Using a Computer to Teach Patients about Fecal Occult Blood Screening

A Randomized Trial

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OBJECTIVE: To determine whether a multimedia computer program could effectively teach patients about fecal occult blood testing (FOBT) and increase screening rates.

DESIGN: Randomized trial.

SETTING: University-affiliated, community-based Internal Medicine outpatient practice.

PARTICIPANTS: All English-speaking patients aged 50 years and older who were offered FOBT screening by their providers were invited to participate. Two hundred and four patients enrolled in the study. Ten patients were later determined to be ineligible.

INTERVENTIONS: Patients were randomized to either the educational multimedia computer program or usual nurse counseling about FOBT screening. Screening instructions were based on the material pre-printed on each test kit. Educational sessions were held in a private setting immediately after each patient's office visit.

MEASUREMENTS AND MAIN RESULTS: A knowledge-assessment questionnaire was administered in a blinded fashion by telephone the following day. Successful screening was defined as return of the test kits within 30 d. Completion of the FOBT kits was similar in both groups: 62% (58/93) in the computer group and 63% (64/101) in the nurse group ($P=.89$). Mean knowledge scores were also similar, but there was a trend toward increased knowledge mastery in the computer group (56% vs 41%, $P=.09$).

CONCLUSIONS: A multimedia educational computer program was as effective as usual nurse counseling in educating patients and achieving adherence to FOBT screening. Future studies are needed to determine whether computer-assisted instruction can improve health outcomes.

KEY WORDS: computer-assisted instruction; colorectal neoplasms; mass screening; patient education; occult blood.

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Colorectal cancer (CRC) is the second leading cause of cancer-related death in the United States.¹ Recommended screening tests that have been proven cost-effective include fecal occult blood testing (FOBT), flexible sigmoidoscopy, colonoscopy, and double-contrast barium enema.²⁻⁴ Although lower endoscopy is receiving growing attention, FOBT is the screening modality most often recommended by physicians and most preferred by patients.^{5,6}

Despite the proven ability of screening to reduce CRC mortality, fewer than 25% of Americans over age 50 have un-

dergone FOBT screening within the past year, and half are not currently screened for CRC by any modality.^{2,7} According to patients, 2 barriers to screening are lack of knowledge about CRC and confusion about the FOBT screening procedure.^{8,9} At the same time, physicians report difficulty finding the time to educate their patients about preventive medicine interventions.¹⁰⁻¹²

Computer-assisted instruction (CAI), the use of a computer program to deliver an educational message, offers the potential to overcome knowledge barriers and therefore improve screening rates. In contrast to usual office-based counseling or printed materials, CAI can combine graphics, video clips, and audio segments to reinforce the educational message. In addition, CAI standardizes the material being presented and allows patients to proceed at their own pace. Several randomized trials have demonstrated that CAI can increase patients' knowledge about health topics.¹³⁻¹⁸ We are aware of no studies examining whether CAI can improve CRC screening rates.

We hypothesized that CAI could educate patients about FOBT screening more effectively than individual counseling sessions and thereby increase the likelihood that patients will complete the screening procedure. To test this hypothesis, we conducted a randomized-controlled trial comparing a multimedia educational computer program with usual nurse counseling.

METHODS

Study Population

We conducted the study at a university-affiliated community-based Internal Medicine outpatient practice composed of 44 medical residents, 7 attending physicians, and 4 physician assistants. All English-speaking patients aged 50 years and older whose providers offered them routine fecal occult blood screening between July 23, 2001 and April 3, 2002, were invited to participate in this study. Because we conducted the study in a standard office environment, we did not limit the information providers could give their patients about CRC screening prior to referring them for FOBT. We excluded patients with a history of colorectal neoplasia, and patients for whom fecal occult blood testing was ordered for diagnostic purposes, such as to evaluate suspected gastrointestinal bleeding or pathologic weight loss. The Wake Forest University Institutional Review Board approved the study protocol, and all patients gave written informed consent prior to participating in the study.

