Electronic Patient Messages to Promote Colorectal Cancer Screening

A Randomized Controlled Trial

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Background: Colorectal cancer is a leading cause of cancer mortality, yet effective screening tests are often underused. Electronic patient messages and personalized risk assessments delivered via an electronic personal health record could increase screening rates.

Methods: We conducted a randomized controlled trial in 14 ambulatory health centers involving 1103 patients ranging in age from 50 to 75 years with an active electronic personal health record who were overdue for colorectal cancer screening. Patients were randomly assigned to receive a single electronic message highlighting overdue screening status with a link to a Web-based tool to assess their personal risk of colorectal cancer. The outcomes included colorectal cancer screening rates at 1 and 4 months.

Results: Screening rates were higher at 1 month for patients who received electronic messages than for those who did not (8.3% vs 0.2%, \(P < .001\)), but this difference was no longer significant at 4 months (15.8% vs 13.1%, \(P = .18\)). Of 552 patients randomized to receive the intervention, 296 (54%) viewed the message, and 47 (9%) used the Web-based risk assessment tool. Among 296 intervention patients who viewed the electronic message, risk tool users were more likely than nonusers to request screening examinations (17% vs 4%, \(P = .04\)) and to be screened (30% vs 15%, \(P = .06\)). One-fifth of patients (19%) using the risk assessment tool were estimated to have an above-average risk for colorectal cancer.

Conclusion: Electronic messages to patients produce an initial increase in colorectal cancer screening rates, but this effect is not sustained over time.

Trial Registration: clinicaltrials.gov Identifier: NCT01032746


Colorectal cancer is the second leading cause of cancer mortality in the United States. Colorectal cancer screening detects cancers at more curable early stages and reduces colorectal cancer mortality. As a result, national guidelines strongly recommend screening with colonoscopy, flexible sigmoidoscopy, or fecal occult blood testing for average-risk adults older than 50 years.

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Many patients do not receive recommended screening examinations. The barriers to colorectal cancer screening are multifaceted, with patients often citing lack of motivation and awareness of the need for colorectal cancer screening as well as reporting that their provider did not recommend screening. Direct-to-patient mailings can increase rates of colorectal cancer screening by heightening awareness and facilitating performance of recommended tests. However, such mailing programs cannot deliver information to patients in a highly personalized and interactive manner, and many patients remain unscreened even in the presence of such programs. One promising strategy could be to provide patients with information on overdue screening examinations and to highlight their personal risk of cancer, because individuals who perceive that their own risk of colorectal cancer is high are more likely to get screened.

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Innovative use of health information technology offers the potential to overcome the limitations of paper mailings and the limited availability of personalized risk information. Personal health records directly
integrated into electronic health records allow the efficient and direct delivery of information from physicians to patients. Such information can engage patients and encourage them to promote their own health behaviors. However, data are limited regarding how to use personal health records effectively in this manner. Therefore, we conducted a randomized, controlled trial to assess the impact of electronic patient messages coupled with personalized risk assessments delivered via an integrated personal health record on the rate of colorectal cancer screening.

**METHODS**

**STUDY SETTING**

This 4-month trial was conducted from November 2009 to March 2010 at Harvard Vanguard Medical Associates (HVMA), a multispecialty group practice comprising 14 ambulatory health centers in eastern Massachusetts. Since 1997, clinical practices within HVMA have used a common electronic health record (Epic Systems Corp, http://www.epic.com/) that includes clinical notes, diagnostic codes, procedure codes, and laboratory results. Screening tests for colorectal cancer can be ascertained via an automated electronic algorithm using laboratory results, diagnostic codes, procedure codes, and outpatient and hospital encounters from the electronic health record.

The electronic health record also supports a personal health record through an integrated Web-based patient portal, referred to as MyHealth. This patient portal allows bidirectional electronic messaging between patients and their physician's office. The portal also allows patients to view their current medication list and recent laboratory results and to request medication refills and office appointments. Patients voluntarily choose to register for a password-protected personal health record account, which allows access to all of this information via the patient portal in the electronic health record.

