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Original investigation

Automated Telephone Follow-up for Smoking Cessation in Smokers With Coronary Heart Disease: A Randomized Controlled Trial

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Abstract

Introduction: Smokers with coronary heart disease (CHD) benefit from in-hospital cessation treatment, but relapse is common without ongoing support postdischarge. The purpose of this study was to determine if smoking abstinence would be higher after hospital discharge in smokers who received automated telephone follow-up (ATF) and nurse-counseling, compared with a standard care (SC) control group.

Methods: A total of 440 smokers hospitalized with CHD were randomly assigned to the ATF group ($n = 216$) or to the SC group ($n = 224$). Participants in the ATF group received automated phone calls 3, 14, 30, 60, 90, 120, 150, and 180 days after hospital discharge. The ATF system posed questions concerning smoking status, confidence in staying smoke-free, and need for assistance. If flagged by the ATF system, a nurse-counselor provided additional counseling by phone. Self-reported continuous smoking abstinence was assessed 26 and 52 weeks postdischarge using intention-to-treat analysis. The main outcome measure was continuous abstinence for weeks 1–26 postdischarge.

Results: Participants in the ATF group achieved higher abstinence rates for weeks 1–26 than those in the SC group (odds ratio [OR] = 1.53, 95% confidence interval [CI] = 1.01 to 2.33). There was no significant difference between groups in abstinence rates for weeks 27–52 (OR = 1.37; 95% CI = 0.89 to 2.09).

Conclusions: ATF-mediated follow-up helped smokers with CHD achieve abstinence during the intervention period. There was a trend toward clinically important improvements for weeks 27–52; but between-group differences for this time point did not achieve statistical significance.

Clinical Trial Number: NCT00449852.

Implications: Automated telephone follow-up exerts its effect by reinforcing participants' efforts to be smoke-free and by proactively linking people requiring assistance to individualized support (eg, telephone counseling). This study shows that automated telephone follow-up can assist smokers with CHD in remaining smoke-free; however, the success of automated telephone follow-up is limited to the treatment period and abstinence rates after the treatment period were not statistically different from among those receiving standard care. Extended treatment via automated telephone follow-up may provide a solution to extend cessation assistance beyond hospital discharge.

Introduction

Quitting smoking is the most effective means to reduce mortality, disease recurrence, and rehospitalization among smokers who have been hospitalized for coronary heart disease (CHD).[1,2] Still, the majority of smokers with CHD resume smoking after hospital discharge.[3,4,5] Interventions commenced during, rather than after, hospitalization are most effective,[6] and consistent patient follow-up posthospitalization is important to maximize quitting success.[7] Unfortunately, hospitals often lack resources to follow smoking-patients after hospital discharge.

To overcome this issue, we developed an automated telephone follow-up (ATF) system to maximize the efficiency of patient follow-up and support. The ATF system uses natural language to inquire about progress with smoking cessation; patients respond to questions in their natural voice and their speech is translated into text that populates a database. A nurse-counselor can then review the information about the patient's smoking cessation needs and provide assistance if needed. Results from a pilot study showed that patients randomized to ATF had a self-reported 7-day point-prevalence abstinence rate, at 52 weeks posthospitalization, 11.3% higher than those receiving standard care (46.0% vs. 34.7%; odds ratio [OR] = 1.60, 95% CI = 0.71 to 3.60).[8] However, this pilot study was underpowered to provide definitive evidence about intervention efficacy. Other smoking cessation trials have demonstrated the efficacy of ATF technology to support hospitalized smokers[9] and to re-engage relapsed smokers.[10] To date, the technology has not been shown to increase rates of continuous abstinence.[9,11]

The purpose of this randomized trial was to examine the effectiveness of a 26-week, 8-call ATF intervention on smoking cessation among smokers with CHD. Our primary hypothesis was that continuous abstinence for weeks 1–26 posthospitalization would be higher in patients receiving the ATF intervention compared with patients in the standard care (SC) control group. It was expected that ATF would have a two-pronged effect on cessation rates: (1) ATF calls would serve as a reminder to motivate participants to remain smoke-free and (2) the ATF-linked support from a nurse-counselor would help participants remain smoke-free if their confidence in remaining abstinent was low or encourage them to make another quit attempt if they had relapsed.

