

# Automated Telephone Calls Improved Completion of Fecal Occult Blood Testing

David M. Mosen, PhD, MPH,\* Adrienne C. Feldstein, MD, MS,\*† Nancy Perrin, PhD,\*  
A. Gabriela Rosales, MS,\* David H. Smith, RPh, PhD,\* Elizabeth G. Liles, MD,\*  
Jennifer L. Schneider, MPH,\* Jennifer E. Lafata, PhD,‡ Ronald E. Myers, PhD,§  
Michael Kositch, MD,† Thomas Hickey, MD,† and Russell E. Glasgow, PhD¶

**Background:** Although colorectal cancer (CRC) prognosis is improved by early diagnosis, screening rates remain low.

**Objective:** To determine the effect of an automated telephone intervention on completion of fecal occult blood testing (FOBT).

**Research Design:** In this randomized controlled trial conducted at Kaiser Permanente Northwest, a not-for-profit health maintenance organization, 5905 eligible patients aged 51 to 80, at average risk for CRC and due for CRC screening, were randomly assigned to an automated telephone intervention (n = 2943) or usual care (UC; n = 2962). The intervention group received up to three 1-minute automated telephone calls that provided a description and health benefits of FOBT. During the call, patients could request that an FOBT kit be mailed to their home. Those who requested but did not return the cards received an automated reminder call. Cox proportional hazard method was used to determine the independent effect of automated telephone calls on completion of an FOBT, after adjusting for age, sex, and prior CRC screening.

**Results:** By 6 months after call initiation, 22.5% in the intervention and 16.0% in UC had completed an FOBT. Those in the intervention group were significantly more likely to complete an FOBT (hazard ratio, 1.31; 95% confidence interval, 1.10–1.56) compared with UC. Older patients (aged 71–80 vs. aged 51–60) were also more likely to complete FOBT (hazard ratio, 1.48; 95% confidence interval, 1.07–2.04).

**Conclusions:** Automated telephone calls increased completion of FOBT. Further research is needed to evaluate automated telephone interventions among diverse populations and in other clinical settings.

**Key Words:** colorectal cancer (CRC), fecal occult blood testing (FOBT), reminder calls

(*Med Care* 2010;48: 604–610)

From the \*Center for Health Research, and †Northwest Permanente, Kaiser Permanente Northwest, Portland, OR; ‡Henry Ford Health System, Detroit, MI; §Thomas Jefferson University, Philadelphia, PA; and ¶Institute for Health Research, Kaiser Permanente Colorado, Denver, CO. Reprints: Adrienne C. Feldstein, MD, MS, 3800 N. Interstate Avenue, Portland, OR 97227-1110. E-mail: adrienne.c.feldstein@kpchr.org. Copyright © 2010 by Lippincott Williams & Wilkins  
ISSN: 0025-7079/10/4807-0604

Colorectal cancer (CRC) is the third most common type of cancer and the second leading cause of cancer-related death in the United States.<sup>1</sup> In 2009, CRC will be newly diagnosed in about 112,340 people, resulting in over 52,180 deaths.<sup>2</sup> Total direct costs associated with treating CRC are \$17 billion, with 9.8 million work days lost annually to hospitalization for colon cancer.<sup>2</sup>

The early detection of high-risk lesions or CRC through appropriate screening is associated with decreased incidence and mortality from CRC.<sup>3–5</sup> The US Preventive Services Task Force (USPSTF) recommends that men and women of average risk begin screening for CRC starting at age 50,<sup>6</sup> and specialty care guidelines provide recommendations for higher-risk groups.<sup>7</sup> Among the currently recommended CRC screening modalities for average-risk patients, only routine fecal occult blood testing (FOBT) has been evaluated in the context of a randomized clinical trial (RCT) for reducing CRC mortality.

Despite the benefits of CRC screening, it is estimated that only 50% to 60% of adults aged 50 and older receive screening tests at recommended intervals.<sup>8–14</sup> Moreover, rates for CRC screening are substantially lower than for other types of recommended cancer screening,<sup>9</sup> and there is a need to enhance CRC screening efforts.<sup>15</sup>

Telephone reminder calls using live callers were effective in prompting adults eligible for CRC screening to complete needed the needed tests.<sup>16–22</sup> Interventions ranged from simple telephone reminder calls to intensive personalized messaging, including targeted and tailored contacts delivered by telephone and mail<sup>19–21</sup> to reduce screening barriers. Although successful, live-caller interventions to increase CRC screening are often expensive and resource-intensive. In contrast, automated-call interventions offer a low-cost method for delivering CRC screening messages and may be more sustainable in a variety of healthcare delivery systems. We sought to determine the effect of an automated telephone contact campaign on completion of FOBT, an evidence-based screening method for populations with average risk for CRC.