**PATIENT ELIGIBILITY**

We identified 10 283 patients (age range, 50-75 years) of 174 primary care physicians at 14 health centers who had a visit with an HVMA primary care physician during the prior 18 months and an active MyHealth personal health record account (Figure 1). Of these patients, 1831 (18%) of 159 physicians were overdue for colorectal cancer screening based on the absence of a recorded colonoscopy within the prior 10 years, flexible sigmoidoscopy within the prior 5 years, or fecal occult blood testing within the prior 12 months. Because the electronic patient messages were designed to come from individual primary care physicians, we next provided each of the eligible physicians with a list of their eligible patients who were overdue for colorectal cancer screening and who also had active MyHealth accounts. Each physician was asked to approve patients who should receive the electronic outreach message from the physician, with 80% of physicians responding. Our final study cohort included 1103 patients of 109 physicians, representing 60% of the 1831 potentially eligible patients.

Harvard Medical School and HVMA Human Studies Committees approved the study protocol, including a waiver of informed consent for patients because the study was promoting the HVMA standard of care for colorectal cancer screening.

**PATIENT INTERVENTION**

The intervention was randomized at the level of individual patients within each health center and each physician's patient panel. Patients who were overdue for colorectal cancer screening in the intervention group received a personalized electronic message from their primary care physician through the integrated personal health record messaging system. The message served several functions, including (1) highlighting the patients' overdue screening status and providing information on screening options; (2) facilitating electronic requests to the clinical practice to arrange specific screening examinations; and (3) providing a link to a specially tailored version of a validated Web-based tool that enables patients to assess their risk of colorectal cancer (http://www.yourdiseaserisk.siteman.wustl.edu/) within their secure personal health record.

The 2 screening options recommended by local guidelines in the HVMA medical group included colonoscopy or home fecal occult blood testing with 3 stool cards. Patients could reply to the electronic message to request colonoscopy or to have a fecal occult blood test kit mailed to their home. For colonoscopy requests, a physician assistant screened patients by telephone for contraindications, provided instructions for bowel preparation, and scheduled the procedure. Gastroenterologists performed procedures either at an ambulatory endoscopy center operated by HVMA or at an affiliated hospital-based endoscopy center. The waiting time for colonoscopy at HVMA during the study intervention was approximately 3 weeks. Patients randomized to the control group did not receive electronic messages.

The organization does have a strong commitment to colorectal cancer screening, including the use of programs such as paper mailings to patients overdue for screening and the delivery of electronic reminders to physicians. However, these interventions were deactivated for more than 1 year before the initiation of our current study. There were no additional programs or tools to promote colorectal cancer screening during the study period.

**PATIENT RISK WEB SITE**

The electronic message to patients contained a hyperlink to a modified version of a validated Web-based tool that enabled patients to assess their personal risk of colorectal cancer. This modified Web tool focused on colorectal cancer and was hosted on the internal server of HVMA to protect patient confidentiality and to allow tracking of patient responses. Patients using the risk

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**Diagram of patient eligibility and randomization.** Patients were randomized within health center and physician panels.
tool provided their age, sex, family history of colorectal cancer, relevant personal medical history, and diet and exercise patterns. This information was used to assess their personalized risk of colorectal cancer on a 7-point ordinal scale ranging from very much below average to very much above average relative to other individuals of the same age and sex. The risk status was displayed using a graphic format that demonstrated how much their risk could be lowered based on normal colorectal cancer screening examination results (Figure 2). Patients were given the option of sharing their risk information with their primary care physician on the final Web page of the risk tool.

Before receiving their personalized risk assessment, patients were asked to respond to the statement “I intend to be screened for colon cancer within the next year” on a 4-point Likert scale from “strongly agree” to “strongly disagree.” After receipt of their risk assessment, patients responded to the question “Would you recommend this Web site to your friends?” using a dichotomous yes or no response.

