

Improving Endoscopy Completion: Effectiveness of an Interactive Voice Response System

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Colorectal cancer (CRC) is the third leading cause of cancer deaths in the United States.¹ Colonoscopy and flexible sigmoidoscopy (FS) are used to detect precancerous and cancerous polyps in the colon and rectum. Recent evidence-based screening guidelines prioritize these tests over other screening modalities because they can prevent CRC rather than simply detect it early.²

National CRC screening rates remain low compared with frequencies of other cancer screening tests.³ Likewise, completion rates of follow-up diagnostic tests after a positive screening test result are low. In a study⁴ conducted through the Veterans Health Administration, where screening rates are typically higher than in other settings, only 44% of those with a positive fecal occult blood test result completed a diagnostic colonoscopy within 12 months. Even when appointments are scheduled, screening completion rates are low, with a study⁵ finding that only 44% of those scheduled for a colonoscopy and 59% of those scheduled for an FS completed their examination. Clinicians, researchers, and patients agree that preparation for endoscopy examinations is complex and can be difficult but needs to be performed properly to complete the examination.⁶ In addition to finding transportation home after the procedure, other barriers to endoscopy that reduce attendance and completion rates include the following: fear of positive findings⁷; poor understanding of the procedure⁸; discomfort, embarrassment, and anxiety about the procedure⁹; forgetting the appointment^{10,11}; lack of patient self-efficacy¹²; and worries and concerns about the procedure and an absence of symptoms.¹³ Studies have found that patient education¹⁴ and appointment reminder phone calls¹¹ significantly reduce appointment cancellations. Other researchers have found that education can lead to higher endoscopy completion rates, especially when information is delivered multiple times and in understandable formats.¹⁵

Using innovative cost-effective approaches for improving FS and colonoscopy completion rates might benefit patients by assuring essential and timely care that could reduce morbidity and mortality. A novel approach used in other healthcare settings is an interactive voice response (IVR) system, an automated phone-based technology that allows for 2-way communication between clinics and patients. Interac-

tive voice response is a mode of message delivery that has been shown to be effective in medical contexts.^{16,17} It allows for calls to be delivered at any appointed

Objective: To test whether an interactive voice response (IVR) system phone call was equally effective as a nurse-delivered phone call at educating and preparing patients for flexible sigmoidoscopy (FS) and colonoscopy examinations.

Study Design: Three-arm randomized controlled trial.

Methods: The trial included patients with upcoming FS or colonoscopy appointments to test the equivalence of an IVR system to nurse-delivered phone calls in reducing appointment nonattendance and inadequate preparation for an examination. Message timing and satisfaction with the intervention were assessed. The 3 study conditions included the following: nurse phone call 7 days before the procedure, IVR system call 7 days before the procedure, and IVR system call 3 days before the procedure. All calls included an appointment reminder, information about preparation for the examination, and encouragement to prepare for and attend the examination.

Results: A total of 3610 patients were eligible for the study; of these, 1229 (34%) were scheduled for FS and 2381 (66%) for colonoscopy. There were no statistically significant differences across the 3 study arms in appointment attendance or adherence to preparation instructions. Significantly more patients in IVR conditions reported neutral perceptions about the phone calls, and more patients receiving nurse calls reported very positive perceptions about the phone calls.

Conclusion: An IVR system call is as effective as a nurse phone call for ensuring that patients attend appointments and are adequately prepared for endoscopy examinations.

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Take-Away Points

An interactive voice response (IVR) system, an automated phone-based technology that allows for 2-way communication between clinics and patients, was used to remind patients of upcoming flexible sigmoidoscopy and colonoscopy appointments and to provide them with information about how to prepare for the examination. Our findings include the following:

- The IVR system was effective at reminding patients of their appointments.
- An IVR system can effectively deliver complex information, such as preparation information.
- An IVR system is equally effective as phone calls from clinic nurses at delivering information.
- Patients receiving IVR messages reported more “neutral” perceptions about the phone calls; patients receiving nurse calls reported more “very positive” perceptions about the phone calls.

time and for information to be repeated, both of which increase the likelihood that the call will be delivered and received. For example, phone appointment reminders delivered via IVR have been shown to increase appointment adherence and preappointment procedure completion¹⁸ and to decrease appointment nonattendance.^{16,17,19-27} Fewer studies²⁸⁻³¹ have used IVR to deliver educational messages.

Guided by models of behavior change³² and social marketing principles,^{33,34} we developed an IVR system that provided patients with cues to action for appointment attendance and procedure preparation, including targeted educational information about susceptibility and severity of CRC and motivational messages that addressed risks, benefits, barriers, and self-efficacy associated with preparation and procedures. Our objectives were to assess the following: (1) the equivalence of theory-based phone messages and education provided by an IVR system and by nurse-delivered calls (NDCs) in promoting appointment attendance and adherence to preparation instructions for FS and colonoscopy, (2) the effect of the timing of IVR messages delivered 3 days versus 7 days before the scheduled appointment, and (3) any differences in patient satisfaction between IVR messages and NDCs.

