Web-Based Proactive System to Improve Breast Cancer Screening

A Randomized Controlled Trial

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Background: Screening mammography is recommended for early detection of breast cancer but screening rates remain suboptimal.

Methods: A primary care portal for a large academic primary practice was developed for all preventive services. Another Web-based system (PRECARES [**PRE**ventive **CA**re **RE**minder **S**ystem]) was developed for appointment secretaries to manage proactive breast cancer screening. Female patients aged 40 to 75 years were randomly assigned to a control group (usual care) and an intervention group. For the intervention group, 2 monthly letters inviting patients to undergo mammography were sent starting 3 months before they were due for annual screening, followed by a telephone call to nonresponding patients. A subgroup of women employees was further randomized to receive a reminder by either US mail or e-mail.

Results: Of the total eligible population of 6665 women identified as having consented to participate in research, 3339 were randomly assigned to the control group and 3326 to the intervention group. The screening rate for annual mammography was 64.3% for the intervention group and 55.3% for the control group ($P<.001$). There were no significant differences between the 2 groups for any of the other adult preventive services. For the employee subgroup, the screening rate was 57.5% for the control group, 68.1% for the US mail group, and 72.2% for the e-mail group (intervention vs control, $P<.001$; e-mail vs US mail; $P=.24$).

Conclusion: The breast cancer screening rate improved significantly with the practice redesign of having appointment secretaries proactively manage breast cancer screening needs.

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BREAST CANCER IS THE MOST common nondermatologic cancer in women in the United States. In 2005, an estimated 211 240 new cases were diagnosed and 40 410 women died of the disease.[1] The US Preventive Services Task Force recommends screening mammography with or without a clinical breast examination every 1 or 2 years for women 40 years and older.[2] Early detection of breast cancer with screening programs has been reported to decrease mortality from breast cancer by as much as 32%.[3,4]

Despite the availability of evidenced-based guidelines for screening, a large number of women do not undergo screening mammography. A recent study[5] reported that only 47% of eligible Medicare patients underwent screening mammography in the preceding 2 years, and other studies[6-10] have reported similar poor performance for this preventive service. Rankings of the performance of this quality indicator show large variation across the United States.[11] The delivery rate of mammography is higher in patients of large practice groups than for those of smaller groups, especially if information technology is available to provide physicians reminders at the point of care.[5,11-13] Many women depend on an annual physical examination or other visit to a primary care physician for breast cancer screening. In an era of increasing health care costs, it would be beneficial for women to undergo mammography without requiring an otherwise unnecessary office visit.

Increasingly, primary care practices are being measured on rates of preventive service delivery to their patients. One aspect of practice consistently designated for measurement is the delivery of preventive services. The challenge for primary care providers is to develop cost-effective processes for delivering mammography and other preventive services to patients in the context of a busy practice.[14] In the past, primary care providers attributed the inability to provide recommended preventive services to

lack of time.[15] It has been reported that primary care physicians would be required to devote most of their workday to address the recommended preventive services for their patients if they were to provide all the preventive services recommended by the US Preventive Services Task Force.[16] Using other allied health members of the practice team has been recommended to overcome this barrier and help the primary care physician enhance delivery of evidence-based preventive services.[17,18]

The primary purposes of our study were as follows: to ascertain the feasibility of developing a Web-based information system used by allied health staff, mainly appointment secretaries, to manage mammography needs for a large patient population of a primary care practice, and to determine the effectiveness of this intervention in improving mammography rates. Secondary goals were to determine the effect of a proactive patient reminder system for scheduling mammography on the utilization rates of annual physical examinations in this population of patients and to compare the effectiveness of reminders sent by e-mail and US mail.

METHODS

PRACTICE SETTING AND PATIENT POPULATION

Mayo Clinic Rochester is a large multispecialty group practice in Rochester, Minn. The Division of Primary Care Internal Medicine (PCIM) consists of 38 internists who provide care for 32 000 adult patients from the population of approximately 120 000 in Rochester. Of these primary care patients, 7183 are women between the ages of 40 and 75 years.

