: 372	Pre: 141 (46.1) Post: 228 (65.9)	Pre: 136 (40.1) Post: 156 (41.9)	18.0	7.6, 28.4
	Jenkins et al, 1999[81]	Educational pamphlet, mass media, culturally sensitive video	Pre: 451 Post: 454	Pre: 482 Post: 422	Pre: 245 (54.4) Post: 217 (47.7)	Pre: 210 (43.6) Post: 156 (37.0)	−0.1	−9.9, 8.3

CI = confidence interval.
*Based on the Papanicolaou smear being recommended or completed.

Sociologic Interventions

Most of the sociologic interventions were targeted to specific ethnic groups and used lay health workers,[126] women recruited from the target population, to encourage women to attend screening.[80,82–84,87] The interventions that used sociologic strategies alone and sociologic and cognitive strategies had similar effects, and most improved Papanicolaou smear use from 2.7% to 9.2%,[78,82–84,88,89,100,122] although not all increases were statistically significant. Two interventions were associated with decreased Papanicolaou smear use,[80,87] although this finding was not statistically significant. The authors of one these interventions speculated that increased outreach efforts in the comparison community were responsible for a lack of effect.[80] Two of the three sociologic, behavioral, and cognitive interventions led to large increases in Papanicolaou smear use, 18.0% and 36.0%.[82,122] The first, conducted by Bird and colleagues,[82] used lay health workers, educational pamphlets, and financial incentives and was culturally specific to Vietnamese-American women. The apparent effectiveness of the second, conducted by Whitman and colleagues,[122] might be due to the decline in Papanicolaou smear use from 39% to 17% in the concurrent control group. The other intervention in this category relied on media to present role model behaviors and did not lead to increased Papanicolaou smear use.[81]

Provider-Targeted and Provider- and Patient-Targeted Interventions

The 27 provider targeted interventions are listed in Table 3,** and the 12 provider- and patient-targeted interventions are listed in Table 4.††

Behavioral Interventions

The nine interventions compared with usual-care controls‡‡ did not appear to have higher rates of screening than similar interventions compared with active controls§§ (Table 3). There was great heterogeneity among the behavioral interventions, ranging from a statistically significant 18% decrease in Papanicolaou smear use[93] to a 44% increase.[90] There was no clear difference in effectiveness between chart reminders and flow sheets requiring completion; in fact, both studies with extreme findings used flow sheets requiring completion. In the study with decreased Papanicolaou smear use, the authors suggested that the intervention was incompletely implemented, leading to an unexpected decline in Papanicolaou smear use. The same intervention, however, was also assessed for other preventive strategies and was associated with increased clinical breast examination, mammography, and three types of immunizations.[93] The intervention associated with a 44% increase in Papanicolaou smear use was based on a potentially inappropriate concurrent control group—preintervention rates of Papanicolaou smear use were 98% in the control group compared with 43% in intervention arm.[92]

Provider- and patient-targeted behavioral interventions were also heterogeneous and ranged in effectiveness from a 6% decrease (95% CI:−10.5, −1.5)[111] to 13.8% increase (95% CI:10.9, 16.7) in Papanicolaou smear use[116] (Table 4).

Cognitive Interventions

The three interventions that used seminars or audit with feedback[97,108,119] led to slight increases in Papanicolaou smear use, from 2%[97] to 8%.[108] Three interventions used a combination of cognitive and behavioral strategies.[97,114,119] The effects were varied and ranged from a significant decline in Papanicolaou smear use of −6% (95% CI: −11.9, −0.1)[119] to an 18% increase (95% CI: −21.3, 57.3)[114] (Table 3).

Interventions targeted to patients and physicians using behavioral and cognitive strategies were also variable in their impact on Papanicolaou smear use, ranging from a 7% decrease in use (95% CI: −10.6, −3.4)[98] to a 13% increase in Papanicolaou smear use (95% CI: −7.5, 32.5).[121] Although most estimates were positive, only one, which included six separate intervention components, was statistically significant[106] (Table 4).

Sociologic Interventions

The combined sociologic, behavioral, and cognitive intervention strategy targeted to physicians and patients that used a generic educational strategy had little impact on Papanicolaou smear use,[123] whereas the intervention that used church liaisons,

**References 85,86,90,92,93,95,97,101,104,107,108,111,114,115,118–121,124.
††References 79,85,98,99,106,109–111,116,121,123,124.
‡‡References 92,93,95,97,107,108,115,119,124.
§§References 85,86,90,101,104,111,118,120,121.

Table 3. Provider-Targeted Interventions to Increase Papanicolaou Smear Use.