STUDY OUTCOMES

All data were collected from the electronic health record. The primary study outcome was receipt of appropriate colorectal cancer screening assessed at 4 months. Appropriate screening examinations included colonoscopy, flexible sigmoidoscopy, or a 6-specimen home fecal occult blood test kit. We chose 4 months to allow for scheduling and performance of colonoscopy as well as to ensure that any immediate effects on screening rates were sustained. We defined a secondary outcome of receipt of colorectal cancer screening at 1 month to assess any immediate effects of the electronic patient outreach.

We also collected information on uptake of the intervention components. The electronic messaging function allowed for tracking of whether patients viewed the message, and the Web-based risk tool captured whether patients accessed the Web site and completed the risk assessment.

DATA ANALYSIS

Baseline characteristics of patients in the intervention and the control groups were compared using the Pearson χ² test for dichotomous variables and the t test for continuous variables. We analyzed the impact of the interventions by fitting a logistic regression model to predict performance of an appropriate screening examination. We adjusted standard errors for clustering of patients by health center using generalized estimating equations. The independent variable in this model was patient intervention status. All analyses were performed using SAS version 9.2 (SAS Institute Inc, Cary, North Carolina), and 2-tailed P values or 95% confidence intervals were reported for all comparisons.

RESULTS

STUDY PARTICIPANTS

Patients in the intervention and control groups were similar according to age, sex, race/ethnicity, and insurance coverage (Table 1). The median number of eligible patients per physician was 9 (interquartile range, 5-13). During the 4-month intervention period, the proportion of patients with at least 1 primary care office visit was the same in the intervention and the control groups (46% vs 44%), and screening examinations for colorectal cancer were ordered by primary care clinicians for 28% of patients.

INTERVENTION EFFECT ON SCREENING RATES

Of 552 patients randomized to receive the intervention, 255 (46%) viewed the electronic message within 1 month, 296 (54%) viewed the electronic message within 4 months, and 17 (3%) made electronic requests for colorectal cancer screening. At 1 month, the colorectal screening rates were significantly higher in the intervention group than in the control group (8.3% vs 0.2%, P < .001, Table 2). However, the primary end point at 4 months showed no difference between the intervention and the control arms in the rates of colorectal cancer screening (15.8% vs 13.1%, P = .18). Among all patients, most (79%) new screening examinations were colonoscopy, with fecal occult blood testing (21%) accounting for the remainder.

Table 1. Baseline Patient Characteristics

<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>Intervention Group (n=552)</th>
<th>Control Group (n=551)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD), y</td>
<td>56.6 (6.8)</td>
<td>56.0 (6.1)</td>
<td>.15</td>
</tr>
<tr>
<td>Male</td>
<td>215 (39)</td>
<td>213 (39)</td>
<td>.92</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td>.51</td>
</tr>
<tr>
<td>White</td>
<td>441 (80)</td>
<td>412 (75)</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>21 (4)</td>
<td>24 (4)</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>20 (4)</td>
<td>26 (5)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>9 (2)</td>
<td>11 (2)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>8 (1)</td>
<td>10 (2)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>53 (10)</td>
<td>68 (12)</td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
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<td></td>
<td>.84</td>
</tr>
<tr>
<td>Commercial</td>
<td>448 (81)</td>
<td>448 (81)</td>
<td></td>
</tr>
<tr>
<td>Medicare</td>
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<td>65 (12)</td>
<td></td>
</tr>
<tr>
<td>Medicaid</td>
<td>25 (5)</td>
<td>28 (5)</td>
<td></td>
</tr>
<tr>
<td>Self-pay</td>
<td>14 (3)</td>
<td>10 (2)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2. Patients were provided with comparative risk assessment for colorectal cancer when using the Web-based risk tool. Reprinted with permission from http://www.yourdiseaserisk.siteman.wustl.edu/.