METHODS

Design

We conducted a 3-arm randomized controlled trial among patients with upcoming FS or colonoscopy appointments scheduled in 2 gastrointestinal (GI) endoscopic procedure clinics at the Minneapolis Veterans Affairs Medical Center. Patients included those being screened and those having follow-up appointments after receipt of abnormal test results. While these clinics provide both upper and lower GI examinations, we included only the 2 lower GI examinations (FS and colonoscopy) because they comprise 67% of the endoscopic workload and because 69% of all cancellations in these clinics are for these 2 procedures.

During the study period, an automated program was applied each night to the hospital computerized record system to identify new appointments made in the clinics. Patients scheduled for an appointment were evaluated for study eligibility criteria (described herein). Those eligible were randomized to 1 of 3 study arms, with the randomization stratified by procedure type. Clinic procedure nurses and physicians were blinded to the randomized conditions. Study arms included the following: (1)

NDC (phone call from a nurse 7 days before the procedure), (2) IVR7 (phone call from the IVR system 7 days before the procedure), and (3) IVR3 (phone call from the IVR system 3 days before the procedure). The NDC was the clinic's usual care procedure. For the intervention to be unobtrusive to clinic staff and to retain blinding to the intervention condition, an NDC at 3 days before the procedure was not included. Intervention calls were initiated from a Minneapolis Veterans Affairs Medical Center computer server running a software program (AudioCARE; AudioCARE Systems, Berwyn, PA), and NDCs were initiated by nurses in the recovery room of the GI clinic.

Appointment and GI procedure data, including patient appointment records and procedure notes for the initial scheduled appointment, were extracted from medical records to assess study outcomes for all condition arms. Additional patient health information was extracted, including diagnoses of chronic physical and mental health conditions in the year before the index appointment.

One week following the initial appointment, patients were sent a questionnaire about their experiences with the reminder system and the scheduled procedure. The questionnaire asked patients if they recalled a preappointment phone call, the type of call (whether an IVR message or an NDC was received), and (if they received the call) their opinion about the thoroughness of preparation instructions. If they prepared for and attended their appointment, they were also queried about their experiences with the preparation and procedure and any perceived barriers and facilitators to appointment attendance and procedure preparation. Questionnaires were mailed directly to participants' homes by study staff.

Patients

All patients scheduling an FS or a colonoscopy appointment between August 20, 2007, and October 31, 2008, in either clinic were assessed for study inclusion. Patients were ineligible for the study if, based on a medical record review

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before randomization, they lived in a nursing or group home or a homeless shelter, had no listed phone number, scheduled the appointment less than 8 days in advance, had multiple GI procedures scheduled for the same day (such as patients with both upper and lower GI procedures), or had a diagnosis of type 1 diabetes mellitus, dementia, or Alzheimer's disease. These patients had unreliable means of receiving the intervention (eg, no phone), or the IVR system would have provided inappropriate or inaccurate information (eg, based on their health conditions).

Procedures

Intervention. More than 95% of the FS and colonoscopy appointments were scheduled within 40 days before the appointment; 85% were scheduled 20 to 40 days before the appointment. The clinic protocol was to mail all patients their appointment information, preparation instructions, and preparation materials within 1 week after their appointment was made. For patients in the NDC arm, a recovery room nurse attempted to call to remind patients of the appointment and review preparation instructions 7 days before the appointment. Nurses used computerized templates to guide them through the call. The templates, one for FS and another for colonoscopy, included logistical information about the appointment (such as time, place, what to bring, and whether the patient needed someone to drive him or her home) and preparation instructions (such as what medications to stop and how and when to take the prescribed colon cleansing laxatives). Nurses also answered any questions during the call. An NDC was considered complete if a nurse spoke directly with the patient. Per clinic protocol, nurses did not leave any message if a patient was not reached, but made 1 more attempt the following afternoon. If that call was unsuccessful, no message was delivered.

Patients in the IVR study arms (IVR7 and IVR3) were mailed appointment information and preparation instructions and materials identical to those mailed in the NDC arm. Instead of NDCs, they received appointment reminder information and preparation instructions via an IVR system.

There is no evidence base concerning effective time frames for prompting patients. We selected a 7-day window based on current NDC practices and protocol and a 3-day window because this was the day before patients were to start the colon cleansing preparation, and we hypothesized that the immediacy of the message might be a cue to action. While the IVR system allows for calls to be delivered at any time, patient preferences for the time of day to be called for the NDC were unknown. Phone calls were programmed to start in the morning. If an answering machine picked up on the initial call, the IVR system left a general message about

the purpose of the call. The system was programmed to call again in the afternoon and then again in the evening until the patient answered. Messages were left only on the first attempt. If the IVR call was not completed that day, the process was repeated the following day. Patients who answered the call had the option to have the system call back at a later time. An IVR call was considered complete if the patient answered and confirmed his or her appointment.