## METHODS

The protocol for this study was approved by the institutional review board within the study health maintenance

organization (HMO). The need for individual signed consent was waived.

### Study Setting and Data Sources

The study was conducted in 2008 at Kaiser Permanente Northwest (KPNW), a nonprofit group-model HMO operating in southern Washington and northern Oregon, consisting of 15 medical clinics and about 485,000 members. At the time of the study, FOBT was the recommended method of screening for those with average risk of CRC within KPNW.

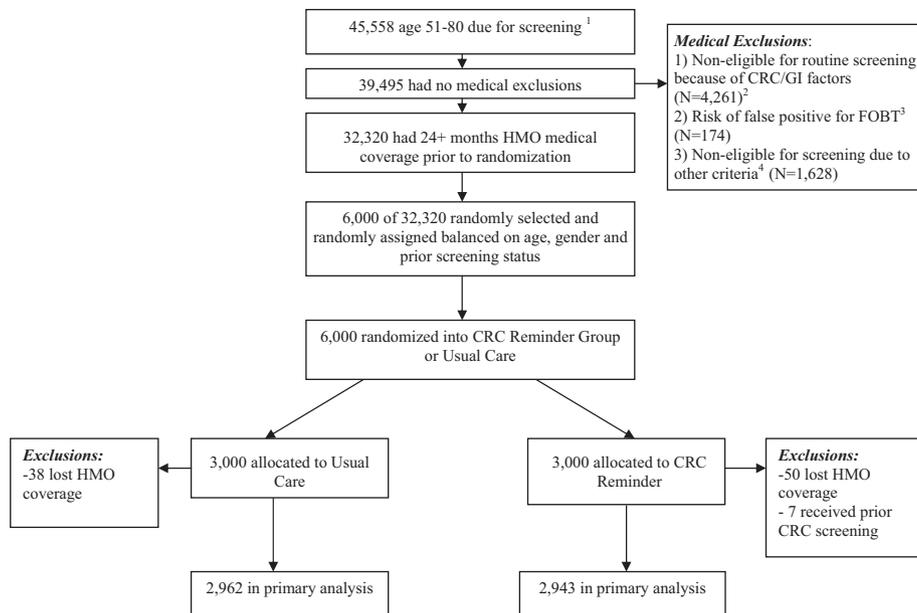
KPNW member demographics (age, sex, and race or ethnicity) are similar to those of the area population. KPNW regional electronic databases provided data on patient membership, demographics, primary care assignment, clinical data, including weight and height, laboratory results, and other healthcare utilization, including CRC screening. These data capture >95% of all medical care and pharmacy services that members receive, and data are linked through each member's health record number.

### Patient Selection

Figure 1 outlines the study design and participant flow during the trial. Our goal in participant selection was to identify an age-eligible population at average risk for developing CRC, for whom CRC screening using FOBT was both appropriate and due. The rationale for selecting FOBT as the primary CRC screening method was based on the USPSTF

report that FOBT is the only evidence-based CRC screening test for those with average CRC risk. Second, on the basis of prior organizational-use trends, the investigators and KPNW clinical experts felt that encouraging FOBT (at a minimum, even if patient also later chose to have endoscopy) was likely to be acceptable to the largest number of people.

We first identified HMO members aged 51 to 80 who did not have any of the following: (1) colonoscopy within 10 years, (2) flexible sigmoidoscopy or double-contrast barium enema (DCBE) within 5 years, (3) FOBT screening within the past 12 months, or (4) a clinician order or referral for FOBT or DCBE in the past 3 months (n = 45,558). We then excluded a total of 6063 patients because of medical conditions that suggested they were inappropriate for CRC screening through FOBT. These included (1) active CRC/gastrointestinal risk factors (n = 4261) in the previous 12 months (referral for chronic diarrhea, esophageal reflux, iron deficiency, polyp follow-up or rectal surgery, diagnosis of adenomatous polyps, diagnosis of HIV/AIDS, or referral for colonoscopy or sigmoidoscopy in the past 3 months); (2) use of medications (n = 174) in the previous 4 months (plavix or warfarin) that elevated the risk of a false-positive FOBT; or (3) other medical conditions (n = 1628) for which routine screening was not indicated (end-stage renal disease, hospice care, or receipt of total colectomy). Of the remaining 39,495 individuals, 7175 were excluded because continuous medical