The authors have no conflicts of interest pertaining to this study.

Preliminary results of this study were presented at the Society of General Internal Medicine 26th Annual Meeting, May 2, 2003, Vancouver, British Columbia.

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Randomization and Data Collection

Prior to randomization, all patients answered a series of up to 8 questions assessing their prior experiences with CRC screening, their attitudes toward screening, and their prior computer experience. A research assistant recorded the patients' responses to each item and gathered basic patient demographic data. Following this data collection, patients were randomized with equal probability using permuted blocks to either the educational computer program or usual nurse counseling about fecal occult blood screening. The block randomization scheme was kept in a computerized data file inaccessible to the research assistant.

Interventions

Educational Computer Program. Using Macromedia Director Version 8 (Macromedia, Inc., San Francisco, Calif), we developed an educational multimedia computer program to teach patients about fecal occult blood screening. A desktop PC with a 19-inch monitor and 3-piece speaker system displayed the program. Patients used a standard 2-button mouse to click on a button on the screen at various times to advance the program to the following segments. A research assistant briefly taught the patients how to use the mouse and observed the patients click on a single object. The patients were then left to view the program without assistance from the clinic staff.

The computer program began with a 2-minute segment on the incidence of colon cancer and the rationale for screening. The program then went on to explain the screening process, including necessary dietary and medication modifications, procedures for sample collection, and sample mailing. The program delivered the educational message by using a variety of computer animations, digital photographs, audio clips of clinic personnel's voices, and digital video segments. The program may be viewed on the internet at <http://intmedweb.wfubmc.edu/cai/fobt.htm>. Screening instructions were based on the "Patient Instructions" segment preprinted on the Hemoccult II Sensa patient test kits (Beckman Coulter, Inc., Fullerton, Calif).

Nurse Counseling. For patients randomized to nurse counseling, an office nurse met with each patient in a private setting to teach them how to complete the FOBT kit. All 6 nurses employed at the study site were instructed to review with each patient the Hemoccult II Sensa test kit's printed instructions (Appendix A, available online). Specific topics included dietary and medication restrictions, proper sample collection technique, and sample mailing. Although the sessions were standardized to the printed instructions, we did not monitor them for specific content or duration.

Fecal Occult Blood Test Kit Distribution. Following either the computerized or nurse-based instructions above, all patients were given a Hemoccult II Sensa serial test kit that contained 3 guaiac-impregnated paper cards, each with 2 windows for sample application. All kits contained standardized written instructions about the screening procedure and an addressed, stamped U.S. Postal Service-approved mailing envelope for the return of the screening cards.

Outcome Measures

The primary outcome of interest was the return of the test kit within 30 d of distribution as defined by postmark.

Secondary outcomes included measures of patients' knowledge of the screening procedure and their attitudes toward CRC screening as assessed by a postintervention questionnaire. The day following enrollment, a research assistant or investigator blinded to the randomization scheme contacted each patient by telephone to complete the questionnaire. The research assistant who enrolled the patients was excluded from making any phone calls. The questionnaire surveyed patients about their perceived risk of acquiring CRC, their beliefs about the utility of FOBT screening, their marital status and educational training, and their knowledge of the screening procedure (Appendix B, available online).

The knowledge assessment portion contained 7 questions (6 multiple-choice, 1 fill-in-the-blank). Four questions focused on how patients should prepare themselves for the screening period, including needed dietary and medication adjustments. The remaining 3 questions focused on how the samples should be collected. All questions related to the FOBT kits' printed instructions, the basis for the computer program, and nurse counseling sessions.

After the questionnaires were completed, the investigators discovered the FOBT kit manufacturer had changed the content of the printed instructions from a prior version. One knowledge question tested information that was no longer included in the instruction sheet. Accordingly, this question was discarded to prevent biasing the results in favor of the computer intervention. All analysis was completed on the remaining 6 questions.