Methods

Setting and participants

Participants were recruited at the University of Ottawa Heart Institute (UOHI), a smoke-free, tertiary care cardiac facility that has implemented a systematic process to identify and assist smokers admitted to the hospital (the Ottawa Model for Smoking Cessation, OMSC).[12] Specially-trained nurse-specialists visit all smoking-patients to initiate medications to address nicotine withdrawal and to provide counseling on tactics to remain smoke-free after hospital discharge. Eligibility criteria included: smoking five or more cigarettes per day in the past month; admission for acute coronary syndrome (ACS), elective percutaneous coronary intervention (PCI), diagnostic catheterization for CHD, or coronary artery bypass graft (CABG) surgery; availability for follow-up; and ability to read and understand English. The protocol was approved by the UOHI Research Ethics Committee and all participants provided written informed consent.

Procedures

Recruitment and baseline assessment

All smokers admitted to UOHI are automatically referred to an in-house smoking cessation program. The program nurse-counselors approached patients meeting basic eligibility criteria about study participation, explained the study, and obtained informed consent. A study coordinator gathered information from participants' charts regarding demographics (age, gender, and education) and reason for hospital admission. Participants completed a brief questionnaire concerning smoking and quitting history, intentions to quit smoking completely over the next 30 days and 6 months, self-efficacy, and level of nicotine dependence.[13]

Randomization and blinding

Following baseline assessment, participants were placed into strata according to the reason for hospital admission (ie, ACS, PCI, catheterization, or CABG) and randomly allocated to the ATF group or SC groups. For allocation, the study coordinator used a computer-generated sequence and notified each participant of their intervention immediately. Research assistants blinded to treatment allocation gathered outcome data at 26 and 52 weeks.

Interventions

For SC participants, a trained nurse-counselor delivered in-hospital counseling, guided by a standardized flowsheet, and provided written information about smoking cessation. The nurse-counselor assessed the need for nicotine replacement therapy (NRT) in the hospital based on nicotine withdrawal symptoms[14]; participants experiencing withdrawal were provided with NRT for the duration of their hospital stay. At hospital discharge, all participants received a written recommendation to use NRT for 10 weeks. After the first 262 participants were randomized, new funding allowed us to provide a cost-free, 4-week supply of NRT to participants at discharge.

The ATF group received all elements of the SC intervention and additionally their contact information was entered into the automated telephone follow-up system (TelAsk Technologies, Ottawa, Canada). The ATF system called participants 3, 14, 30, 60, 90, 120, 150, and 180 days after hospital discharge and posed a series of questions to participants concerning their smoking status, confidence in staying smoke-free, use of smoking cessation aids (medication and behavioral support), and need for assistance (Supplementary Appendix A). If participants indicated that they: (1) were smoke-free but their confidence in the remaining abstinent was low (3 or less on a 5-point scale); (2) had resumed smoking but wanted to make another quit attempt; or (3) desired a call back, they were flagged by the ATF system and contacted by a nurse-counselor, who provided additional assistance as appropriate.

Follow-up assessments

Participant smoking status was assessed 26 and 52 weeks post hospital discharge. Continuous abstinence over the preceding 26-week period (ie, from week 1 to 26 and from week 27 to 52) and point-prevalence abstinence over the preceding 7-day period were assessed by self-report. Self-reports of smoking abstinence were validated in a random subsample of nonsmokers using expired carbon monoxide levels (≤4 ppm). Participants completed questionnaire assessments concerning the use of smoking cessation medications and extra-study counseling resources.

Outcome measures

The primary outcome was the continuous abstinence rate for weeks 1–26 after hospitalization. Continuous abstinence was defined as self-reported abstinence from any tobacco product during the time period. The secondary outcome was the continuous abstinence rate for weeks 27–52. Other secondary outcomes included the 7-day point-prevalence abstinence rates at weeks 26 and 52. Point-prevalence abstinence was defined as no smoking (not even a puff) in the preceding 7 days.

Intervention costs

Costs associated with providing SC and the ATF interventions were collected. SC costs included the average staff time involved to deliver the bedside intervention, daily in-hospital NRT provision, and a 4-week supply of postdischarge NRT. ATF costs included SC costs plus a per-patient ATF system license fee and the average time involved with postdischarge telephone counseling.