**FIGURE 1.** Study design and population selection. Eligible patients were due for routine CRC screening (and in whom stool occult blood testing was a clinically appropriate option) and who met other criteria detailed below:<sup>1</sup> Those due for CRC screening who have not had any of the following: (1) colonoscopy within 10 years, (2) flexible sigmoidoscopy or DCBE within 5 years, (3) FOBT screening within past 12 months, or (4) order for FOBT/DCBE in past 3 months.<sup>2</sup> Remove population with (1) active colon cancer/risk factors that would indicate need for disease monitoring, diagnostic testing, or nonroutine screening frequency defined as gastrointestinal referral for chronic diarrhea, esophageal reflux, iron deficiency, polyp follow-up, or rectal surgery in past 12 months, (2) ever diagnosed with adenomatous polyps or HIV/AIDS, or (3) referred for colonoscopy or sigmoidoscopy in last 3 months.<sup>3</sup> Remove population at risk for a false-positive stool occult blood test because of receipt of plavix or warfarin medications in past 4 months.<sup>4</sup> Remove population where screening not indicated due to patient with total colectomy, in hospice care, or with ESRD.

coverage was not maintained for the minimum duration of 2 years before randomization. This left a total eligible patient population of 32,320. We then randomly selected 6000 of these patients for study participation.

### Study Design and Randomization

We conducted an RCT with randomization at the patient level. The 6000 patients were randomly assigned either to receive usual care (UC;  $n = 3000$ ) or automated telephone contacts ( $n = 3000$ ), using a stratified randomization approach, balancing on age, sex, and prior CRC screening. After randomization but before the start of the intervention, 38 patients in UC and 57 patients in the intervention group had either disenrolled from the HMO or received CRC screening. These patients were excluded from the primary analyses.

### Automated Telephone Contact Intervention

#### General FOBT Screening Reminder Calls

The general automated call (call type 1) lasted about 1 minute and provided a brief overview, including information about the benefits of CRC screening, and encouraged FOBT as a relatively simple and low-risk method of cancer screening. Recipients could request FOBT cards by pressing a number via touch-tone telephone. If a live person did not answer, callers heard a detailed message with a telephone number they could call to request cards. Patients who did not complete FOBT screening received up to 2 reminder calls, 6 weeks apart. Call content was identical to the first automated telephone call. Call scripts were developed in close collaboration with KPNW quality improvement and care management staff.

#### FOBT Return Reminder Calls

One additional reminder call was targeted to intervention participants who had requested an FOBT kit but did not return the completed FOBT cards within 4 to 5 weeks from the date of request. The call to nonreturners (call type 2) emphasized the benefits of CRC screening and reminded patients to return completed FOBT cards. Patients were given the opportunity to request additional FOBT cards if needed.

#### Usual Care

Patients randomized to UC did not receive the telephone contact intervention but may have been referred for CRC screening by their clinicians during normal care processes. KPNW clinicians have access to national guidelines, Intranet-based screening guidelines (available since November 9, 2007), and KPNW's "panel support tool," an electronic prompt system embedded in the electronic medical record that informs physicians which patients are overdue for preventive services (including CRC screening) at primary care visits and prompts physicians to order needed services.

#### Study Variables

The primary outcome measure was completion of FOBT during the 6 months after call initiation. FOBT screening used the guaiac method, which required samples from 3 consecutive stools. The secondary outcome was screening

through any USPSTF-recommended CRC screening modality during the RCT and included receipt of FOBT, colonoscopy, flexible sigmoidoscopy, or DCBE.

Explanatory variables included age (51–60, 61–70, 71–80), sex, prior CRC screening status (yes or no, for whether the patient had ever been screened by any method at study site), race or ethnicity (white, nonwhite, or unknown), primary care provider (PCP) assignment (yes or no), obesity status (yes, no, or unknown), and receipt of prior CRC reminder calls (yes or no). Receipt of prior CRC reminder calls included whether a prior automated call was sent to the study population. As part of an ongoing quality improvement effort, eligible patients overdue for CRC screening received similar automated messages as the study population in the RCT. Automated calls began 4 months before the initiation of the RCT, included 1 automated call, and did not target nonresponders. Age was assessed on randomization, whereas race or ethnicity was available at the individual level for 60% of patients, with the remainder being geo-coded.<sup>23</sup> Obesity status was defined as body mass index  $\geq 30$ , if height and weight were available, or  $>250$  pounds if height was not available. Height and weight values were collected as close to the call-initiation date as possible or within a window of 60 months before and 5 months after call initiation. Primary care utilization ( $\geq 1$  visits) was also measured 6 months after call initiation.