STUDY DESIGN

The study was a randomized controlled trial. All women between the ages of 40 and 75 years who were patients of PCIM were eligible for the study, and all of them who were due for annual mammography in the next 3 months were identified from the Primary Care Physician Portal. These eligible patients were randomly assigned to either the control group who received usual care or the intervention group who, in addition, received a personalized letter via US mail from the patient's physician indicating the need for screening mammography, together with a brochure that explained all adult preventive services. The letter advised the patient to call the PCIM appointment desk and schedule an appointment for mammography. Women in the intervention group who were Mayo Clinic employees were further assigned randomly to receive a reminder by either US mail or e-mail through their work e-mail account sent on behalf of their primary provider. Patients who did not respond to the initial reminder received a second e-mail or letter 1 month after the first reminder. Those who did not respond to the second reminder received a scripted telephone call from an appointment secretary at PCIM 1 month after the second reminder. Other than the letter or telephone call reminders, there was no difference in the care provided to the patients in the 2 groups.

The study was approved by the institutional review board of the Mayo Foundation. All patients in the intervention group were sent a detailed research authorization form used by our institution and were requested to complete and return it to the study coordinator. To comply with the recent regulations, a Health Insurance Portability and Accountability Act form was similarly sent to patients.

PRIMARY CARE PHYSICIAN PORTAL

The Primary Care Physician Portal is a Web-based information system at Mayo Clinic Rochester that consolidates data from institutional operational, clinical, and administrative data sources to assist primary care physicians in the management of their assigned patient population. Among many other functions, this system defines patient eligibility and completion for preventive services including mammography.

ELIGIBLE POPULATION

All of the 7183 eligible patients were randomly assigned to the intervention group or the control group (usual care). From the eligible patient population, 6665 women were identified to have consented to participate in this specific study or had documented authorization allowing access to their medical records for general research. Of these women, 3339 composed the control group and 3326 composed the intervention group. Two hundred eighty-six women in the control group and 232 in the intervention group either declined to participate in the study or their records indicated general denial for research authorization. Of the 3326 women in the intervention group, 2927 received reminders by US mail and 399 (employee patients) by e-mail.

PROACTIVE WEB-BASED INTERVENTION PROCESS

A Web-based system (PRECARES [**PRE**ventive **CA**re **RE**minder System]) was developed for appointment secretaries to manage proactive mammography for the patients in the intervention group. Each month, a list of patients due to undergo mammography in the next 3 months was retrieved from this application by an appointment secretary at PCIM. The secretary assessed the appointment system to determine whether a mammography appointment was already scheduled. If mammography was appropriate for the patient, the appointment secretary sent a letter inviting the patient to call to schedule mammography. When the patient called for the appointment, the appointment secretary scheduled the test and recorded the response in PRECARES. If the patient refused mammography or indicated that mammography had been performed elsewhere, this also was recorded. Patients who were previously scheduled for or had refused mammography or who had undergone screening elsewhere were excluded from reminder lists for the next 12 months. Two appointment secretaries from the existing staff were trained to manage the patient population for mammography; a 0.2 full-time equivalent was allocated to manage the practice of 38 physicians for this purpose. No additional staff were recruited.

USUAL CARE FOR BREAST CANCER SCREENING

There are many different avenues for patients in the control group (usual care) to undergo mammography. Many undergo mammography as part of an office visit for an annual examination or any other visit. In our practice, every patient who comes for any appointment is assessed for the need for all preventive services. Some patients also call to request breast cancer screening, in which case the appointment secretaries forward the request to the nurse and physician team. The team then reviews the record and sends a message to the appointment secretaries to schedule the screening test.