Statistical analysis

A sample size of 440 (provided 80% power to detect a between-group difference of 10% in abstinence rates at any time point. Point-prevalence and continuous abstinence rates were compared between groups using binary logistic regression. Variables associated with outcomes, baseline differences between groups, or loss-to-follow-up were used as covariates. Intention-to-treat principles were used, whereby if smoking status could not be determined, the participant was considered a smoker for the purposes of analysis. Participants who died or moved to an untraceable address were excluded from the primary analysis.[15] Secondary analyses were conducted using only complete cases.

Results

Participation and participant flow

A total of 3553 patients were screened, and 1402 smokers who met eligibility criteria were identified. Of these, 440 smokers (31.4%) agreed to participate and were randomly assigned to treatment group (Figure 1). The primary analytical sample included 200 participants randomly assigned to ATF and 210 participants assigned to SC. There were no significant differences between groups at baseline (Table 1). Figure 2 shows outcome data. Outcome data were available at 26 weeks for 147 participants in the ATF group (68.0 %) and 159 participants in the SC group (71.0 %). At 52 weeks, outcome data were available for 164 (75.9 %) and 165 (73.7%) participants in the ATF and SC groups, respectively. During the study, six ATF and five SC participants died, and 10 ATF and nine SC participants moved to an untraceable address.

Delivery of intervention

Completion rates for ATF and associated nurse-counselor calls at various time points for ATF participants are shown in Table 2. A call was considered complete if smoking status was ascertained. Most (83.5%) ATF calls were completed. The mean number of ATF calls completed per participant was 6.7 ± 1.8, and nearly half (43.5%) of participants completed all eight calls. As a result of flagging by the ATF system, 170 participants in the ATF group (85.0%) completed at least one nurse-counselor call. Most nurse-counselor calls (49.5%) were triggered by participants whose confidence in remaining abstinent was low; 39.5% of the nurse-counselor calls were to smokers who had relapsed and were ready to try to quit again. The mean number of completed nurse-counselor calls to ATF participants was 2.7 ± 2.0 calls.

Outcome measures

Continuous and point-prevalence abstinence rates over time during the trial are shown in Figure 2. The continuous abstinence rate for weeks 1–26 was higher in the ATF compared with the SC group (38.0% vs. 29.5%; OR = 1.54; 95% CI = 1.01 to 2.34; $p = .046$). The 7-day point-prevalence abstinence rate at 26 weeks was higher in the ATF compared with the SC group, but this difference did not reach statistical significance (42.0% vs. 36.2%; OR = 1.32; 95% CI = 0.88 to 1.99; $p = .177$). The continuous abstinence rate for weeks 26–52 was higher in the ATF compared with the SC group, but this difference was not statistically significant (34.5% vs. 28.6%; OR = 1.37; 95% CI = 0.89 to 2.09; $p = .148$). The 7-day point-prevalence abstinence rate at 52 weeks was higher in the ATF compared with the SC group, but this difference was not statistically significant (40.0% vs. 33.3%; OR = 1.41; 95% CI = 0.93 to 2.12; $p = .105$). A secondary analysis using only complete cases showed similar results (data not shown).

Validation of self-reported abstinence

We confirmed self-reports of nonsmoking in a random subsample of all self-reported nonsmokers (Total, $n = 118$; ATF, $n = 59$; SC, $n = 59$). At 26 weeks, the verification rate was 91.4% in the ATF group and 83.1% in the SC group. At 52 weeks, the verification rate was 91.9% in the ATF group and 89.5% in the SC group.

Use of smoking cessation medications and extra-study counseling supports

Descriptive statistics regarding the use of smoking cessation medications and extra-study counseling supports used by participants at 26- and 52-week follow-up is summarized in Table 3. At 52 weeks, more participants in the SC compared with ATF group reported using NRT ($p = .008$); otherwise, there were no between-group differences in use of medications or supports. An analysis of the primary outcome (continuous abstinence from week 1 to 26) stratified by offering NRT (yes/no) found that ATF and SC groups had higher within-group abstinence rates when NRT was offered to participants and that ATF participants reported higher abstinence compared with SC participants both when free NRT was offered (42.0% vs. 33.6%, respectively) and not offered (32.0% vs. 23.8%, respectively). There were no statistically significant differences in scores for self-efficacy between groups at any time point (data not shown). However, both groups saw an increase in self-efficacy from baseline to week 26 and from baseline to week 52 ($p < .0001$).