The IVR system allowed patients to verify and confirm their appointment, respond to instructions about logistics, request additional preparation materials, answer queries about their current health, listen to preparation instructions, have any information repeated, ask for a summary of instructions, or leave a message for a nurse who would call back within 24 hours. Embedded in these messages was the educational information about susceptibility and severity of CRC, as well as motivational messages that addressed risks, benefits, barriers, and self-efficacy associated with preparation and procedures. At any time during the call, the patient could request to be transferred to the clinic to leave a message for a nurse.

Process Measures. To assess whether the intervention was delivered in a uniform way, we collected details about the appointments and then calculated the proportion of attempted and completed calls for each study condition. Attempted and completed IVR calls were collected via the IVR system, while attempted and completed NDCs were recorded on the computerized nurse template. For the IVR system, the proportion of requests to be transferred to the clinic was also assessed and compared across IVR arms. The mean number of attempts made before reaching the patient was also calculated, and the total time spent on the IVR call was recorded. For NDCs, these data were unavailable; however, for the number of attempted calls, the nurse protocol was to make a maximum of 2 attempts to reach each patient.

Survey. All randomized patients were mailed a questionnaire regardless of appointment attendance. The questionnaire was based on health belief model³² constructs and assessed attitudes and beliefs about preparing for and completing an endoscopy examination. Sent with an introduction letter, postage-paid return envelope, and \$5 unconditional cash incentive, the 12-page survey included questions about perceived disease susceptibility and severity and about benefits, barriers, and self-efficacy relative to completing an endoscopy examination. We also included questions about satisfaction with the reminder phone calls and about general patient demographics, including age, employment status, race/ethnicity, education, income, and marital status. Using a modification of the method by Dillman et al,³⁵ we mailed a reminder postcard 14 days after the survey was sent. A second survey packet without the incentive was sent to nonresponders 21 days after

the initial mailing. Study staff phoned patients 28 days after the initial mailing to remind them about the survey but did not attempt to administer the questionnaire over the phone.

Hypotheses

We hypothesized that equal proportions of patients in the NDC and IVR conditions (1) would not attend their scheduled FS or colonoscopy appointment and (2) would not have thorough bowel preparation for the scheduled FS or colonoscopy. Likewise, we hypothesized that equivalent proportions of patients would be nonadherent to appointment attendance and preparation instructions when the intervention message was delivered 3 days versus 7 days before the index appointment date. Finally, we hypothesized that patients in the NDC arm would have a more positive perception of the calls than those in the IVR arms.

Sample Size

The standard equivalence test (at a .015 significance level) examines whether a 97% 2-sided confidence interval for a difference in outcome rates falls within a prespecified equivalence boundary. Because no literature specifies the clinically significant difference in completion rates, we relied on clinician experts to specify the equivalence boundary. Four practicing gastroenterologists were queried about their perceptions of equivalence. The unanimous opinion was that at least a 10% difference in completion rates would be clinically significant and that anything less than 10% would be considered equivalent.

Clinic data from a 6-month period before the study (December 2006 through May 2007) showed appointment completion rates of 67% and 62% for FS and colonoscopy, respectively. Using an equivalence boundary of 0.10, a sample size of 743 subjects per group provided 90% power for the study with a level of .05 divided by 3 and an underlying 65% baseline completion rate. We initially planned to obtain 743 patients in each study arm for each procedure, but changes in clinic practices after the study planning prohibited recruitment of sufficient numbers of FS cases.

Outcome Measures

The study evaluated the following 2 main outcomes: appointment nonattendance and preparation nonadherence. Nonattendance was defined as canceling the appointment or not attending the appointment. We did not consider appointments canceled by the clinic as nonattendance. Preparation nonadherence assessed whether patients had adequately prepared to complete the procedure. We used procedure notes to determine if the patient was adequately prepared or if the physician was unable to evaluate the quality of the prepara-

tion. Four participants arrived for their appointment but were then deemed inappropriate for the procedure because of serious complicating health conditions. These 4 patients were excluded from analyses.

Perceptions of preappointment phone calls were measured using a survey question about how satisfied respondents were with the reminder phone calls. Response options were “very positive,” “positive,” “neutral,” “negative,” or “very negative.”

Analysis

All hypotheses were tested separately for FS and colonoscopy using intent-to-treat analysis. To test whether outcomes for NDCs and IVR messages were equivalent and whether the 2 IVR interventions were equivalent, we constructed 2-sided 97% confidence intervals for the difference in completion rates, with the confidence level chosen as a Bonferroni multiple comparisons adjustment for the main comparisons. If the confidence interval fell within -10% and 10%, the conditions were considered equivalent.

To address potential survey response bias, we estimated response propensities using administrative measures available for all subjects, stratified the sample into strata with estimated propensities within .05 of one another, and verified the balance of the covariate measures between respondents and nonrespondents within strata. We estimated treatment differences using weighted means of within-stratum differences, weighting by the sample proportions of the strata. Likelihood ratio tests comparing a generalized linear model using only stratum as a predictor and a model using stratum, treatment, and their interaction were used to test for differences.