### Statistical Analysis

Based on the sample size of 6000, we had 80% power to detect an absolute difference of 2.8% (relative difference of 28.6%), assuming the FOBT return rate was 9.7% in UC versus 12.5% in the intervention group. We used Cox proportional hazard models for the primary analysis of time until completion of FOBT, in days, during the 6-month follow-up period. Group (automated telephone call vs. UC group) was the primary independent variable of interest. The association between completion of FOBT with other factors—age, sex, prior receipt of CRC screening, race or ethnicity, whether or not the patient had a PCP-assigned obesity status, and receipt of prior CRC screening reminder call—were tested with bivariate Cox proportional regression models. Significant associations ( $P < 0.10$ ) were included in the final model as covariates. In addition, we examined whether the intervention effect differed across age groups, sex, and prior CRC screening by testing interaction terms with the intervention group. Interactions with the intervention group were selected to better understand whether subgroups respond differently from one another.

The final Cox model included (1) intervention status (UC [reference group] vs. CRC automated telephone contact group); (2) age (51–60 [reference group] vs. 61–70 and 71–80); (3) age  $\times$  intervention interaction term (intervention  $\times$  age 51–60 [reference group] vs. intervention  $\times$  61–70 and intervention  $\times$  71–80); (4) sex (male [reference group] vs. female), and (5) prior receipt of CRC screening (no [reference group] vs. yes).

**TABLE 1.** Baseline Population Characteristics by Condition

Characteristic	Intervention Group (N = 2943)	Usual Care (N = 2962)
Age (mean ± SD)	60.5 ± 7.6	60.4 ± 7.4
Age categories, n (%)		
51–60	1711 (58.2)	1731 (58.4)
61–70	857 (29.1)	858 (29.0)
71–80	375 (12.7)	373 (12.6)
Sex, n (%) limit to % male or % female		
Male	1469 (49.9)	1474 (49.8)
Female	1474 (50.1)	1488 (50.2)
Received any prior CRC screening*		
Yes, n (%)	904 (30.7)	908 (30.7)
Race/ethnicity,† n (%)		
White	2729 (92.7)	2728 (92.1)
Nonwhite	192 (6.5)	215 (7.3)
Unknown	22 (0.8)	19 (0.6)
Assigned primary care physician		
Yes, n (%)	2702 (91.8)	2688 (90.8)
Obesity status, n (%)		
Yes‡	1170 (39.8)	1153 (38.9)
No	1520 (51.6)	1532 (51.7)
Unknown	253 (8.6)	277 (9.4)
Received prior reminder call§		
Yes, n (%)	395 (13.4)	366 (12.4)
Primary care utilization, 6-mo post call initiation¶	1451 (49.3)	1411 (47.6)

\*Received any of the following before call initiation: (1) colonoscopy >10 years, (2) flexible sigmoidoscopy or DCBE >5 years, or (3) FOBT screening >12 months. Look-back period as far back as HMO membership available.

†Race or ethnicity identified by a combination of self-report data (60%) and geo-coded information (40%).

‡Obesity defined as BMI ≥30 (if height and weight are available) or weight >250 (if weight but no height available). Measures closest to call initiation used in window 60 months before and 5 months after call initiation date.

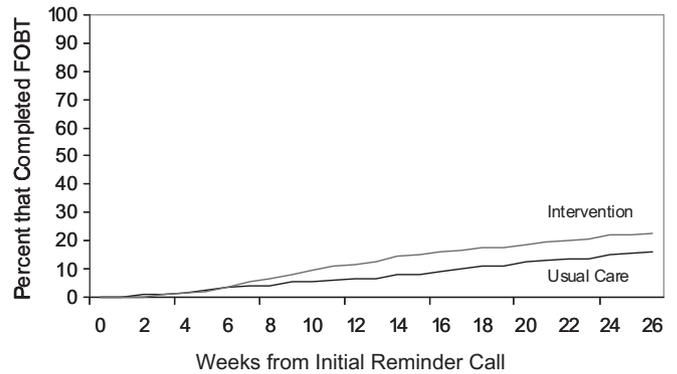
§Received a CRC screening reminder call within the 4 months before call initiation.