Costs

The average per-patient cost to provide an in-hospital smoking cessation intervention with ATF-mediated follow-up to smokers hospitalized with CHD ranged from $80.66 without postdischarge NRT to $153.98, including 4 weeks of cost-free NRT. The incremental cost of ATF over SC was $50.24. Detailed costs are shown in Supplementary Table 1, Appendix A.

Conclusions

In this randomized, single-blind trial, ATF-mediated follow-up was superior to SC for smoking cessation at the end of the ATF treatment period. ATF-mediated follow-up increased the continuous abstinence rate for weeks 1–26, the primary outcome, by an absolute 8.5%

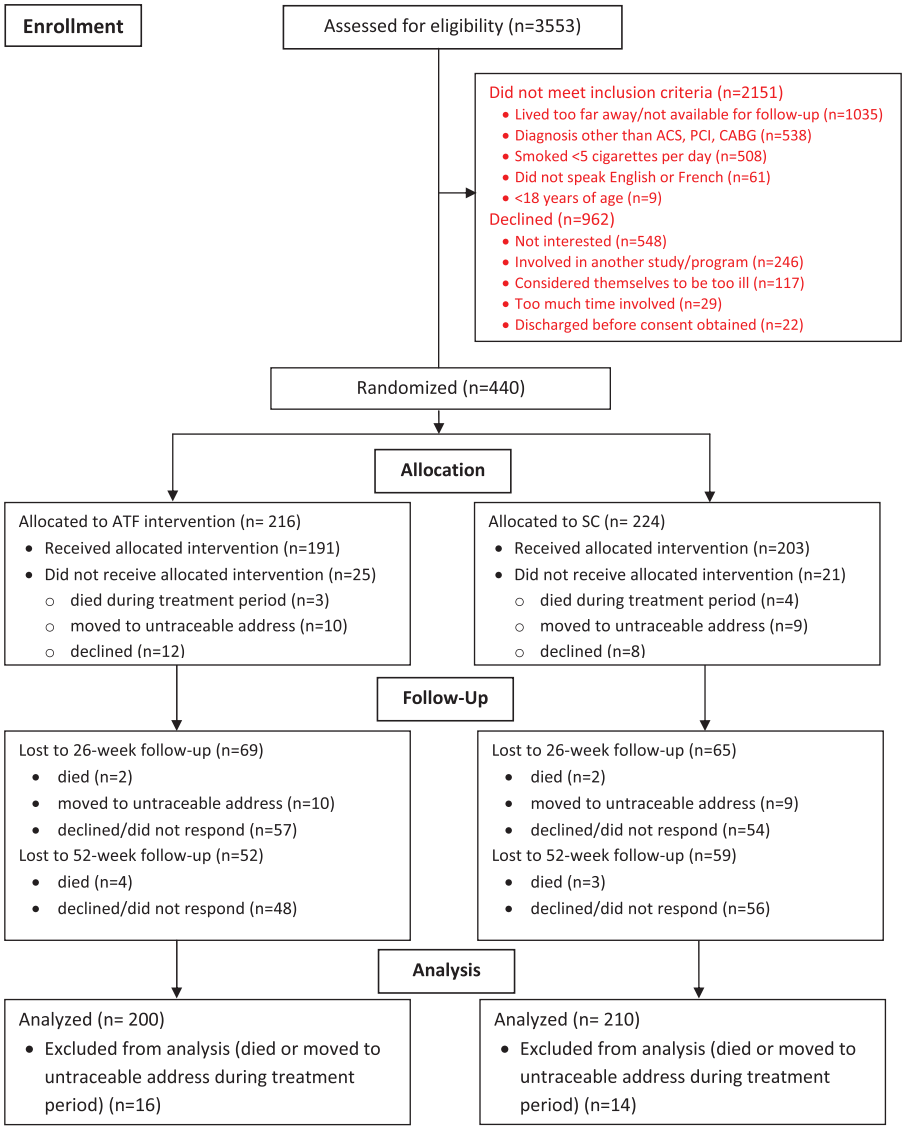

Figure 1. Participant flow and response rate. ATF: Automated Telephone Follow-up; SC: Standard Care.