We initially measured knowledge as the number of questions answered correctly. However, after further contemplation, we reasoned that a patient would need to answer at least 5 of the remaining 6 questions correctly in order to complete the screening kit properly. We considered this to be a more clinically significant outcome and defined it as knowledge mastery.

Statistical Analyses

The primary objective of this study was to assess the effect of an educational computer program on patient adherence to FOBT screening. Adherence was operationally defined as the return of the screening cards within 1 month of the patient's clinic visit. According to pilot data collected at the study site, the baseline FOBT adherence rate was 49% over a 6-month period. The study was designed to enroll 400 patients from 2 sites to yield 200 patients in the computer and nurse counseling groups. This sample size would allow us to detect a difference in adherence rates of 15% or more with 80% power. After study initiation, 1 clinic site failed to participate. The revised sample size of 200 patients would allow us to detect a difference in return rates of 20% or more with 80% power, a difference we considered clinically significant.

Univariate and multivariate logistic models were used to assess the effect of the educational computer program alone and after adjusting for other patient characteristics and to determine which patient characteristics were associated with adherence. Variables used in these models included age, gender, race, education (categorized as high school graduate or less vs

more than high school), marital status (characterized as married/living together vs other), insurance status (commercial insurance/Civilian Health and Medical Program of the Uniformed Services (CHAMPUS), Medicare, Medicaid, and personal pay), prior computer experience (yes vs no), prior history of colorectal cancer screening (yes vs no), and self-reported likelihood of complying with annual FOBT screening (very likely, likely, and not sure/unlikely/very unlikely). A backward stepping algorithm was used to remove nonsignificant variables from the model.

A secondary objective of the study was to assess the effect of the educational computer program on CRC screening knowledge as determined by the patients' answers to the remaining 6 knowledge-assessment questions asked during the follow-up survey. We assessed knowledge outcomes by comparing the mean number of questions answered correctly, and by comparing the proportion of patients who achieved knowledge mastery as defined above. Because we considered knowledge mastery to be the more clinically significant measure, we used univariate and multivariate logistic regression analyses, adjusted for the same covariates included in the adherence model above, to determine which factors were associated with this outcome.

RESULTS

A total of 204 patients were randomly assigned to receive usual nurse counseling or the multimedia educational computer program about FOBT screening. After randomization, 10 patients were determined to be ineligible and were therefore excluded from analysis, leaving 101 patients in the nurse arm and 93 patients in the computer arm (Fig. 1).

Baseline characteristics for the 194 eligible patients are shown in Table 1 and are similar for the 2 intervention groups. The majority of participants were black, slightly more than 60% were female, most were single, half had not graduated from high school, and few had ever used a computer. Ages ranged from 50 to 86 years with a median of 60. In addition, the majority of patients (65%) had never received any screening test for colon cancer (FOBT, flexible sigmoidoscopy, or colonoscopy).

Although most of the participants had never used a computer, the majority had no difficulty using the mouse and successfully navigating the program. Eleven of the 92 participants

Table 1. Baseline Patient Characteristics by Intervention Group*

Characteristic	Nurse Counseling # (%)	Computer Program # (%)
Total	101 (100)	93 (100)
Age—median (range)	59 (50 to 86)	60 (50 to 83)
Gender		
Female	60 (59)	59 (63)
Race		
Black	73 (72)	67 (72)
White	28 (28)	26 (28)
Education		
< 12th grade	37 (52)	30 (48)
High school graduate	23 (32)	17 (27)
Post-high school	11 (15)	15 (24)
Current marital status		
Married/living together	9 (13)	12 (19)
Other	61 (87)	50 (81)
Insurance status		
CHAMPUS/commercial	6 (6)	8 (9)
Medicare	50 (50)	43 (46)
Medicaid	18 (18)	15 (16)
Personal pay	27 (27)	27 (29)
Computer use		
Daily/weekly	7 (7)	7 (8)
Monthly/yearly	11 (11)	9 (10)
Never	83 (82)	77 (83)
Screening history		
Never screened	64 (63)	63 (68)
Ever screened		
With FOBT	33 (33)	28 (30)
With flexible sigmoidoscopy	20 (20)	18 (19)
With colonoscopy	15 (15)	6 (6)
Screening current†	23 (23)	17 (18)
Intent to comply with annual FOBT		
Very unlikely/unlikely/not sure	11 (11)	6 (6)
Likely	37 (37)	41 (44)
Very likely	53 (52)	46 (49)

*Not all patients answered all questions. None of the differences between groups are statistically significant.