¶≥1 primary care visit, 6 months after call initiation.

**RESULTS**

Table 1 presents the baseline characteristics for the CRC reminder population (intervention group) and UC group. No statistically significant differences were found between the 2 populations for any of the baseline characteristics. The mean age was about 60 years. There were nearly equal proportions of men and women, and about 92% were white. Nearly 40% were considered obese. Lastly, about 30% in each condition had ever received any prior CRC screening, nearly 90% were assigned to a PCP, and a similar proportion of each group had received 1 prior CRC screening reminder call (intervention group = 13.4%, vs. UC = 12.4%). Nearly 50% in each group had 1+ primary care visits, 6 months after call initiation.

By 6 months after call initiation, 22.5% in the intervention versus 16.0% in the UC group had completed FOBT, and 23.9% in the intervention versus 17.6% in the UC group had completed any CRC screening method (results not shown). Of the total intervention group, 2943 (100%) received the initial call type 1 (general reminder), 2406 (81.8%)



**FIGURE 2.** Kaplan-Meier curve: time to completion of FOBT ( $P < 0.001$ ). Log-rank test used to assess statistical significance.

received 2 calls of type 1, and 1632 (55.5%) received 3 calls of type 1 (results not shown). Of those that received general reminder calls, 488 of 2943 (16.6%) requested stool cards on the first reminder; 290 of 2406 (12.1%) requested them on the second call; and 85 of 1632 (5.2%) did so on the third general call. Call type 2 (FOBT return reminder) was administered to 18.3% (540 of 2943) of the intervention group.

Figure 2 shows the unadjusted time-to-completion of FOBT curves for both study groups. Overall, a larger proportion of the intervention group completed FOBT over time. This effect seems to begin at about 8 weeks. After maximum effect at about 12 to 14 weeks, there does not seem to be much additional intervention effect, with study group lines becoming and remaining parallel until the end of the observation period. In the unadjusted model, the intervention group was 1.48 times more likely (95% confidence interval [CI], 1.31–1.66) to complete the test than the UC group ( $P < 0.001$ ). Completion of FOBT did not vary by sex ( $P = 0.066$ ), race or ethnicity ( $P = 0.724$ ), whether or not the patient had an assigned primary care physician ( $P = 0.221$ ), obesity status ( $P = 0.108$ ), or receipt of prior CRC automated telephone call ( $P = 0.373$ ), but was associated with age ( $P < 0.001$ ) and prior screening ( $P < 0.001$ ). Only the interaction of age and intervention group was significant ( $P = 0.018$ ).

Table 2 presents the multivariable Cox proportional hazards models predicting time until FOBT. After adjusting for the other variables in the model, those in the CRC reminder group were 1.31 times more likely (95% CI = 1.10–1.56,  $P < 0.001$ ) to complete an FOBT, compared with those in UC. Receipt of prior CRC screening was also strongly associated (hazard ratio [HR] = 2.68; 95% CI = 2.37–3.02;  $P < 0.001$ ) with completion of FOBT screening, when compared with no prior CRC screening. The significant group-by-age interaction revealed that the 71- to 80-year-old group was also more likely to respond to the intervention than the 51- to 60-year-old group (HR = 1.48; 95% CI = 1.07–2.04;  $P = 0.02$ ). Using any CRC screening (including all modalities) as an outcome measure did not substantively change these results.

In additional analysis (results not shown), after removing adults aged 76 to 80 from the final Cox model, those aged 71 to 75 were more likely to complete FOBT (HR = 1.56,

**TABLE 2.** Adjusted Cox Regression Results: Receipt of FOBT—6 Months After Call Initiation

Characteristic	HR	95% CI	P
Experimental condition group*			
Usual care (reference group)	1.00	NA	NA
Intervention group	<b>1.31</b>	<b>1.10–1.56</b>	<0.001
Age			
51–60 (reference group)	1.00	NA	NA
61–70	1.17	0.96–1.44	0.123
71–80	<b>1.30</b>	<b>1.01–1.68</b>	0.045
Interaction term (age × group [UC] or intervention)			
Group × age 51–60 (reference group)	1.00	NA	
Group × age 61–70	1.19	0.91–1.55	0.204
Group × age 71–80	<b>1.48</b>	<b>1.07–2.04</b>	0.018
Gender			
Male (reference group)	1.00	NA	NA
Female	1.04	0.93–1.17	0.501
Received any prior CRC screening <sup>†</sup>			
No	1.00	NA	NA
Yes (reference group)	<b>2.68</b>	<b>2.37–3.02</b>	<0.001

Bolded text indicates statistically significant results.