(38.0% vs. 29.5% abstinence in ATF and SC groups, respectively). Some participants resumed smoking after the ATF intervention ended and there was no statistical difference between groups at week 52 (34.5% vs. 28.6% abstinence in ATF and SC group, respectively). Nonetheless, a 5.9% increase in long-term abstinence postintervention is clinically important,[16] given the dramatic effects of smoking cessation on disease recurrence and mortality in CHD patients,[17] and is superior to 6-month cessation outcomes of behavioral support interventions reported on from other trials.[18–20] Though this study was not powered to detect statistically significant differences between subgroups, the ATF was found to produce higher continuous abstinence rates compared with SC, whether or not participants received free NRT at hospital discharge. A meta-analysis of hospital-initiated cessation interventions has found that adding NRT to intensive counseling significantly increases smoking abstinence compared with intensive counseling alone (RR = 1.54, 95% CI = 1.34 to 1.79, six trials).[3] The ATF system was able to successfully complete patient calls 83.5% of the time and efficiently identify and connect smokers requiring assistance to trained nurse-counselors.

These results can be compared with previous work.[8,9] In our previous pilot study (N = 99), we used three ATF calls over a 30-d period; this current study used eight calls over a 180-day period. The completion rates for ATF calls were 70% and 83.5% in the pilot and present trials, respectively; the proportions of ATF participants receiving at least one counseling call from a nurse-counselor were 46% and 85%. Clearly, providing more opportunities for nurse-counseling over a longer time period resulted in higher participant engagement.

Regan et al.[9] enrolled smokers (N = 738) who received inpatient counseling in a large urban hospital in their trial. Participants were randomized to receive four ATF calls (at 3, 7, 14, and 30 days postdischarge) with the option of a call back from a smoking counselor, or one ATF call at 2 weeks postdischarge and no offer of counseling support. Call-back offers in the first group were made only to those who either had not smoked in the past 7 days, or wanted to quit in the next 2 weeks. Self-reported 7-day point-prevalence tobacco abstinence assessed 12 weeks after hospital discharge did not differ between the two groups (29% vs. 26%; OR = 1.11; 95% CI = 0.0 to

Table 1. Baseline Characteristics of Participants in Study

Variable	All participants (*n* = 410)	ATF group (*n* = 200)	SC group (*n* = 210)
Age (years, mean ± SD)	54.2 ± 8.9	53.9 ± 8.4	54.6 ± 9.4
Sex (*n*, %)			
Males	305 (74.4)	153 (76.5)	152 (72.4)
Females	105 (25.6)	47 (23.5)	58 (27.6)
Education (highest level completed, *n*)			
Postsecondary	194	93	101
High school	190	100	90
Primary school	26	7	19
Reason for hospital admission (*n*)			
ACS	254	122	132
Diagnostic catheterization	100	52	48
PCI	30	14	16
CABG	26	12	14
Cigarettes per day (*n*)			
≤10	64	31	33
11–20	137	65	72
21–30	162	84	78
31+	45	19	26
Fagerstrom score (mean ± SD)	5.1 ± 2.2	5.2 ± 2.2	5.1 ± 2.2
Readiness to quit within next 30 days (*n*, %)	391 (95.4)	188 (94.0)	203 (96.7)
Received cost-free NRT (*n*, %)			
Yes	141 (35.1)	67 (33.5)	74 (35.2)
No	269 (65.6)	133 (66.5)	136 (64.8)

ATF: Automated Telephone Follow-up; ACS: acute coronary syndrome; CABG: coronary artery bypass grafting; PCI: percutaneous coronary intervention; NRT: nicotine replacement therapy; SC: Standard Care; SD: standard deviation.