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WEB-BASED RISK TOOL

Of 296 intervention patients who viewed the electronic message, 47 (16%) accessed and completed the Web-based tool. Of the 47 patients who used the Web tool, three-quarters (74%) strongly or somewhat agreed that they intended to be screened for colon cancer within the next year. Approximately one-fifth (19%) had an above-average risk of colorectal cancer, with 11% having an average risk and 70% demonstrating a below-average risk. No patients elected to have their risk information shared with their primary care physician, although 84% would recommend the Web tool to friends. Among the 296 intervention patients who viewed the electronic message, risk tool users were more likely than risk tool nonusers to request screening examinations (17% vs 4%, \( P = .04 \)) and tended more commonly to be screened (30% vs 15%, \( P = .06 \)).

In a cohort of average-risk adults, electronic outreach via an integrated personal health record produced an initial increase in colorectal cancer screening rates, but this effect was not sustained. Only half of patients in the intervention group viewed the electronic message even though it had been sent from their personal physician, which limited the overall effectiveness of the intervention. Users of the Web-based risk assessment tool represented a small and generally low-risk subset of all eligible patients; however, they responded favorably to the tool and more often requested and received colorectal cancer screening examinations than patients who were invited to use the tool but did not do so.

Increased screening is essential to reduce the incidence, morbidity, and mortality of colorectal cancer. \(^{17}\) Informed decision making and education can motivate patients to pursue appropriate screening. \(^{18-21}\) However, primary care physicians face increasing pressures to provide a wide range of preventive counseling during increasingly shorter office visits. \(^{22}\) Colorectal cancer screening presents a particular challenge given the multiple screening options, and many patients do not receive adequate counseling for colorectal cancer screening. \(^{10,23}\)

Prior research has suggested that patient-directed interventions, including videotaped decision aids, \(^{24}\) educational mailings, \(^{12,25,26}\) and nurse counseling, \(^{27}\) can increase colorectal cancer screening rates. Even in the presence of such programs many patients remain unscreened, and such programs can have substantial costs. \(^{23,28}\)

Personal health records offer the promise of engaging patients in a more efficient and interactive manner. \(^{14,29,30}\) Patients have expressed interest in interacting with their medical record using electronic portals similar to the one used in our intervention. \(^{31}\) However, rigorous evaluations of targeted uses of such systems to improve care have been limited in number and have had mixed results. \(^{13}\) One pilot study of an e-mail outreach program failed to increase colorectal cancer screening rates, but only 25% of patients viewed the messages. \(^{32}\) In another study within a large health maintenance organization, electronic messages delivered within an integrated personal health record found that two-thirds of patients viewed the messages, and colorectal cancer screening rates were improved at 3 months. \(^{33}\)

Our study builds on this prior work in important ways. First, about half of the patients (54%) in our study viewed the personalized electronic messages, a rate that was intermediate relative to these 2 prior studies of personalized messages. \(^{32,33}\) One of the significant challenges to the effective use of personal health records to improve quality of care is to increase their adoption by physician practices as well as to ensure effective use by patients. \(^{33}\) The solutions to this issue may be straightforward, such as ensuring accurate e-mail addresses, or more complex, such as ensuring that the information and services provided by the personal health record meet the needs of patients. Our study highlights the notion that while personal health records are often promoted to improve quality of care, it is important to evaluate such systems to ensure that they are implemented in a manner that achieves this goal.

Second, we demonstrated a promising initial increase in screening, similar to a prior study; \(^{33}\) however, we found that this effect was not sustained over the long term. This lack of a long-term effect may have been attributable to the effects of prior programs in this system to promote colorectal cancer screening, including annual paper mailings to adult patients who were overdue for colorectal cancer screening. \(^{15}\) Future work should focus on the impact of quarterly or semiannual electronic outreach to patients on their screening rates and on how such regular outreach is received by patients. Third, the baseline screening rate in our population was very high (82%), exceeding that in a successful prior study of electronic patient outreach (69%). \(^{33}\) Leaving an unscreened population of patients who may have been much more resistant to screening. As colorectal cancer screening rates rise across the country, \(^{9}\) it is increasingly important to understand how to promote screening in this remaining unscreened group.