Intervention	Author, Year	Content Intervention	Sample Size		Number (%) Screened		Effect Size	95% CI
			Intervention	Control	Intervention	Control		
Behavioral, usual-care control	McDonald et al, 1984[107]*	Computerized reminder	NA	NA	(38.0)	(23.0)	15.0	NA
	Tierney et al, 1986[119]	Computerized reminder	409	409	106 (26.0)	115 (28.0)	−2.0	−8.1, 4.1
	Cheney & Ramsdell, 1987[93]	Flow sheet w/completion	132	132	75 (57.0)†	99 (75.0)†	−18.0	−29.2, −6.8
	Becker et al, 1989[124]	Chart reminder	146	123	9 (6.2)	7 (5.7)	0.5	−5.2, 6.1
	Cowan et al, 1992[95]*	Chart reminder	32	23	4 (12.5)	1 (4.3)	8.2	−5.9, 22.3
	Dietrich et al, 1992[97]*	Flow sheet w/completion	NA	NA	(71.0)	(61.0)	10.0	NA
	Cardozo et al, 1998[92]	Flow sheet w/completion	Pre: 82 Post: 74	Pre: 94 Post: 82	Pre: 35 (43.0) Post: 58 (79.0)	Pre: 92 (98.0) Post: 74 (90.0)	44.0	28.2, 59.8
	Schreiner et al, 1988[115]*	Chart reminder	NA	NA	Pre: (25.0) Post: (34.0)	Pre: (28.0) Post: (31.0)	6.0	NA
Behavioral, active control	Gonzalez et al, 1989[90]*	Flow sheet w/completion	Pre: 52 Post: 52	Pre: 47 Post: 47	Pre: 21 (40.0) Post: 34 (65.0)	Pre: 14 (30.0) Post: 15 (32.0)	23.0	−3.4, 49.4
	McPhee et al, 1989[108]‡	Computerized reminder	432	432	245 (56.7)†	199 (46.0)†	10.7	4.1, 17.3
	Turner et al, 1989[121]	Computerized reminder	42	42	14 (33.1)	12 (27.5)	5.6	−14.0, 25.2
	Turner et al, 1990[120]*	Patient carried prompt	94	151	28 (29.8)	30 (19.9)	10.0	−1.2, 21.2
	Ornstein et al, 1991[111]	Computerized reminder	1,111	843	487 (43.8)	388 (46.0)	−2.2	−6.7, 3.3
	Litzelman et al, 1993[104]	Flow sheet w/completion	1,460	1,459	307 (21.0)	263 (18.0)	3.0	0.1, 5.9
	Tape & Campbell, 1993[118]*	Computerized reminder	462	443	114 (24.7)	106 (23.9)	0.8	−4.8, 6.4
	Binstock et al, 1997[86]	Memo reminder	1,526	1,526	389 (25.5)	249 (16.3)	9.2	6.3, 12.1
	Binstock et al, 1997[86]	Computerized reminder	1,526	1,526	365 (23.9)	249 (16.3)	7.6	4.8, 10.4
	Burack et al, 1998[85]	Computerized reminder	960	964	278 (29.0)	270 (28.0)	1.0	−3.0, 5.0
	Hillman et al, 1998[101]*	Financial incentives	NA	NA	(42.7)	(33.1)	9.6	NA
Cognitive, usual-care controls	Tierney et al, 1986[119]	Audit with feedback	409	409	131 (32.0)	115 (28.0)	4.0	−2.3, 10.3
	McPhee et al, 1989[108]‡	Audit with feedback	432	432	233 (54.0)†	199 (46.0)†	8.0	1.4, 14.6
	Dietrich et al, 1992[97]*	Workshop, audit with feedback	NA	NA	(63.0)	(61.0)	2.0	NA
Behavioral and cognitive, usual-care controls	Tierney et al, 1986[119]	Audit with feedback, computerized reminder	409	409	90 (22.0)	115 (28.0)	−6.0	−11.9, −0.1
	Robie, 1988[114]	Workshop, chart reminder	Pre: 13 Post: 20	Pre: 28 Post: 32	Pre: 4 (31.0) Post: 10 (50.0)	Pre: 6 (21.0) Post: 7 (22.0)	18.0	−21.3, 57.3
	Dietrich et al, 1992[97]*	Workshop, audit with feedback, flow sheet w/completion	NA	NA	(65.0)	(61.0)	4.0	NA

NA = not available.
*Based on the Papanicolaou smear being recommended or completed.
†Represents compliance scores.
‡Three-year rates of Papanicolaou smear use converted to annual rates.