\*Completed FOBT test 6 months after call initiation.

<sup>†</sup>Received any of the following before call initiation: (1) colonoscopy >10 years, (2) flexible sigmoidoscopy or DCBE >5 years, or (3) FOBT screening >12 months. Look-back period as far back as HMO membership available.

95% CI = 1.16–2.08) than were younger adults aged 51 to 60. Moreover, the overall effect of intervention (CRC reminder call vs. UC) remained significant, even after removing the population aged 71+ (HR = 1.31, 95% CI = 1.10–1.56).

## DISCUSSION

We found that an automated telephone contact intervention for FOBT screening was effective in increasing CRC screening when compared with UC in a population aged 51 to 80 at average risk for CRC. At 6 months, FOBT screening rates were 22.5% in the intervention group and 16.0% for UC. The intervention increased the likelihood of FOBT screening by about 30%, markedly so for patients aged 71 to 80 compared with those aged 51 to 60. Although statistically significant, the effect size of the intervention was modest in that <25% of the intervention population completed FOBT.

Our study findings are consistent with previous research that reported positive effects of telephone contact interventions. Previous studies have found that telephone contact interventions using live callers were associated with increased screening for CRC<sup>16–22</sup> and breast and cervical cancers.<sup>22–26</sup> These interventions are least effective when using telephone contact alone (odds ratio = 1.7–1.9),<sup>22,25</sup> and most effective when using targeted and tailored contacts by telephone and mail (odds ratio = 1.9–4.4).<sup>19,21</sup>

This study is the first randomized trial to examine the effect of an automated telephone contact intervention with CRC screening. Only 1 other study has evaluated the use

of automated calls to improve cancer screening in a similar population overdue for screening: Feldstein et al<sup>27</sup> found that automated telephone calls after a reminder mailing and followed by a live call for nonresponders were effective in increasing use of mammography, compared with UC (HR 1.51; 95% CI = 1.40–1.62). In this study, an informational postcard was sent before delivery of automated calls, and live-callers were used to schedule mammography for nonresponders. The multimodal approach of this intervention may explain the stronger effect size, compared with results found in our study (HR 1.31; 95% CI = 1.10–1.56). The automated call content regarding mammography was similar to the message regarding FOBT delivered in our study. In both studies, respondents were informed of the importance of screening and encouraged to complete screening.

The main finding, that simple automated telephone calls can increase use of FOBT screening, has large implications for real-world medical practices. These types of patient calls could be implemented in a variety of delivery systems. Moreover, the effect size of the intervention may be even stronger in delivery systems that do not have other active system interventions, such as the clinician electronic visit-based CRC screening prompts at this study site (KPNW).

Although this study did not include a formal cost-effectiveness analysis, automated telephone contact interventions are relatively inexpensive compared with live-person telephone-contact interventions. Live-person interventions are often labor-intensive and require hiring telephone staff for implementation. Conversely, automated telephone contact interventions do not require telephone-based staff and are much less resource-intensive. These less-costly interventions can be delivered through public delivery systems, which are often constrained for resources. Moreover, because the intervention's maximum effect occurs by 12 to 14 weeks, automated reminder campaigns do not need to be lengthy, which further reduces delivery costs.

Of particular interest was the finding that individuals aged 71 to 80 were most likely to complete a FOBT in response to automated telephone calls, compared with younger individuals (aged 51–60). Supporting our findings, a recent study that evaluated telephone-based motivational interviewing followed by telephone reminder calls also found that older individuals were more responsive to mailed reminders for CRC screening.<sup>20,21</sup> Although our study did not isolate the reasons for such higher responsiveness, we hypothesize that older individuals are more receptive to the intervention because they are more sensitive to their increased risks for CRC; furthermore, older people are generally home more often to receive calls.