Finally, we incorporated a link to a Web-based risk tool to further personalize the information regarding colorectal cancer screening, as many high-risk patients are

| Table 2. Receipt of Colorectal Cancer Screening by Intervention Status |
|---------------------------|---------------------------|
| Screening Rates  | Intervention Group | Control Group | Difference, % |
| At 1 mo        | 46 (8.3)            | 1 (0.2)        | 8.1 (5.2 to 11.1) |
| At 4 mo        | 87 (15.6)           | 72 (13.1)      | 2.7 (−1.3 to 6.7) |
| P Value        | <.001                | .18            |
not screened appropriately. Most patients report having the greatest trust in health information received from their physician, but many turn to the Internet for convenience, particularly for cancer-related information. We used a model that combined the trust of a recommended information source from the physician’s office with the convenience of an Internet-based tool. We chose 1 validated Web-based risk tool that was available when our study was implemented, and other options, including the National Cancer Institute Colorectal Cancer Risk Assessment Tool, can also be used to provide patients with risk information. Those who accessed the tool in our study found it helpful and often sought screening afterward, but only a small proportion of patients used the tool. While providing accurate information in an easily interpretable format should remain essential goals of Internet-based tools, future work also needs to focus on how to engage patients in using such tools when they are recommended by their physicians.

Our study findings should be considered in the context of some limitations. First, we relied on physicians to approve the inclusion of their patients in the study, and their approval was not obtained for 40% of eligible patients. This factor represents an important consideration for future work involving this type of direct patient outreach focused on quality improvement. Involvement of physicians before such patient outreach can provide an important safety screen; however, it can also represent a barrier to quality improvement, particularly if physicians do not respond to requests to enroll their patients.

We do not have long-term follow up of patients regarding colorectal cancer outcomes, nor do we have information regarding patient perceptions of receiving electronic messages or of using the online risk assessment tool. The risk assessment tool we used provided the level of risk relative to other age-matched peers and therefore may have downplayed the steadily increasing risk of colorectal cancer developing after the age of 50 years.

Finally, some issues may limit the generalizability of our study findings to other settings and patient populations. The organization that we studied has a history of focusing on colorectal cancer screening, and it has already achieved a relatively high rate of colorectal cancer screening. Also, patients actively using personal health records, such as those enrolled in our trial, may differ from the broader population in race/ethnicity or socioeconomic status as well as in their enthusiasm and comfort with using Web-based applications. In the large medical group that we studied, approximately 18% of patients ranging in age from 50 to 75 years were active users of the personal health record in late 2009. Future research will be needed to understand how our results extend to other settings.

In conclusion, this randomized trial of electronic messages to patients within an integrated personal health record demonstrated an initial increase in the rate of colorectal cancer screening that was not sustained over time. However, only about half of eligible patients viewed the electronic messages, and fewer than 10% accessed the Web-based risk tool. Further research is needed to understand the most effective ways for patients to use interactive health information technology to improve their care and to reduce the morbidity and mortality of colorectal cancer.

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Author Contributions: Dr Sequist had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Sequist, Zaslavsky, Colditz, and Ayanian. Acquisition of data: Sequist. Analysis and interpretation of data: Sequist, Zaslavsky, Colditz, and Ayanian. Drafting of the manuscript: Sequist. Critical revision of the manuscript for important intellectual content: Sequist, Zaslavsky, Colditz, and Ayanian. Statistical analysis: Sequist and Zaslavsky. Obtained funding: Sequist and Ayanian. Administrative, technical, and material support: Colditz. Study supervision: Ayanian.

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