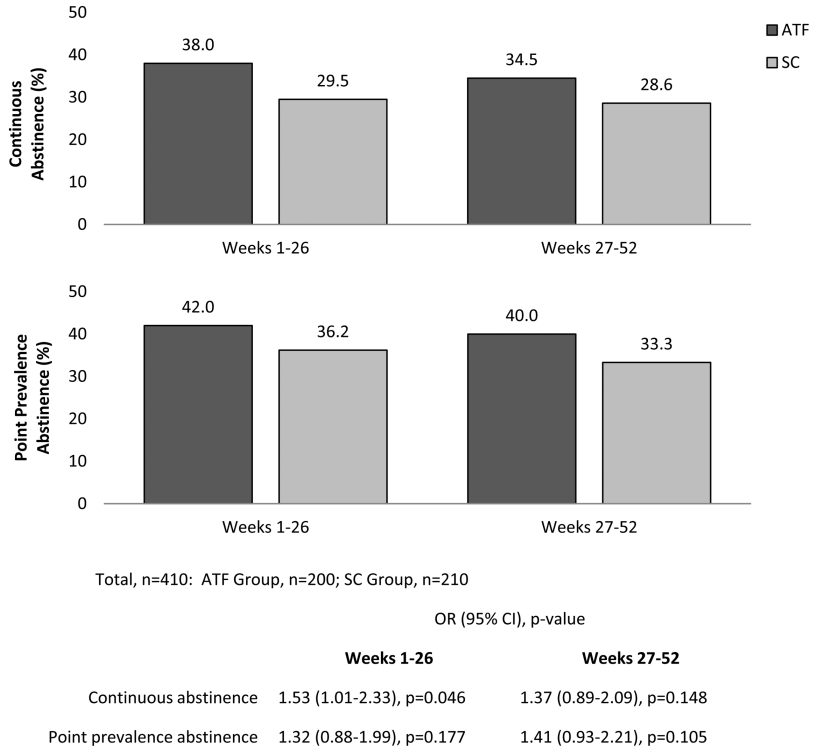

Figure 2. Abstinence rates for weeks 1–26 and weeks 27–52. Analyses adjusted for age, level of education completed (postsecondary vs. high school or less) and readiness to quit smoking within next 30 days, assessed at baseline, and exposure to complimentary NRT offer at discharge from hospital. ATF: Automated Telephone Follow-up; NRT: nicotine replacement therapy.

Table 2. Completion Rates for ATF and Nurse-Counselor Calls at Various Points After Hospitalization for Participants in ATF Group

Call timing after hospitalization	3 d	14 d	30 d	60 d	90 d	120 d	150 d	180 d	Total[1]
					ATF calls (*n*, %)				
ATF call complete[2]	166 (83.0)	176 (88.4)	174 (87.0)	175 (87.5)	168 (84.0)	159 (79.5)	165 (82.5)	153 (76.5)	1336 (83.5)
Unreachable by ATF	32 (16.0)	16 (8.0)	21 (10.5)	17 (8.5)	27 (13.5)	35 (17.5)	24 (12.0)	32 (16.0)	204 (12.8)
ATF call cancelled	2 (1.0)	8 (4.0)	5 (2.5)	8 (4.0)	5 (2.5)	6 (3.0)	11 (5.5)	15 (7.5)	60 (3.8)
					Nurse-counselor calls (*n*, %)				
Nurse-counselor call required[2]	75 (37.5)	76 (38.0)	88 (44.0)	77 (38.5)	62 (31.0)	55 (27.5)	57 (28.5)	65 (32.5)	555 (34.7)
Relapsed and ready to quit	27 (36.0)	31 (40.8)	26 (29.6)	23 (29.9)	18 (29.0)	18 (32.7)	19 (33.3)	17 (26.1)	179 (32.2)
Relapsed and not ready to quit	5 (6.7)	7 (9.2)	11 (12.5)	11 (14.3)	10 (16.1)	9 (16.4)	12 (21.1)	18 (27.7)	83 (15.0)
Smoke-free and call back requested	39 (52.0)	36 (47.4)	49 (55.7)	40 (52.0)	34 (54.8)	26 (47.3)	25 (43.8)	26 (40.0)	275 (49.5)

[1]Percentages for ATF calls complete and nurse-counselor calls required were calculated based on denominator of 200 calls placed per time point. [2]Number of calls triggered by ATF system; percentage for nurse-counselor calls by reason were calculated based on number of nurse-counselor calls required per time point. ATF: Automated Telephone Follow-up.