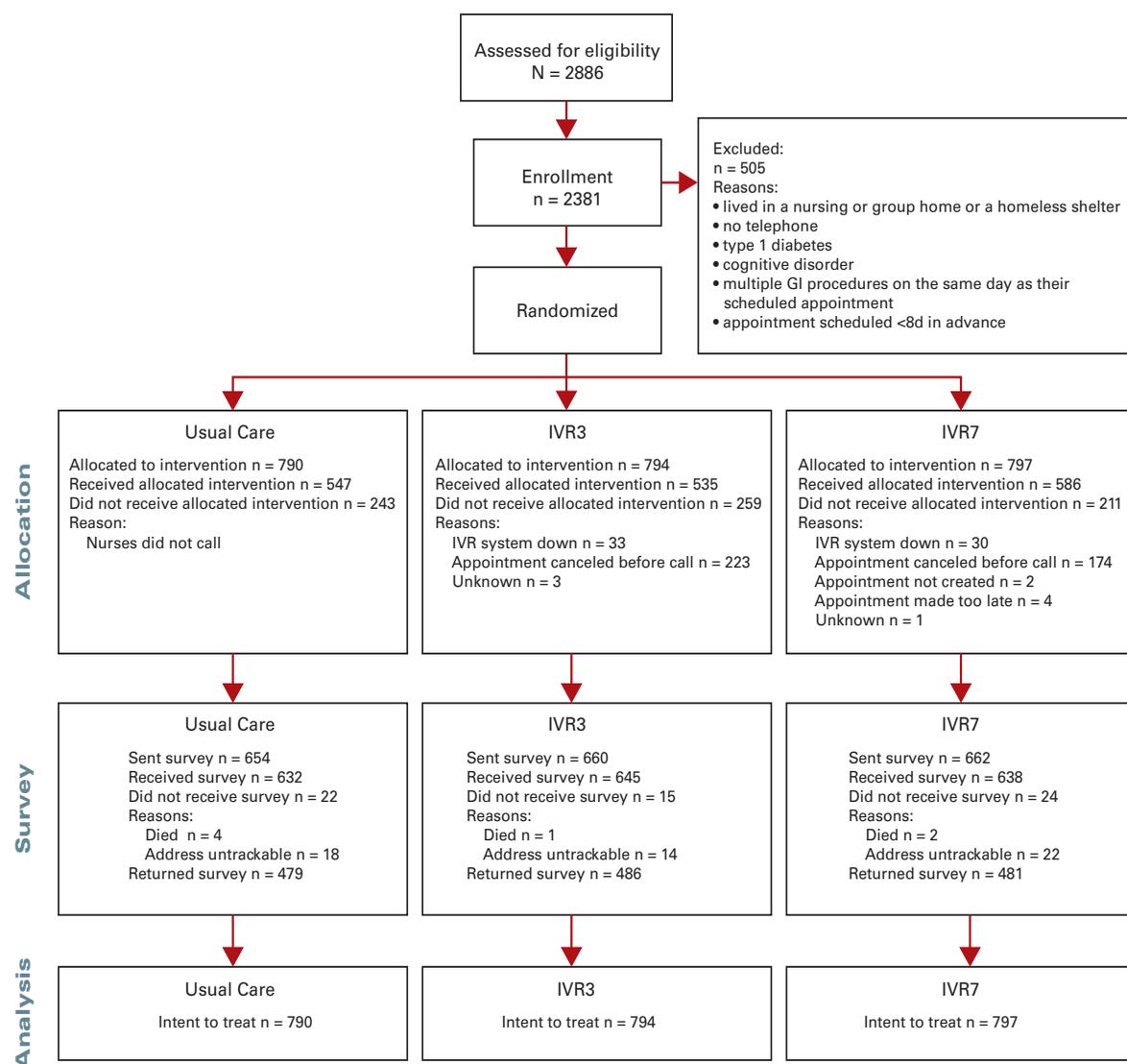
To assess whether the intervention was implemented uniformly across patients in the intervention arms, appointment details (including distance traveled to the appointment, appointment day and time, and proportion of attempted and completed calls) were compared across intervention arms.

RESULTS

Figure 1 and **Figure 2** show the flow of participants for the intervention and survey using Consolidated Standards of Reporting Trials guidelines.^{36,37} A total of 3610 patients were eligible for the study. Of these, 1229 (34%) were scheduled for FS and 2381 (66%) for colonoscopy. Approximately 36% of all procedures were for screening, while the others were for diagnosis or surveillance.

