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Cost-Effectiveness of Patient Mailings to Promote Colorectal Cancer Screening

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Abstract

Background—Programs to promote colorectal cancer screening are common, yet information regarding the cost effectiveness of such efforts is limited.

Objective—To assess the cost effectiveness of patient mailings to increase rates of colorectal cancer screening.

Research Design—Incremental cost-effectiveness analysis of a randomized, controlled trial. The intervention involved 21,860 patients aged 50 to 80 years across 11 health centers overdue for colorectal cancer screening. Patients were randomized to receive a mailing that included a tailored letter, educational brochure, and fecal-occult-blood test kit at baseline and 6 months follow up.

Measures—We calculated the incremental cost-effectiveness of these mailings to promote colorectal cancer screening via fecal-occult-blood testing, flexible sigmoidoscopy, or colonoscopy using internal cost estimates of labor and supplies.

Results—Colorectal cancer screening rates were higher for patients in the intervention compared to control patients (44% versus 38%, $p < 0.001$). The total cost of the intervention was approximately \$5.48 per patient, resulting in a cost-effectiveness ratio of \$94 per additional patient screened. This estimate ranged from \$69 to \$156, based on assumptions of the cost of the intervention components, magnitude of intervention effect, age range and size of the targeted patient population.

Conclusion—Tailored patient mailings are a cost-effective approach to improve rates of colorectal cancer screening.

Keywords

Colorectal cancer screening; cost effectiveness; quality improvement; patient mailings

Introduction

Colorectal cancer is the second leading cause of cancer mortality among US adults.¹ Screening with fecal occult blood testing, flexible sigmoidoscopy, and colonoscopy can reduce this risk,^{2–6} and these screening tests have been shown to be cost-effective.^{7–9} Based

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on this evidence, colorectal cancer screening is strongly endorsed by national guidelines for average-risk adults 50 years and older.^{10, 11}

Despite strong evidence supporting its effectiveness, colorectal cancer screening remains underused, with only 60% of patients reporting an up-to-date screening status.¹² The reasons for lack of screening include a combination of patient, physician, and health system factors ranging from lack of motivation on the part of patients to a failure to recommend screening on the part of physicians.¹³ A variety of strategies have been developed to address these barriers to colorectal screening, including approaches that target physicians, patients, or both.¹⁴⁻²⁶

As health systems consider adopting programs to increase colorectal cancer screening rates, it becomes increasingly important to understand the costs and feasibility associated with different approaches.²⁷ We recently conducted a randomized trial involving both tailored patient mailings from a medical group to average-risk adults overdue for colorectal cancer screening as well as alerts delivered to their primary physicians within an electronic medical record during office visits. This 2×2 randomized trial demonstrated that the patient mailings significantly increased screening rates, while the physician alerts did not have a significant effect.²⁸ The goal of the current study was to estimate the incremental cost-effectiveness of the tailored patient mailing program per additional patient screened.

Methods

Study Setting and Intervention

The study was conducted from April 2006 to June 2007 at 11 ambulatory health centers within Harvard Vanguard Medical Associates, a multispecialty group practice in eastern Massachusetts. These centers were all using a common electronic medical record system (Epic Systems Corporation, Verona, Wisconsin) that included clinical notes, diagnostic and procedure codes, and laboratory results. We identified 59,181 patients ages 50 to 80 years old being cared for by 110 primary care physicians as of April 2006. From this overall cohort, we enrolled 21,860 (37%) patients who were currently overdue for colorectal cancer screening, defined as the absence of either 1) fecal occult blood testing within the prior 12 months combined with flexible sigmoidoscopy within the prior 5 years, or 2) colonoscopy within the prior 10 years, a definition consistent with the current internal HVMA guidelines for colorectal cancer screening.

The intervention involved a 2×2 design with both patient and physician intervention components.²⁸ Patients overdue for colorectal cancer screening were randomized to receive a mailing with the following 4 components: (1) a tailored cover letter identifying the patient as overdue for screening and indicating the dates of their most recent screening examinations, (2) an educational pamphlet detailing screening options, (3) a 6-sample fecal-occult-blood test kit and a stamped return envelope, and (4) a dedicated telephone number to schedule flexible sigmoidoscopy or colonoscopy. The initial mailing occurred during the first month of the intervention. A second mailing, which did not contain the fecal-occult-blood test kit, was sent to patients still overdue for screening 6 months later. Throughout the 15-month intervention period, primary care physicians were randomized to receive electronic reminders during office visits with their patients overdue for colorectal cancer screening. The alerts to physicians provided details regarding the most recent screening tests and facilitated electronic ordering of screening examinations.