Table 4. Patient- and Provider-Targeted Interventions to Increase Papanicolaou Smear Use.

Intervention	Author, Year	Intervention Content	Sample Size		Number (%) Screened		Effect Size	95% CI
			Intervention	Control	Intervention	Control		
Behavioral, usual-care control	Becker et al, 1989[124]	Chart reminder, reminder letter	114	123	14 (12.3)	7 (5.7)	6.6	−0.7, 13.9
	McPhee et al, 1991[109]*	Computerized reminder, patient-carried prompt	710	710	366 (51.6)†	286 (40.3)†	11.3	6.1, 16.5
Behavioral, active controls	Ornstein et al, 1991[111]	Computerized reminder, reminder letter	1,006	843	402 (40.0)	387 (46.0)	−6.0	−10.5, −1.5
	Somkin et al, 1997[116]	Reminder letter, reminder with completion	1,188	1,188	271 (22.8)	108 (9.1)	13.8	10.9, 16.7
Behavioral and cognitive, usual-care controls	Gemson et al, 1995[99]‡	Educational pamphlet, health diary, office reminder	Pre: 38 Post: 71	Pre: 35 Post: 53	Pre: NA Post: NA	Pre: NA Post: NA	6.0	NA
	Dietrich et al, 1998[98]‡	Chart reminder, educational workshop, patient-carried prompt	1,059	918	585 (55.2)	572 (62.2)	−7.0	−10.6, −3.4
	Melnikow et al, 2000[110]	Computerized reminder, reminder with completion, educational workshop, office reminder	Pre: 295 Post: 295	Pre: 310 Post: 310	Pre: 136 (46.0) Post: 139 (47.0)	Pre: 205 (66.0) Post: 198 (64.0)	3.0	−8.0, 14.0
Behavioral and cognitive, active controls	Turner et al, 1989[121]	Computerized reminder, educational pamphlet	42	42	17 (40.0)	12 (27.5)	12.5	−7.5, 32.5
	Burack et al, 1998[85]	Letter reminder, educational pamphlet, computerized reminder	960	964	307 (32.0)	270 (28.0)	4.0	−0.1, 8.1
	Manfredi et al, 1998[106]	Reminder with completion, audit with feedback, patient-carried prompt, educational workshop	821	647	429 (52.3)	269 (41.6)	10.0	4.9, 15.1
Behavioral, cognitive (generic), and sociologic	Williams et al, 1998[123]	Reminder letter, educational pamphlet, computerized reminder, educational workshop	725	725	159 (21.9)	183 (25.2)	−3.3	−7.7, 1.1
Behavioral, theory-based cognitive and sociologic	Paskett et al, 1999[79]	Reminder letter, health diary, chart reminders, educational mass media, educational pamphlet, educational counseling, lay health worker, educational workshop	Pre: 125 Post: 168	Pre: 123 Post: 134	Pre: 91 (73.0) Post: 146 (87.0)	Pre: 82 (67.0) Post: 80 (60.0)	21.0	6.0, 36.0

NA = not available.
*Three-year rates of Papanicolaou smear use converted to annual rates of Papanicolaou smear use.
†Represents compliance scores.
‡Based on Papanicolaou being recommended or completed.

educational mass media campaigns, lay health workers, theory-based education, and community activities as the cognitive strategies[79,127] led to a 21% increase in Papanicolaou smear use (95% CI: 6.0, 36.0) (Table 4).

System Interventions

Finally, two interventions introduced system changes.[105,117] One altered how medical care was delivered by integrating into a clinic a nurse-practitioner who was able to perform same-day screening.[105] This intervention was extremely effective, leading to a 32.7% increase in Papanicolaou smear use (95% CI: 20.5, 44.9). The other system intervention used trained community health workers and led to a 7% increase in Papanicolaou smear use (95% CI: −1.3, 15.3), although it was not statistically significant.

Discussion

As shown in this systematic review of interventions to increase Papanicolaou smear use, many patient and provider barriers can be overcome with well-implemented interventions. Selection and implementation of intervention strategies to improve Papanicolaou smear screening can be based, in part, on the characteristics of the underlying patient and provider populations. For example, patient forgetfulness can be overcome with behavioral reminders sent to the home or delivered by telephone. Telephone reminders increased Papanicolaou smear use by up to 18% (95% CI: 15.8, 21.8).[86] Such reminder interventions might be particularly effective in increasing regular screening among women who previously had a Papanicolaou smear. Forgetfulness in providers can also be overcome with behavioral reminders included on the chart or flow sheets requiring completion, although these findings varied widely.