Because of study modifications, questionnaires were approved by the institutional review board 6 weeks after initiation of the intervention trial. The protocol was to survey within 1 week of the initial appointment to assure that patients were assessing the initial appointment and not subse-

■ **Figure 1.** Flow Chart for Participants Scheduled for Colonoscopy



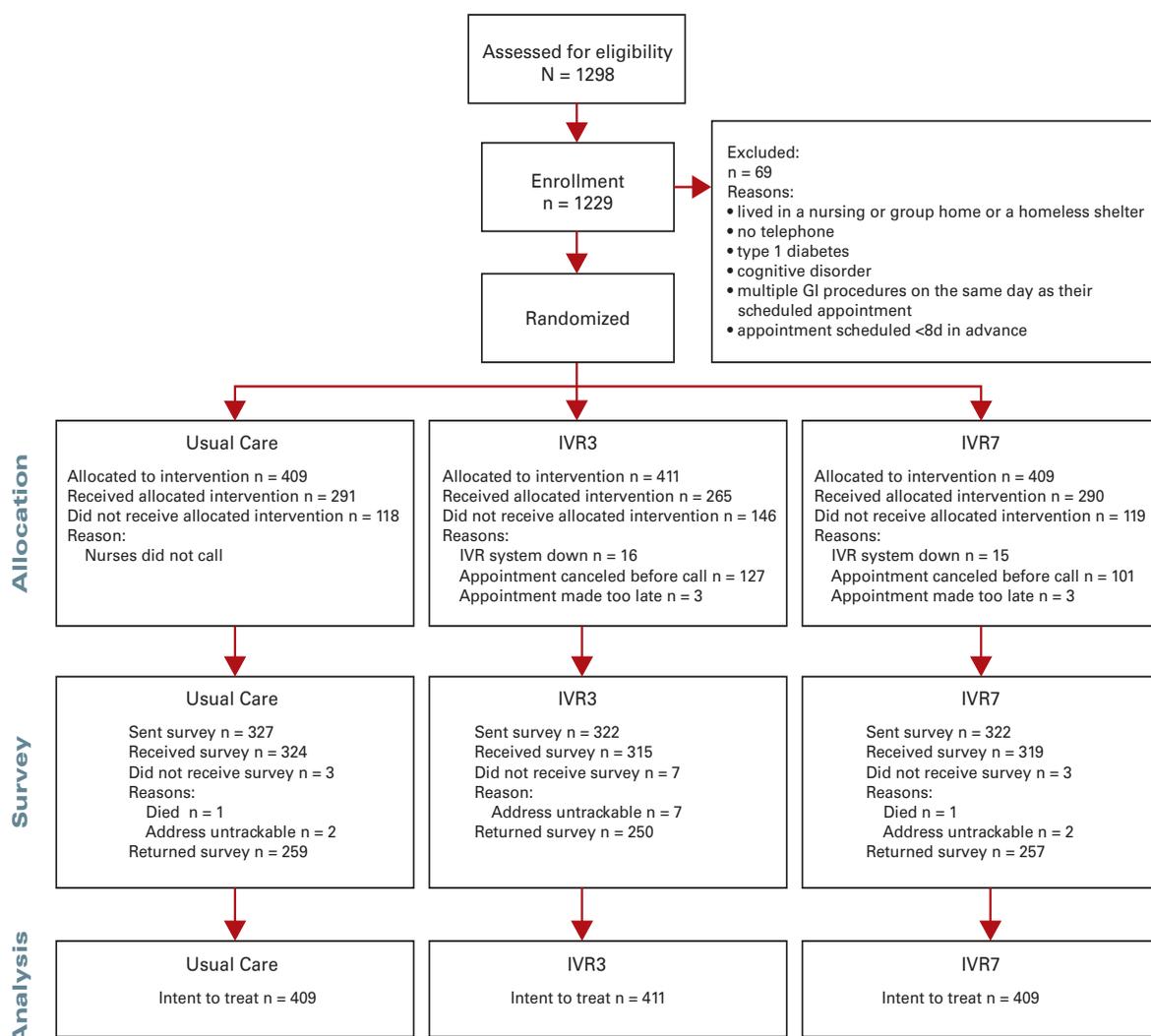
GI indicates gastrointestinal; IVR3, interactive voice response message 3 days before procedure; IVR7, interactive voice response message 7 days before procedure.

quent appointments. Therefore, the number of questionnaires did not equal the number of patients eligible for the trial. We mailed questionnaires to 2947 of 3610 patients (82%) eligible for the trial. Of those, almost 75% returned a questionnaire, 7% refused, almost 3% had either died or did not have a valid address, and 15% did not return a questionnaire. Response rates for FS and colonoscopy patients were almost equal, as were the rates across study conditions and outcomes.

There were no significant differences in age, sex, marital status, race/ethnicity, employment status, education, or yearly income across the 3 study arms (Table 1). In separate analyses for FS and colonoscopy (data not shown), there were no significant differences in patient demographics across intervention arms.