The primary study outcome was ascertained from electronic medical record data and defined as the completion of one of the following three screening options during the 15-month study period: fecal occult blood testing, flexible sigmoidoscopy, or colonoscopy. We analyzed the

impact of the interventions by fitting a single linear regression model to predict performance of an appropriate screening examination after adjusting standard errors for clustering of patients by physician. Independent variables included patient intervention status, physician intervention status, and physician baseline screening rate.

Estimation of Intervention Costs

Given the lack of a statistically significant effect of the electronic reminders to physicians, we focused our estimation of costs on the patient mailing intervention, which did increase screening rates significantly.²⁸ We conducted this analysis from the perspective of the integrated medical group conducting the intervention. Fixed costs included vendor charges to create the electronic database to identify patients overdue for screening (\$11,546), design of the educational brochure (\$1,487), and printing of the brochures (\$5,300). Variable costs which were incurred on a per-patient basis included the cost of the remainder of the mailings, including all materials, postage, and packing. The per patient costs for the first patient mailing (\$3.77) were higher than for the second patient mailing (\$1.10) as we did not include a fecal-occult-blood test kit with stamped return envelope in the second mailing. The second mailing was delivered to 67% of the initial unscreened cohort that remained unscreened 6 months following the first mailing.

An additional variable cost included the staff time related to answering telephone requests for colonoscopy and scheduling the procedure (\$13.82 per procedure). This process involved two steps. First, an initial screening interview was conducted by a scheduling coordinator. Second, for patients identified at increased risk for procedure-related complications such as those with active cardiopulmonary disease, a physician assistant in the gastroenterology department conducted a telephone interview to clarify this risk. The time costs associated with this process were collected directly from the screening staff, with 30% of patients requiring more advanced screening by a physician assistant. The salaries of the scheduling coordinator and the physician assistant were estimated as \$40,900 and \$98,300 respectively; with each call requiring 17.5 minutes to complete. We added 30% to these salary estimates to account for fringe benefits. All costs were converted to 2008 dollars using the Bureau of Labor Statistics Producer Price Index for medical group practices.²⁹ We excluded any costs that were explicitly linked to evaluation of the effectiveness of the intervention, such as study team salaries devoted to outcome assessment.

Calculation of Cost-Effectiveness Ratio

We calculated the incremental cost effectiveness ratio by first subtracting the screening rate in the control group from the rate in the intervention group to obtain the incremental increase in screening attributable to the intervention. We used this estimate to calculate the increased number of colorectal screening exams expected among the entire cohort of 21,860 patients as a result of the patient mailing intervention. We then applied the cost estimates detailed above to calculate the costs associated per additional person screened.

We conducted four sets of sensitivity analyses for this base case estimate of cost effectiveness. First, we varied the estimate of the effectiveness of the intervention based on the 95% confidence intervals obtained from the original randomized trial. Second, we varied the intervention cost estimates by $\pm 10\%$. Third, we analyzed the incremental cost effectiveness according to age groups, as our randomized trial demonstrated an increase in the magnitude of intervention effect with increasing patient age.²⁸ Finally, we varied the size of the patient population from 20,000 to 100,000 to understand the applicability of our findings to smaller and larger practice groups, relative to the population of approximately 59,000 patients from which our study cohort was derived. All analyses were performed using Microsoft Excel 2003. The study protocol was approved by the human studies

committees at Harvard Medical School and Harvard Pilgrim Healthcare and registered at ClinicalTrials.gov (NCT00355004).

Results

Among the 21,860 patients in the randomized trial, colorectal cancer screening rates were higher among patients in the intervention group compared to the control group (44.0% versus 38.1%, $p<0.001$), as previously reported.²⁸ The primary driver of this effect was through increased performance of fecal occult blood testing among patients in the intervention group. Based on this increase in screening, we estimated that among the original 21,860 patients an additional 1,274 patients would undergo screening as a result of the patient mailings; including 1,108 fecal occult blood test kits and 166 flexible sigmoidoscopies and colonoscopies (Table 1).