†Screening current defined as receiving FOBT within prior 12 months, flexible sigmoidoscopy within 5 years, or colonoscopy within 10 years. FOBT, fecal occult blood testing.

FIGURE 1. Study enrollment.

(12%) in the computer group chose to have a family member work the computer for them or encountered difficulties requiring further direction from the research assistant. The time spent using the computer program ranged from 6.4 to 16.4 minutes with a median of 8.0 minutes.

The primary outcome was whether or not the patients returned their test kits within 30 d. Overall, 63% (64/101) of patients in the nurse counseling group and 62% (58/93) in the computer group returned their cards within this time frame (95% confidence interval for difference −15% to +13%, $P=.89$, χ^2 test). An additional 8 patients in the nurse counseling group and 3 patients in the computer group returned their cards later after a reminder letter was sent. When including these late returners in the analysis, we still found no significant difference in return rates ($P=.42$).

Logistic regression was used to examine the association between baseline patient characteristics and successful return of the test kits. Those most likely to return their test kits on time were females (71% vs 51% of males, $P=.006$) and patients with a prior history of CRC screening (79% vs 54% of those with no screening history, $P<.001$). These results were con-

Table 2. FOBT Knowledge and Attitude Results by Intervention Group*

Outcome	Nurse Counseling n=101 # (%)	Computer Program n=93 # (%)
Completed follow-up survey	71 (70)	63 (68)
Questions (n=6) answered correctly		
Mean (SD)	4.1 (1.1)	4.3 (1.3)
Self-reported intent to comply with annual FOBT		
Less likely than baseline	24 (34)	18 (29)
Same as baseline	33 (47)	34 (54)
More likely than baseline	13 (19)	11 (17)
Perceived risk of CRC		
Very low/low	27 (39)	30 (50)
Average	32 (46)	18 (30)
High/very high	11 (16)	12 (20)
Utility of FOBT for early detection		
Not useful/a little/moderately	12 (18)	9 (15)
Quite a bit	25 (37)	17 (29)
Extremely useful	31 (46)	33 (56)

*Not all subjects answered all survey questions. None of the differences between groups are statistically significant.
FOBT, fecal occult blood testing; CRC, colorectal cancer.

sistent in both the univariate and multivariate models. No statistically significant association was found for treatment arm, age, race, education, marital status, insurance status, computer experience, or patients' self-reported intent to receive annual screening.

Approximately 70% of participants completed the follow-up telephone survey the day after their office visit (70% of nurse group, 68% of computer group). Only gender was significantly associated with completing the follow-up survey (76% of females vs 59% of males, $P=.01$). Of the 60 participants not completing surveys, 35 were unavailable at their phone numbers on 3 attempts, 4 had no working phone, 2 gave the wrong phone number, 4 refused to take the survey, and 15 were not called by study personnel.

Survey results are shown in Table 2 for each group. Participants' attitudes about FOBT screening, their self-reported intentions to be screened, and their mean knowledge scores were similar in both groups. More patients in the computer

group achieved the benchmark of knowledge mastery (≥ 5 correct responses) compared with the nurse group, with a trend toward statistical significance (56% vs 41%, $P=.09$). Only gender and education were associated with knowledge mastery with female patients and those with a post-high school education more likely to answer at least 5 of the questions correctly (Table 3).

DISCUSSION

To our knowledge, ours is the first study examining the potential ability of CAI to increase CRC screening. We found that an educational multimedia computer program was as effective as nurse counseling, resulting in similar FOBT completion rates and a trend towards higher knowledge scores. In addition, our computer-based intervention was easily incorporated into routine office visits and was accessible to computer-naïve, relatively uneducated patients. Although over 80% of the study subjects had never used a computer, fewer than 15% encountered difficulties with the program.