For FS and colonoscopy, appointment nonattendance and preparation nonadherence were equivalent across all 3 study arms (Figure 3). For colonoscopy, 38%, 42%, and 41% did not attend in the IVR7, IVR3, and NDC arms, respectively; likewise, 40%, 44%, and 44% did not have adequate preparation in the IVR7, IVR3, and NDC arms, respectively. For FS, 38%, 41%, and 40% did not attend in the IVR7, IVR3, and NDC arms, respectively, while 40%, 42%, and 41% did not have adequate preparation in the IVR7, IVR3, and NDC arms, respectively. Timing of the IVR message did not influence appointment attendance or preparation adherence. Comparing colonoscopy patients in the IVR7 versus IVR3 arms, participants were equally likely to not attend their ap-

■ **Figure 2.** Flow Chart for Participants Scheduled for Flexible Sigmoidoscopy



GI indicates gastrointestinal; IVR3, interactive voice response message 3 days before procedure; IVR7, interactive voice response message 7 days before procedure.

pointment (39% vs 42%) or to not prepare adequately (40% vs 44%); findings were similar for FS, with 38% versus 41% not attending appointments and 40% versus 42% not adequately preparing.

As summarized in **Table 2**, most colonoscopy and FS patients had very positive or positive reactions to both IVR messages and NDCs; less than 6% in any study condition had negative or very negative perceptions about the call. There were no significant differences in perceptions of experiences across conditions for the FS group. However, for the colonoscopy group, significantly more patients who received the NDC versus the IVR3 versus the IVR7 (35% vs 21% vs 26%) had very positive perceptions about the call. Almost equal proportions had positive perceptions. However, more colonoscopy patients had neutral

perceptions about the call in the IVR3 versus the IVR7 (27% vs 20%) and in the IVR3 versus the NDC (27% vs 18%) ($P < .01$ for both). Across both IVR and NDC arms, more patients with very positive perceptions about the call attended their appointments and prepared appropriately, while fewer patients with neutral perceptions attended their appointments and prepared appropriately (data not shown).

Process Outcomes

On average, appointments were made 28 to 29 days in advance and did not vary by study arm. Appointment day or time also did not vary by study arm. Differences in proportion of received calls between IVR groups were not significantly different for colonoscopy (56% for NDC, 51% for IVR7, and

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■ **Table 1.** Demographics for the Total Study Sample and by Intervention Arm^a

Demographic	Total Study Sample (n = 3610)	Study Arm			P
		NDC (n = 1199)	IVR3 (n = 1205)	IVR7 (n = 1206)	
Age, mean (SD), y	62.6 (10.1)	62.6 (9.9)	62.8 (10.2)	62.5 (10.2)	.76
Sex, No. (%)					.90
Male	3456 (95.7)	1149 (31.8)	1151 (31.9)	1156 (32.0)	
Female	154 (4.3)	50 (1.4)	54 (1.5)	50 (1.4)	
Marital status, No. (%)^b					.80
Single	1505 (41.7)	506 (14.0)	491 (13.6)	508 (14.1)	
Married	2103 (58.3)	693 (19.2)	713 (19.8)	697 (19.3)	
Unknown	2 (0.06)	0	1 (0.03)	1 (0.03)	
Race, No. (%)^a					.17
White	2999 (83.1)	1010 (28.0)	1001 (27.7)	988 (27.4)	
Nonwhite	198 (5.5)	71 (2.0)	61 (1.7)	66 (1.8)	
Other or >1 race	69 (1.9)	13 (0.4)	27 (0.8)	29 (0.8)	
Unknown	344 (9.5)	105 (2.9)	116 (3.2)	123 (3.4)	
Ethnicity, No. (%)^b					.49
Hispanic	39 (1.1)	9 (0.3)	18 (0.5)	12 (0.3)	
Non-Hispanic	3258 (90.2)	1086 (30.1)	1086 (30.1)	1086 (30.8)	
Unknown	313 (8.7)	104 (2.9)	101 (2.8)	108 (3.0)	
Employment status, No. (%)					.16
Employed for wages	731 (20.2)	258 (7.2)	213 (5.9)	260 (7.2)	
Not employed	1110 (30.7)	367 (10.2)	394 (10.9)	349 (9.7)	
Unable to work	337 (9.3)	110 (3.1)	112 (3.1)	115 (3.2)	
Not surveyed or nonrespondent	1432 (39.7)	464 (12.9)	486 (13.5)	482 (13.4)	
Highest year of education, No. (%)					.52
<High school	184 (5.1)	64 (1.8)	58 (1.6)	62 (1.7)	
High school graduate	798 (22.1)	289 (8.0)	262 (7.3)	247 (6.8)	
Some college or trade school	751 (20.8)	243 (6.7)	241 (6.7)	267 (7.4)	
College or postgraduate	444 (12.3)	138 (3.8)	157 (4.4)	149 (4.1)	
Not surveyed or nonrespondent	1433 (39.7)	465 (12.9)	487 (13.5)	481 (13.3)	
Yearly income before taxes, \$, No. (%)					.98
<10,000	236 (6.5)	82 (2.3)	73 (2.0)	81 (2.2)	
10,001 to 20,000	624 (17.3)	211 (5.8)	212 (5.9)	201 (5.6)	
20,001 to 40,000	717 (19.9)	244 (6.8)	230 (6.4)	243 (6.7)	
>40,000	478 (13.2)	157 (4.4)	161 (4.5)	160 (4.4)	
Not surveyed or nonrespondent	1555 (43.1)	505 (14.0)	529 (14.7)	521 (14.4)	