For these 2 reasons, the responsiveness of older participants (aged 71–80) remains important, despite the recent USPSTF guidelines recommending against CRC screening for populations between ages 76 and 85. First, the USPSTF recommendation was based on life expectancy concerns and time needed to benefit from screening but did not largely apply

to this study population, because fewer than 10% of participants were aged 76 to 80. Second, the intervention was equally effective even after removing individuals aged 76 to 80.

Interestingly, although both Rosen and Schneider<sup>28</sup> and Ferrante et al<sup>29</sup> found that obese patients were less likely to complete FOBT screening, our research demonstrated that obesity was not associated with completion of FOBT. It is unclear why our findings differed; more research is needed to fully understand the effect of obesity status on completion of FOBT and CRC screening.

Finally, we found that baseline CRC screening status did not interact with the intervention group. This suggests that the automated messages may be effective for previously unscreened patients and in encouraging repeat CRC screenings. More research is needed to understand what best facilitates a pattern of routine screening.

Although we found increased use of FOBT after implementation of the intervention in KPNW, national trends suggest that colonoscopy is being used over FOBT.<sup>8</sup> Given this trend, we believe that aspects of this automated telephone intervention could be applied to facilitate scheduling of colonoscopy. Feldstein et al<sup>27</sup> found that automated telephone reminder calls resulted in increased mammography use.

This study is not without limitations. First, the magnitude of the results may not be generalizable beyond a group-model HMO setting or populations without telephones. However, notwithstanding this limitation, study results are likely applicable to other delivery systems, given that automated reminder calls are a simple direct-to-patient intervention. Second, the study included few racial or ethnic minorities, which precluded our ability to assess differences in FOBT screening by race or ethnicity. However, the study population was representative of the KPNW population, which is predominantly white, and most members (99%) have telephones. Nevertheless, implementation of automated telephone interventions may have generalizability concerns, because certain subpopulations, such as African-Americans and Hispanics, are more likely to not have telephones compared with the overall US population.<sup>30</sup>

Findings from this research suggest several additional areas for future research. First, work is needed to implement and evaluate automated CRC telephone contact interventions in a variety of public and private delivery systems. Second, more research is needed to better understand provider and patient characteristics associated with noncompletion of FOBT or alternatively a pattern of routine screening. Moreover, given the modest effect size, further methods are needed to strengthen the intervention, perhaps by combining mailings or live calls or both, or switching to a fecal test that is easier to use, such as the fecal immunochemical test.

Last, given advancements in communication technologies, alternative methods for delivering screening reminders, such as e-mail and text messaging, should be tested, especially in younger populations.

## CONCLUSION

We found that an automated telephone contact intervention was effective in increasing CRC screening using FOBT in a population aged 51 to 80 at average risk of CRC,

when compared with UC. The direct-to-patient aspect of automated telephone contact interventions has the potential to increase CRC screening rates in a variety of public and private delivery systems.

## ACKNOWLEDGMENTS

The authors thank the following individuals whose contributions made this research possible: Gail Morgan, Dixie Sweo, Mary Rix, Kara Keel, Heather Block, Stephanie Schoap, Maureen Wright, Mike Lassi, and Andre Smith. This project was supported by grant # R01CA132709 from the National Cancer Institute. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Cancer Institute or the National Institutes of Health.