We chose to compare our computer intervention with nurse counseling because this was the standard practice at the study site. However, teaching patients about screening can be a time-consuming and resource-intensive process. In our study, patients spent an average of 8 minutes with the computer program. Assuming a health care provider would spend the same amount of time to educate each patient, counseling 1,500 patients over the course of one year would require 10% of a full-time provider's effort. In comparison, CAI requires little staff oversight and is accessible to any office with a personal computer. With physicians frequently reporting inadequate time with patients, CAI is a potentially time-saving and cost-effective patient education solution.¹⁹

Because we compared our computer program with nurse counseling, we cannot comment on its effectiveness relative to other less intensive interventions such as the distribution of brochures or screening kits without further counseling. However, studies of other health conditions have found that patients using CAI had higher knowledge retention than patients who were given traditional printed materials.^{17,20} Furthermore, many patients prefer CAI over educational pamphlets.^{13,21}

Our finding that over 60% of patients in both the computer and nurse counseling groups returned their FOBT kits was unexpected. Prior to study initiation, nurse counseling about FOBT screening was the study site's standard practice, and the FOBT completion rate was 49%. Although patients were unaware that we were tracking completion rates, being enrolled in our study may have encouraged adherence through indirect mechanisms. This increased adherence may have reduced our ability to detect any difference in return rates.

Our computer intervention was designed primarily to reduce knowledge barriers and therefore increase self-efficacy as described by Bandura's Social Cognitive Theory.²² Factors other than knowledge also affect patient adherence to FOBT screening. Prior studies have cited patients' concerns about the inconvenience of testing, embarrassment, or anxiety about potential results as barriers to FOBT screening.^{23,24} In addition, patients are more likely to accept screening if they believe they are susceptible to CRC and that screening is beneficial.²⁵ While we did ask patients to rate their perceived risk of CRC and the usefulness of FOBT screening, we did not attempt to measure specific attitudes or their family history of cancer.

Table 3. Multivariate Associations Between Baseline Characteristics and Knowledge Mastery*

Variable	N	Achievement of Knowledge Mastery	
		# (%)	Odds Ratio (95% CI) [†]
Intervention group			
Computer program	63	35 (56)	1.5 (0.7 to 3.2)
Nurse counseling	71	29 (41)	
Gender			
Female	90	49 (54)	2.5 (1.1 to 5.6)
Male	44	15 (34)	
Education			
More than high school	26	19 (73)	3.9 (1.5 to 10.4)
High school or less	107	44 (41)	

*Knowledge mastery defined as answering at least 5 of 6 questions correctly.

[†]Only gender ($P=.02$) and education ($P=.007$) were statistically significant predictors of knowledge mastery.
CI, confidence interval.

Our study does have additional limitations. First, as with any single-site study, our results may not be generalizable to other settings. Second, we did not measure what information providers may have given their patients about CRC screening before referring them for FOBT. However, we would not expect this information to vary by randomization arm. Third, although all nurses were instructed to review the printed FOBT instructions with the patients, we did not monitor the individual nurse counseling sessions for their content or duration. We also did not attempt to measure individual nurse's counseling skills, although all nurses had several years of experience. Lastly, we were unable to obtain knowledge results for 30% of our study sample, the most common reason being that patients were unavailable at their phone numbers on 3 attempts.

In summary, we found that a multimedia computer program was as effective as individual counseling in educating patients and achieving adherence to FOBT screening. Because CAI is an effective educational tool, it promises to be a resource-saving option for time-constrained health professionals. Further studies are needed to investigate ways in which CAI might improve health outcomes.

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Supplementary Material

The following supplementary material is available for this article online:

Appendix A. Patient Instructions—Hemocult® Sensa® Slide.

Appendix B. Knowledge and Attitude Questionnaire.