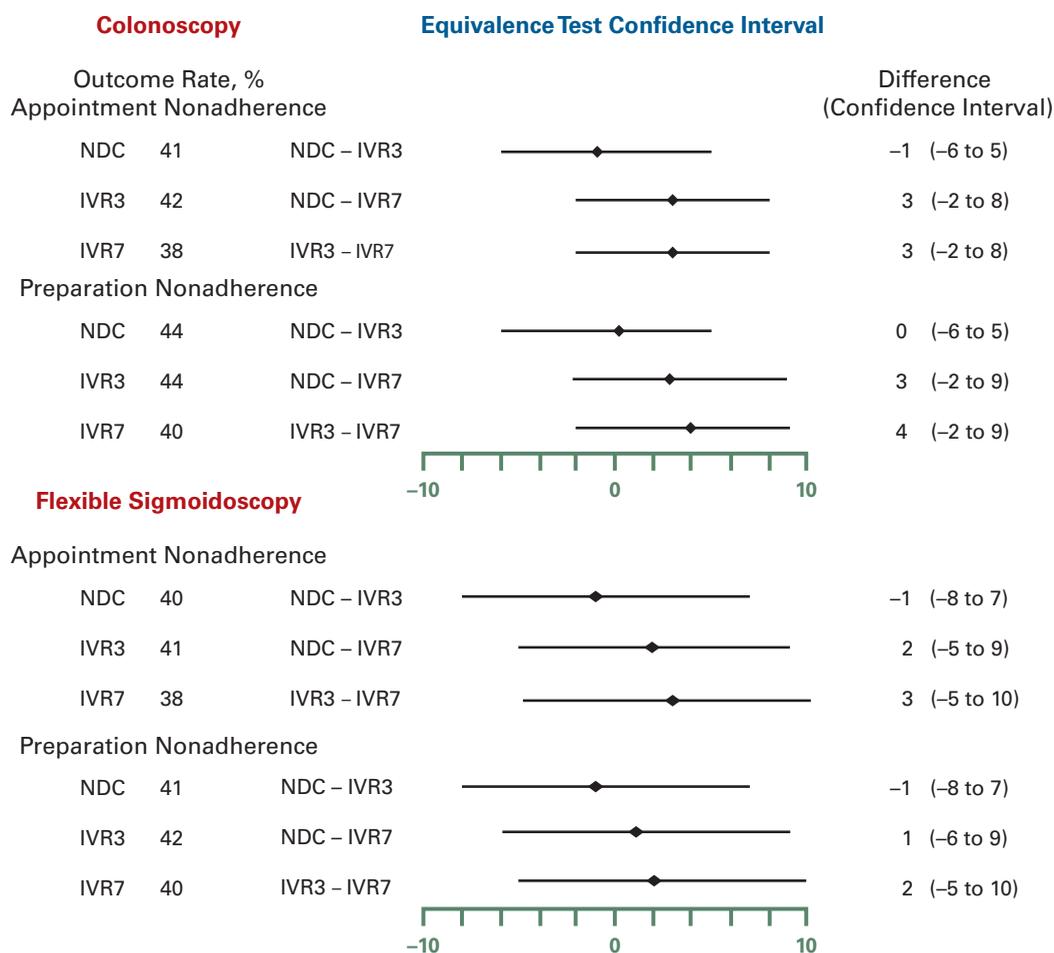
IVR3, indicates interactive voice response message 3 days before procedure; IVR7, interactive voice response message 7 days before procedure; NDC, nurse-delivered call.
^a Study arm proportions are proportions to the total n and those that exceed 100% are due to rounding.
^b For missing data, survey data were supplemented with administrative data.

52% for IVR3) or for FS (46% for NDC, 48% for IVR7, and 50% for IVR3). Of patients in the IVR arms, 4% of those who confirmed their appointment requested to be transferred to the clinic to talk to a nurse; these requests did not vary across the IVR7 and IVR3 arms.