In the base case, the total costs associated with applying the intervention to all 21,860 patients were approximately \$120,000, or approximately \$5.48 per patient. These costs included \$18,333 related to fixed costs and \$101,518 related to variable costs (Table 2). Only a small number of incremental flexible sigmoidoscopies and colonoscopies occurred ($n=166$), resulting in incremental scheduling costs of approximately \$3,000. Based on these total costs, the cost per incremental patient screened was \$94. This cost ranged from a low of \$55 to a high of \$156 depending on assumptions about the effectiveness of the intervention, the cost of the intervention components, the age of the targeted population, and size of the targeted population (Table 2).

Discussion

Assessing the costs associated with promoting colorectal cancer screening in average-risk populations is an integral component of developing and sustaining such programs.²⁷ We conducted a cost-effectiveness analysis within the context of a randomized trial of tailored patient mailings to promote colorectal cancer screening among average-risk adults. This program yielded an absolute increase in screening rates of approximately 6% over a 15-month period, with an incremental cost per patient screened of \$94, well within the range of acceptable costs associated with programs to increase the use of proven effective cancer screening services.³⁰ The reasonable incremental costs associated with our intervention support the notion that colorectal cancer screening is a cost effective strategy,⁷⁻⁹ even when including the costs associated with engaging patients to participate in their health care through the use of tailored mailings.

Several prior studies have assessed the cost-effectiveness of interventions to promote colorectal cancer screening.³⁰⁻³⁴ The cost per additional patient screened for interventions that targeted average-risk, unscreened patients has ranged from approximately \$115 to nearly \$6,300 (Table 3). While these interventions varied in terms of the focus of the intervention and the materials used (e.g. generic mailings, tailored telephone calls, instructional DVDs, provider performance reports), it is important to note how our intervention differed from these prior studies. Most prior studies have generally focused on a single clinic or community health center. In contrast, our study was much larger in scale, involving over 20,000 patients treated by 110 primary care physicians across 11 community-based centers of an integrated private medical group. In addition, the baseline colorectal cancer screening rate in our intervention was over 60%, far higher than the baseline rates reported in prior cost-effectiveness studies.

It is crucial to understand how local interventions can be “scaled” to involve larger populations with higher screening rates that are more typical of current practice.³⁵ Our

results are encouraging in that we estimated a similar or lower cost per additional person screened compared to other settings with lower baseline screening rates. In addition, to our knowledge our study is the first one that utilized an advanced electronic health record to create an electronic data registry of patients overdue for colorectal cancer screening. This feature may result in significant cost savings compared with older programs that used manual chart reviews to identify patients overdue for screening.³²

It is equally important to understand how the costs of our intervention compare with previous research on the overall cost-effectiveness of colorectal cancer screening programs. Frazier et al. used a Markov model to project treatment costs and life expectancy associated with various screening strategies for a cohort of patients starting at age 50 with a baseline screening rate of 60%, closely paralleling the characteristics of our study population.⁷ The authors estimated that 23.9 additional patients needed to be screened via annual fecal occult blood testing to gain one additional year in life expectancy. The incremental lifetime treatment costs were \$672 (2008 dollars) per patient, for a total of \$16,060 per additional life year gained. Our intervention would cost approximately \$2,247 to increase screening by 23.9 additional patients, or only 14% of the costs estimated by Frazier et al. Based on this comparison, our intervention costs are unlikely to change the overall cost effectiveness of existing colorectal screening programs.