STUDY DURATION

The study was conducted from October 1, 2003, to October 31, 2004. The study began as a pilot study in October 2003 with

Table 1. Comparison of Preventive Services Screening Rates Between Control and Intervention Groups*

Screening Test	Age, y	Control Group (n = 3339)	Intervention Group (n = 3326)	*P* Value
Annual mammography	40-75	1847 (55.3)	2137 (64.3)	<.001
Papanicolaou smear	18-64	1601 (63.8)	1568 (62.8)	.47
Colorectal screening	>50	1751 (74.7)	1714 (73.8)	.49
Pneumonia vaccine	>65	575 (69.3)	587 (70.7)	.52
Influenza vaccine	>50	1214 (51.8)	1201 (51.7)	.96
Tetanus vaccine	>18 (every 10 y)	2493 (74.7)	2438 (73.3)	.21
Lipid screening	45-75 (every 5 y)	2858 (85.6)	2796 (84.1)	.08

*Data are given as the number (percentage) of subjects who are current with the screening test.

Table 2. Comparison of Preventive Services Screening Rates Between Mayo Clinic Employees in Control and Intervention Groups*

Screening Test	Age, y	Control Group (n = 877)	Intervention Group (n = 847)	*P* Value
Annual mammography	40-75	504 (57.5)	593 (70.0)	<.001
Papanicolaou smear	18-64	636 (73.2)	605 (72.4)	.70
Colorectal screening	>50	357 (78.1)	339 (80.5)	.38
Pneumonia vaccine	>65	NA	NA	NA
Influenza vaccine	>50	337 (73.7)	320 (76.0)	.44
Tetanus vaccine	>18 (every 10 y)	729 (83.1)	699 (82.5)	.74
Lipid screening	45-75 (every 5 y)	786 (89.6)	729 (86.1)	.02

Abbreviation: NA, data not available.
*Data are given as the number (percentage) of subjects who are current with the screening test.

patients of 1 primary care physician used to assess the feasibility of the process of proactively contacting patients for scheduling mammography. In January 2004, all female patients of PCIM were enrolled. Each month, patients were randomly assigned to the intervention group as they became due for mammography; that is, they had not undergone mammography in the past 9 months. The last group of patients was included in the trial in October 2004.

MEASUREMENT

The assessment of mammography rates for analysis was a cross-sectional measurement of annual screening rates using their status as of December 31, 2004, for each group. The rates of all other preventive screening tests were also assessed for both groups for their recommended time frames. The use of annual physical examinations in the preceding 12 months was also determined from the administrative data. Demographic information, including age, insurance payer type, and geographic region, was obtained from the administrative data.

STATISTICAL ANALYSIS

The percentage of patients current with mammography screening recommendations was compared between groups using the χ^2 test. Comparisons between the groups for other preventive screening rates were also based on χ^2 tests. Similar tests were performed to compare the Mayo Clinic employees who received reminders via US mail with those who received e-mail reminders.

Logistic regression was performed on mammography status, with adjustment for the clustering of patients within primary care provider, as well as patient age, payer type, distance from home to Rochester, and study arm. A generalized linear model accounting for the correlation of patients clustered by physician was used to analyze the number of annual physical examination visits per patient. This model included patient age, payer type, distance from home to Rochester, and study arm.

RESULTS

The postintervention rates for all eligible preventive services for the study patients are listed in **Table 1**. Of the women in the intervention group, 64.3% underwent annual mammography compared with 55.3% in the control group ($P<.001$). The rates for all other adult preventive services were not statistically different between the 2 groups. The lipid screening rate was slightly higher in the control group, with 85.6% of patients current for lipid screening compared with 84.1% in the intervention group ($P=.08$). The screening rates for all preventive services for the Mayo Clinic employee subpopulation are listed in **Table 2** and **Table 3**. For annual mammography, 70.0% in the intervention group and 57.5% in the control group underwent annual screening. For employees receiving e-mail reminders, the annual mammography rate was 72.2%. Overall, all screening rates were higher for the Mayo employee subpopulation than for non–Mayo Clinic employees.