## REFERENCES

1. Jemal A, Tiwari RC, Murray T, et al. Cancer statistics, 2004. *CA Cancer J Clin*. 2004;54:8–29.
2. American Cancer Society. What are the key statistics for colorectal cancer? Available at: [www.cancer.org](http://www.cancer.org). Accessed February 22, 2007.
3. Winawer SJ, Flehinger BJ, Schottenfeld D, et al. Screening for colorectal cancer with fecal occult blood testing and sigmoidoscopy. *J Natl Cancer Inst*. 1993;85:1311–1318.
4. Mandel JS, Church TR, Bond JH, et al. The effect of fecal occult-blood screening on the incidence of colorectal cancer. *N Engl J Med*. 2000;343:1603–1607.
5. Atkin WS, Cuzick J, Northover JM, et al. Prevention of colorectal cancer by once-only sigmoidoscopy. *Lancet*. 1993;341:736–740.
6. Whitlock EP, Lin JS, Liles E, et al. Screening for colorectal cancer: a targeted, updated systematic review for the U. S. Preventive Services Task Force. *Ann Intern Med*. 2008;149:638–658.
7. Agrawal S, Bhupinderjit A, Bhutani MS, et al. Colorectal cancer in African Americans. *Am J Gastroenterol*. 2005;100:515–523.
8. Centers for Disease Control and Prevention. Use of colorectal cancer test in the United States; 2002, 2004 and 2006. *MMWR Morb Mortal Wkly Rep*. 2008;57:253–258.
9. Swan J, Breen N, Coates RJ, et al. Progress in cancer screening practices in the United States: results from the 2000 National Health Interview Survey. *Cancer*. 2003;97:1528–1540.
10. Seeff LC, Nadel MR, Klabunde CN, et al. Patterns and predictors of colorectal cancer test use in the adult U.S. population. *Cancer*. 2004;100:2093–2103.
11. Seeff LC, Shapiro JA, Nadel MR. Are we doing enough to screen for colorectal cancer? Findings from the 1999 Behavioral Risk Factor Surveillance System. *J Fam Pract*. 2002;51:761–766.
12. Shapiro JA, Seeff LC, Nadel MR. Colorectal cancer-screening tests and associated health behaviors. *Am J Prev Med*. 2001;21:132–137.
13. Coughlin SS, Thompson TD. Colorectal cancer screening practices among men and women in rural and nonrural areas of the United States, 1999. *J Rural Health*. 2004;20:118–124.
14. Nadel MR, Blackman DK, Shapiro JA, et al. Are people being screened for colorectal cancer as recommended? Results from the National Health Interview Survey. *Prev Med*. 2002;35:199–206.
15. Bowie JV, Curbow BA, Garza MA, et al. A review of breast, cervical, and colorectal cancer screening interventions in older women. *Cancer Control*. 2005;12(suppl 2):58–69.
16. Myers RE, Ross EA, Wolf TA, et al. Behavioral interventions to increase adherence in colorectal cancer screening. *Med Care*. 1991;29:1039–1050.
17. Myers RE, Ross E, Jepson C, et al. Modeling adherence to colorectal cancer screening. *Prev Med*. 1994;23:142–151.
18. Dietrich AJ, Tobin JN, Cassells A, et al. Telephone care management to improve cancer screening among low-income women: a randomized, controlled trial. *Ann Intern Med*. 2006;144:563–571.
19. Basch CE, Wolf RL, Brouse CH, et al. Telephone outreach to increase colorectal cancer screening in an urban minority population. *Am J Public Health*. 2006;96:2246–2253.

20. Myers RE, Hyslop T, Sifri R, et al. Tailored navigation in colorectal cancer screening. *Med Care*. 2008;46(9 suppl 1):S123–S131.
21. Myers RE, Sifri R, Hyslop T, et al. A randomized controlled trial of the impact of targeted and tailored interventions on colorectal cancer screening. *Cancer*. 2007;110:2083–2091.
22. Stone EG, Morton SC, Hulscher ME, et al. Interventions that increase use of adult immunization and cancer screening services: a meta-analysis. *Ann Intern Med*. 2002;136:641–651.
23. US Census Bureau. U.S. Census Bureau. American fact finder. Available at: <http://factfinder.census.gov/home/saff>. Accessed June 1, 2009.
24. Rimer BK, Meissner H, Breen N. Social and behavioral interventions to increase breast cancer screening. In: Schneiderman N, Speers M, Silva J, et al, eds. *Integrating Behavioral and Social Sciences with Public Health*. Washington, DC: American Psychological Association; 2001:177.
25. Bonfill X, Marzo M, Pladevall M, et al. Strategies for increasing women participation in community breast cancer screening. *Cochrane Database Syst Rev*. 2001;1:CD002943.
26. Yabroff KR, Mandelblatt JS. Interventions targeted toward patients to increase mammography use. *Cancer Epidemiol Biomarkers Prev*. 1999;8:749–757.
27. Feldstein AC, Perrin N, Rosales AG, et al. Effect of a multimodal reminder program on repeat mammogram screening. *AM J Prev Med*. 2009;37:94–101.
28. Rosen AB, Schneider EC. Colorectal cancer screening disparities related to obesity and gender. *J Gen Intern Med*. 2004;19:332–338.
29. Ferrante JM, Ohman-Strickland P, Hudson SV, et al. Colorectal cancer screening among obese versus non-obese patients in primary care practices. *Cancer Detect Prev*. 2006;30:459–465.
30. Belinfante A. Telephone subscribership in the United States. 2009. Available at: <http://www.fcc.gov/wcb/aitd/stats.html>. Accessed October 5, 2009.