Although our study is strengthened by the randomized design and inclusion of a large patient population, it also has some potential limitations. First, our study was conducted in a more structured setting than many other health care organizations. In particular, integrated medical groups generally provide higher quality care for screening services,³⁶ and so our findings may not readily extend to all other settings. Second, we did not conduct prospective time-motion studies that might have produced more accurate estimates of time costs associated with certain elements of our program such as scheduling colonoscopies. However, these costs were relatively minor in our cost estimates compared to the costs of assembling the data registry and distributing the patient mailings. While our intervention targeted performance of fecal occult blood testing, flexible sigmoidoscopy, and colonoscopy, the primary intervention effect was to increase rates of fecal occult blood testing. We are unable to comment on the cost of a program that would primarily promote performance of colonoscopy. However, it is important to note that despite the preference for colonoscopy among physicians nationally³⁷ and in our study,²⁸ patients often prefer fecal occult blood testing³⁸ and this option is still supported by national guidelines.¹⁰

While a large population of patients overdue for colorectal cancer screening could be identified very efficiently with a well-established electronic health record, we did not include the broader costs of implementing such an advanced system, which can be substantial. Therefore, our analyses apply more directly to settings already using a similarly advanced electronic health record system. Finally, future work is needed to establish the cost-effectiveness of sustaining such interventions in the long term and how such estimates would vary as the baseline screening rate of the targeted patient population varies.

Our study findings highlight the potential for a structured quality improvement program involving tailored patient mailings to increase rates of colorectal cancer screening with acceptable incremental costs and cost effectiveness. Future research should assess how these findings can be applied to other health care settings and evaluate whether other interventions can achieve similar or better incremental costs per additional patient screened.

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Table 1

Estimated Increase in Screening Exams Among Original 21,860 Patient Cohort

Screening Strategy	Proportion Screened without Intervention, %	Incremental Increase in Proportion Screened, % (95% CI)	Additional Patients Screened, n (95% CI)
Any screening	38.1	5.8 (4.5 to 7.1)	1,274 (743 to 1,793)
Fecal occult blood test	20.4	5.1 (3.8 to 6.3)	1,108 (831 to 1,377)
Flexible sigmoidoscopy	<0.1	0.0 (-0.1 to 0.1)	4 (-22 to 22)
Colonoscopy	17.7	0.7 (-0.3 to 1.8)	162 (-66 to 393)

Table 2

Incremental Cost Effectiveness Per Additional Patient Screened

	Intervention Effect, %	Additional Patients Screened	Intervention Costs	Incremental Cost-Effectiveness
Base case	5.8%	1,274	\$119,851	\$94
Intervention effectiveness sensitivity				
95% upper confidence interval	7.1%	1,793	\$119,851	\$69
95% lower confidence interval	4.5%	743	\$119,851	\$156
Intervention cost sensitivity				
10% increase in costs	5.8%	1,274	\$131,543	\$103
10% decrease in costs	5.8%	1,274	\$108,159	\$85
Patient age sensitivity				
50 to 59 years	3.7%	453	\$66,803*	\$147
60 to 69 years	7.3%	420	\$31,186*	\$74
70 to 80 years	10.1%	399	\$21,857*	\$55
Patient population size sensitivity				
20,000	5.8%	466	\$55,485	\$119
50,000	5.8%	1,166	\$111,213	\$95
100,000	5.8%	2,331	\$204,093	\$88

* Intervention costs pro-rated within each age group according to the proportion of the total population represented by that age group

Table 3
Summary of Cost-Effectiveness Analyses for Comparable Interventions to Increase Colorectal Cancer Screening

Reference	Subjects	Population description	Baseline Screening Rate	Intervention Components	Reported Cost Per Additional Patient Screened	Cost Per Additional Patient Screened (2008 \$)*
Sequist et al	21,860 patients 110 providers	Patients 50 to 80 years old across 11 health centers	63%	Patient mailing with stool card kit and telephone line to schedule colonoscopy	\$94	\$94
Lairson et al ³³	1,546 patients	Patients 50 to 74 years old within single academic family practice clinic	33%	1) Patient mailing with stool card kit 2) Mailing + targeted phone call	\$319 \$5,843	\$344 \$6,292
Wolf, et al ³²	1,978 male patients 113 providers	Patients at least 50 years old within single Veterans Administration general medicine clinic	36%	Baseline educational session followed by quarterly physician performance feedback	\$978	\$1,108
Khankari et al ³⁴	154 patients	Patients at least 50 years old within single federally qualified health center	12%	Physician communication training + patient educational mailing	\$106	\$115

* Costs adjusted to 2008 \$\$ using the Bureau of Labor Statistics Producer Price Index for medical group practices²⁹ to facilitate direct comparisons of cost estimates across studies.