DISCUSSION

Automation of routine clinic processes using technology is often considered a method for reducing costs, especially if the processes include expensive personnel time. If IVR sys-

■ **Figure 3.** Outcome Rates, Difference in Rates Across Intervention Conditions, and Equivalence Test Confidence Intervals



IVR3 indicates interactive voice response message 3 days before procedure; IVR7, interactive voice response message 7 days before procedure; NDC, nurse-delivered call.

tems are more efficient and costs are significantly lower relative to NDCs, even small differences in patient outcomes may be meaningful for clinics. A recent randomized trial tested whether providing an educational and motivational message to patients via IVR was as effective as no intervention in promoting the initiation of CRC screening and found no statistically significant difference between the control and intervention groups.³¹ Our study is the first to date to evaluate the use of IVR to deliver both appointment reminder and educational information after an appointment for CRC testing is made. It is also the first to compare its effectiveness with person-to-person calls having identical message content. While the IVR system may lead to equally effective outcomes, we found that more patients who received the NDC had very positive perceptions about the call, while more patients who received the IVR message had neutral perceptions about the call. Because satisfaction reports are often

positively skewed, differences between neutral, positive, and very positive perceptions might represent a meaningful degree of negative reaction. Therefore, while the IVR system may be equally effective as NDCs, we conclude that additional work to improve patient acceptability of messaging systems is needed to reduce high no-show and cancellation rates for endoscopy examinations.

This study had notable strengths. First, in addition to assessing endoscopy appointment outcomes, we were able to assess satisfaction with the intervention from the patient survey. Even with the advantages that IVR affords, such as flexible calling times, repetition of information, and supplemental messages, we found that patients had more neutral perceptions of IVR messages than of NDCs. Understanding whether patients will accept information in a specific format and whether the benefit of an automated system outweighs the effort and expense of delivering messages personally rep-

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■ **Table 2.** Perceptions of Intervention Call by Procedure and by Study Arm

Perception of Intervention Call	Study Arm Weighted Mean, % (SE)		
	NDC	IVR3	IVR7
Colonoscopy^a			
Very positive	35 (0.03)	21 (0.02)	26 (0.02)
Positive	44 (0.03)	49 (0.03)	48 (0.03)
Neutral	18 (0.02)	27 (0.03)	20 (0.02)
Negative	2 (0.01)	2 (0.01)	5 (0.01)
Very negative	1 (0.01)	1 (0.01)	2 (0.01)
Flexible sigmoidoscopy^b			
Very positive	34 (0.03)	26 (0.03)	29 (0.03)
Positive	46 (0.05)	53 (0.04)	47 (0.04)
Neutral	18 (0.05)	17 (0.03)	24 (0.03)
Negative	1 (0.01)	5 (0.02)	<1 (0.004)
Very negative	1 (0.01)	<1 (0.005)	1 (0.01)

IVR3 indicates interactive voice response message 3 days before procedure; IVR7, interactive voice response message 7 days before procedure; NDC, nurse-delivered call; SE, standard error
^a*P* = .04.
^b*P* = .49.

resents critical information for clinicians and managers when considering technological innovations to improve services. Second, throughout the course of the study, several practice changes were made to improve patient care, including slight changes in preparation materials (the addition of another laxative for colonoscopy preparation) and preparation instructions (prescription of the last dose of laxative the morning of the examination), and broader use of colonoscopy for screening purposes. Despite these changes, which were made across clinics and were equally distributed across intervention arms, the IVR system was as effective as NDCs, suggesting that the IVR system is flexible enough for a dynamic clinical environment.

The study also had several limitations. First, with options for multiple call attempts, the IVR group had more opportunities to receive messages, but it is unclear without data on the length of the NDCs whether patients engaged with nurses for longer periods than patients spent receiving IVR messages. Second, it was not feasible to include another intervention condition with no phone call, which would have provided data to determine if any form of preappointment prompting is effective, although previous meta-analysis and systematic review show that reminder calls are effective and should be the standard of care.^{38,39} Third, the procedure in this setting for scheduling appointments is based on clinic availability and not on patient availability. Therefore, it is possible that other solutions not tested herein, such as flexibility and convenience in scheduling or options for opting in or opting out of the call after the appointment reminder, would help improve overall completion rates.

We conclude that an IVR system is as effective as NDCs for ensuring that patients attend appointments and are adequately prepared for endoscopy examinations. However, strategies to increase patient satisfaction, including additional options integrated into IVR systems, may help improve these outcomes.

With appointment attendance and preparation adherence rates only near 60% across all study conditions, a combination of different approaches may be necessary to improve endoscopy completion. A potential application of an IVR system may be to shift staff effort from preprocedure education phone calls for all individuals with scheduled procedures to more intensive outreach only to those individuals identified before referral or through medical record review with increased likelihood of appointment nonattendance. The less intensive IVR technology could then be used for all other patients.

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tation of data (JMG, Ms Hulbert, SWV, DN, Ms Hagel, SN, ABS, AB, MVR); drafting of the manuscript (JMG, Ms Hulbert, SWV, DN, Ms Hagel, SN); critical revision of the manuscript for important intellectual content (JMG, SWV, DN, Ms Hagel, ABS, MVR); statistical analysis (JMG, DN, Ms Hagel); provision of study materials or patients (JMG); obtaining funding (JMG, DN, MVR); administrative, technical, or logistic support (JMG, Ms Hulbert, SN, ABS, AB); and supervision (JMG).

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