The logistic regression models identified several factors significantly related to mammography status, including patient age ($P<.001$), payer status ($P<.001$), geographic region ($P=.03$), and study arm ($P<.001$). Patients who were older, had Mayo Clinic–provided insurance, lived in southeastern Minnesota, or received proactive

Table 3. Comparison of Preventive Services Screening Rates Between Mayo Clinic Employees Sent Letters and Those Sent E-mail Reminders*

Screening Test	Age, y	Letter Reminder (n = 448)	E-mail Reminder (n = 399)	*P* Value
Annual mammography	40-75	305 (68.1)	288 (72.2)	.19
Papanicolaou smear	18-64	320 (72.4)	285 (72.3)	.98
Colorectal screening	>50	168 (80.4)	171 (80.7)	.94
Pneumonia vaccine	>65	NA	NA	NA
Influenza vaccine	>50	158 (75.6)	162 (75.6)	.84
Tetanus vaccine	>18 (every 10 y)	369 (82.4)	330 (82.7)	.90
Lipid screening	45-75 (every 5 y)	392 (87.5)	337 (84.5)	.20

Abbreviation: NA, data not available.
*Data are given as the number (percentage) of subjects who are current with the screening test.

Table 4. Odds Ratios From a Logistic Model of Being Current for Annual Mammography

Variable	OR (95% CI)
Age, per 5 y	1.22 (1.18-1.26)
Insurance	
Medicare vs contract	0.96 (0.81-1.13)
Other government vs contract	0.37 (0.28-0.50)
Mayo Clinic employee vs contract	1.64 (1.44-1.90)
Self-pay vs contract	0.43 (0.33-0.57)
Geographic region	
Olmsted County, Minnesota, vs outside southeast Minnesota	1.39 (0.96-1.99)
Southeast Minnesota vs outside	1.55 (1.04-2.32)
Case (e-mail or US mail)	1.49 (1.35-1.65)

Abbreviations: CI, confidence interval; OR, odds ratio.

Table 5. Coefficients From a Generalized Linear Model of Annual Physical Examination Visits per Patient

Variable	Estimate	*P* Value
Intercept	−0.06	.70
Age, per year	0.01	.005
Insurance		
Medicare vs contract	0.29	<.001
Other government vs contract	0.30	.003
Mayo Clinic employee vs contract	0.008	.77
Self-pay vs contract	−0.99	.06
Geographic region		
Olmsted County, Minnesota, vs outside southeast Minnesota	0.09	.27
Southeast Minnesota vs outside	0.008	.92
Case (e-mail or US mail)	0.0141	.38

reminders were more likely to be current for mammography, and women who had government-provided insurance (Medicaid) or who paid out of pocket were less likely to be current. Odds ratio estimates and 95% confidence intervals for the logistic model are given in **Table 4**. In a logistic model of Mayo Clinic employees who received a reminder, age was significant ($P=.02$), but there was no difference between women who received proactive US mail reminders and those who received e-mail reminders ($P=.24$). The generalized linear model accounting for the patient clustering within physician practice found no significant difference between groups for adjusted annual physical examination visits during our study ($P=.38$). The parameter estimates and *P* values are listed in **Table 5**.

COMMENT

Our study demonstrates the feasibility and effectiveness of a practice redesign to manage and improve breast cancer screening for a large population of primary care patients. During the 12-month study, appointment coordinators used an administrative database to send timely reminders to 3346 patients due for mammography. As a result of this intervention, a significantly higher completion rate for annual mammography was noted among the women receiving the reminders (intervention group) compared with those receiving usual care (control group). The use of appointment secretaries to proactively manage and schedule breast cancer screening for our patients was a practical solution for our large group practice. This is consistent with other published reports. Practice type had a pronounced effect on the delivery of preventive services.[5] Larger practices have been found to deliver higher quality of care.[19-21] This is attributed to the ability of large practices to apply resources, management systems, and office staff to help physicians provide preventive services for their patients.[21-23]

The results of previous studies of the effect of information technology on delivery of preventive services have been mixed, with some studies showing enhancement and others showing no effect on delivery rates.[12,13,19] It seems that having enhanced information technology alone is insufficient to consistently affect the delivery of preventive services; practice redesign must also occur. A process in which the entire practice team, including allied health staff working at the maximum of their licensure, can significantly improve the performance of the delivery of preventive services.[17] Physician or nursing staff input had no important role in the delivery of this service in our practice.