Table 3. Reported Use of Smoking Cessation Medications and Extra-Study Counseling Supports by Participants at 26- and 52-Week Follow-up

Variable	Weeks 1–26 (*n*, %)			Weeks 27–52 (*n*, %)		
	ATF group (*n* = 200)	SC group (*n* = 210)	*p* value	ATF group (*n* = 200)	SC group (*n* = 210)	*p* value
Smoking cessation medications						
Any medication	113 (56.5)	116 (55.2)		52 (26.0)	74 (35.2)	
NRT	96 (48.0)	102 (48.6)	1.0	38 (19.0)	61 (29.0)	.008
Bupropion	12 (6.0)	6 (2.9)	.145	4 (2.0)	6 (2.9)	.375
Varenicline	5 (2.5)	8 (3.8)	.776	10 (5.0)	7 (3.3)	.309
Extra-study counseling						
Community smoking cessation program	3 (1.5)	4 (1.9)	1.0	3 (1.5)	5 (2.4)	.723
Telephone helpline	2 (1.0)	2 (0.9)	1.0	2 (1.0)	1 (0.5)	1.0
Family doctor	39 (19.5)	51 (24.3)	.258	34 (17.0)	46 (21.9)	.156

ATF: Automated Telephone Follow-up; NRT: nicotine replacement therapy; SC: Standard Care.

1.41). Comparatively, abstinence rates in the present study were superior, despite being measured at later follow-up points and the use of a more rigorous definition of abstinence (ie, continuous abstinence vs. point-prevalence abstinence). The higher abstinence rates in our present study may reflect the underlying study populations; Regan et al.[9] included smokers hospitalized for a variety of conditions whereas we included only smokers hospitalized for CHD. Smokers with CHD have higher quit rates than smokers with other illnesses.[21]

The ATF follow-up system was designed to prevent relapse and encourage smokers who have slipped to return to abstinence. Indeed, half the nurse calls were received by participants who were abstinent, but requested nurse-counseling support to avoid relapse, and one-third of the nurse calls were triggered by participants who had relapsed, but were ready to make another quit attempt. Two potential mechanisms by which the ATF system may have achieved higher continuous quit rates were: (1) serving as a reminder for people to remain abstinent and (2) efficiently connecting participants in need of support with nurse-counseling. Together, the intervention components were expected to motivate continuous abstinence. The advice and coping skills acquired through counseling might have also helped participants return to abstinence after a slip or relapse beyond the treatment period.[22]

Strengths and limitations

Our study had many strengths. First, nearly half of all patients received the full eight-call ATF program, suggesting that the intervention was acceptable to many patients. Second, trained nurse-counselors were available to provide additional support, should a patient need it. Third, we were able to provide cost-free NRT to approximately half of enrolled patients. Cost is often cited as a barrier to accessing smoking cessation medication and the provision of free NRT may have helped some patients quit. Some limitations of this study are noteworthy. First, study participants were not blinded and participants assigned to the SC group may have sought out additional support, thereby potentially suppressing between-group differences. There were indications that SC participants obtained more support from their family doctor and through pharmacotherapy (Table 3). A second limitation is that, because participants in the ATF

group received both ATF and nurse-counseling, it is difficult to discern the effect of each intervention component on quit rates. Finally, we had a relatively low consent rate (31.4%) by eligible patients to participate in the study, potentially affecting the generalizability of the results. Unfortunately, many of those who declined to participate were unavailable for follow-up (ie, they lived too far away) suggesting that ATF may have still been beneficial for them.

Conclusions

Our data provide evidence that when extended beyond hospital discharge, access to cessation assistance improves continuous abstinence. ATF exerts its effect by reinforcing participants' efforts to be smoke-free and by proactively linking people requiring assistance to individualized support (eg, telephone counseling). The ATF intervention was acceptable to participants and offered an efficient way to allocate scarce nursing resources to those in most need. Future research should focus on identifying the optimal frequency and scheduling of ATF calls and the incremental value of the nurse-counseling triggered by the ATF contacts.

Supplementary Material

Supplementary data are available at *Nicotine & Tobacco Research* online.

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Declaration of Interests

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