Women who have not had a previous Papanicolaou smear might be difficult to reach through traditional medical settings and might require more extensive outreach strategies. Sociologic strategies, which use lay health workers, could be effective in populations who might distrust the health care system or have other cultural barriers to screening. Sociologic strategies were marginally effective in increasing Papanicolaou smear use, although a culturally sensitive intervention that also included behavioral and cognitive strategies was particularly effective in a population of Vietnamese-American women, increasing Papanicolaou smear use by 18.0% (95% CI: 7.6, 28.4).[82]

Few interventions focused on patient lack of knowledge or fears of Papanicolaou smear, although use of interactive delivery of cognitive educational interventions by telephone was associated with increased Papanicolaou smear use. Provider educational strategies developed to clarify information about screening efficacy and guidelines or to improve proficiency were marginally effective in increasing Papanicolaou smear use. Interventions that targeted both patients and providers appeared to increase screening, although they were generally not much more effective than similar interventions targeted to either patients or providers alone.

Few interventions introduced system level changes, although one that integrated a nurse practitioner into a primary care practice who could also perform same-day screening led to a large increase in Papanicolaou smear use (32.7%; 95% CI: 20.5, 44.9).[105] Other uncontrolled strategies that use same-day screening in emergency departments[128,129] or churches[130] have been reported to be feasible and to increase Papanicolaou smear use. These opportunistic screening strategies might also be more resource intensive and require reservation of personnel and facilities for performance of screening on demand. Other effective strategies, such as patient or provider reminders, could be inexpensive on an on-going basis, but might require an initial investment in computer infrastructure. Thus, measuring the cost and cost-effectiveness of different intervention strategies will provide important information for health departments, providers, and other health care organizations about the feasibility of implementing interventions to improve Papanicolaou use.[38,131]

In several cases, interventions were ineffective in increasing Papanicolaou smear use, but the same intervention in the same provider and patient populations led to large increases in mammography or other preventive services.[93,119] There are several potential alternative explanations for this finding, including differences in a woman's perception of these tests or likelihood of developing cancer, differences in provider beliefs about proficiency, or the time required for performance of different screening tests. Exploring potential differences in intervention effectiveness and any differential impact of the underlying barriers for screening in

different types of screening tests will be an important area for future cancer control research.

There are some limitations with this review, including the reliance on an electronic search of the published literature for identifying interventions, the combination of multiple measures of Papanicolaou smear utilization (eg, self-report, chart review) or documented Papanicolaou smear ordering, and discrepancies between the unit of randomization and the unit of analysis in published interventions. Our search strategy, although similar to one used successfully for meta-analyses of interventions to increase mammography use,[132,133] found fewer interventions than did the review of bibliographies or the hand search of recent articles published in prevention-oriented journals. Additionally, studies with negative findings might be less likely to be published[91] and found by our search strategy. As a result, the estimates of intervention effectiveness presented here might overstate their true effectiveness.

Studies included here used different mechanisms to determine Papanicolaou smear use, including self-report, chart-audit, and electronic claims. Papanicolaou smear self-report has been reported to overestimate utilization when compared with charts or claims data, with reports of accuracy ranging from 67% to 99% agreement.[134–138] Similarly, the timing of the measurement of Papanicolaou smear receipt differed across the studies, with some studies reporting Papanicolaou smear use within 6 months of the intervention‖‖ and others reporting Papanicolaou smear use 1 year or more 2 years or more after the intervention was initiated.¶¶ Additionally, some of the provider-targeted interventions were based on whether Papanicolaou smears were recommended or ordered,[95,99,101,107,118] rather than on a woman's receipt of Papanicolaou smear. Within a given study, however, women in the intervention and control arms should be equally likely to overstate utilization or not comply with provider recommended Papanicolaou smear, so the relative estimate (intervention-control) is unlikely to be affected. In two studies, Papanicolaou smear use was measured as a 3-year compliance rate and converted to an annual rate because compliance was greater than 100%.[108,109] These annual rates might understate the effectiveness of these interventions.

Several studies randomized clinics, physician practices, churches, or more broadly defined communities to intervention and control conditions and then performed analysis on the number of women in each of the groups, rather than the unit of randomization.[92,111] Women living within a specific community or treated at a similar clinic are more likely to have similar behaviors and are not independent observations.[139] If the actual unit of randomization or the correlation among women was accounted for in analysis, the point estimate of intervention effectiveness would not be affected, but the confidence interval would likely be wider. As a result, the confidence intervals reported here could overestimate the effectiveness of interventions to increase Papanicolaou smear use.

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¶¶References 78–82,88,98,100,106,107,113.

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