In our employee population, the women who received e-mail reminders had an annual mammography rate of 72.2% compared with 68.1% for those who received letters, a statistically insignificant difference. Our study was not powered to detect a difference of this size

as small as 4%. Nineteen hundred fifty-five patients would be needed in each group to declare the same difference as statistically significant with 80% power and with $P = .05$. An electronic notification system was as effective as the US mail system and could provide an efficient, cost-effective system for delivery of reminders of preventive services to primary care patients. In the future, e-mail reminders may be an important way to notify patients, who may prefer these reminders to letters. However, issues of e-mail security need to be further addressed; for example, the Mayo Clinic e-mail policy allows for internal communication about appointment reminders only and not about test or procedure results.

Our intervention did not result in a significant decrease in the number of annual physical examinations performed. Patients in the intervention group visited their physicians for in-office annual physical examinations as frequently as those in the control group. In our study, we did not observe any improvement in completion rates for other preventive services in the intervention group. We had anticipated that the preventive service brochure included in the letters would have a positive effect on completion rates. However, it seems that a more active intervention is necessary and that patients need specific recommendations from their physicians about which preventive service they are due for. We also noted that the baseline screening rates for services such as colorectal cancer and cervical cancer were higher than for mammography and influenza vaccinations. Both mammography and influenza vaccinations are performed annually, and longer than a year can easily elapse before patients see their primary care physician. For this reason, interventions as in our study are needed to improve performance. In addition, many external quality-reporting organizations, including the Minnesota Community Measurement Project,[24] measure and report mammography rates every 24 months. Within that interval, our screening rate is 84%, which is better than the colorectal cancer screening rate.

In 2005, after our study was completed, we implemented the proactive system of scheduling for mammography in our entire patient population, which includes 11 119 women between the ages of 40 and 75 years. The current mammography rate for this population has increased further to 71%. This rate is likely higher than the study rate because we no longer are required to include the confusing research authorization with the patient notification. We have a 0.2 full-time equivalent of our appointment secretary effort to manage the mammography process for the patients of all physicians.

We observed that patients with various insurance coverage had significantly different screening rates. Others also have reported that screening rates for breast cancer can vary depending on the patient's health insurance.[5] In our practice, the care process for all patients is the same regardless of payer. Although we did not ascertain what accounted for this variation in the screening rate, it seems that different populations may need different strategies for improving the delivery of preventive services.

The main limitation of our study was related to patient consent paperwork. The protocol required that paperwork be sent to patients to authorize their participation in the study. This process was complicated and confusing for the patients and seemed to have had a negative effect on the response rate of our patients. We did not ascertain the magnitude of this effect. Another limitation is that both the patient population and available practice resources at the Mayo Clinic may be different from those of other practices, which may raise questions about the generalizability of our study. However, because the baseline screening rates were similar to rates reported nationally,[7,8,11] this practice redesign approach for delivering mammography should be similarly beneficial for all primary care practices. Others have advocated similar practice redesign to overcome barriers in addressing the preventive service needs of their patient populations.[17]

Screening rates for breast cancer and other preventive services are important quality indicators. With pay-for-performance, it will become increasingly important for primary care practices to develop processes to reliably deliver routine preventive screening services to their patients.[25] Many preventive screening services can be delivered without involvement of physicians or physician visits, and office staff can manage the preventive service needs of patients, which should also decrease the costs incurred by practices, patients, and insurers.

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