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Interactive voice response telephony to promote smoking cessation in patients with heart disease: A pilot study

Robert D. Reid *, Andrew L. Pipe, Bonnie Quinlan, Joanna Oda

Minto Prevention and Rehabilitation Centre, University of Ottawa Heart Institute, Ottawa, Canada

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Abstract

Objective: A pilot study was conducted to determine the feasibility and potential efficacy of an interactive voice response (IVR) follow-up system for smokers recently hospitalized with coronary heart disease (CHD).

Methods: Ninety-nine smokers hospitalized with CHD completed a baseline questionnaire, were provided with bedside counseling, and offered nicotine replacement therapy. They were randomly assigned to a usual care (UC) or an IVR group. The IVR group received automated telephone follow-up calls 3, 14 and 30 days after discharge inquiring about their smoking status and confidence in remaining smoke-free. When deemed necessary, they were offered additional counseling. Smoking status was determined 52 weeks after hospital discharge.

Results: The 52-week point prevalence abstinence rate in the IVR group was 46.0% compared to 34.7% in the UC group (OR = 1.60, 95% CI: 0.71–3.60; $P = .25$). After adjustment for education, age, reason for hospitalization, length of hospitalization, and quit attempts in the past year, the odds of quitting in the IVR group compared to the UC group were 2.34 (95% CI: 0.92–5.92; $P = .07$).

Conclusions: IVR is a promising technology for following CHD patients attempting to quit smoking following discharge from hospital, however, a larger trial is required to confirm its efficacy.

Practice implications: IVR may enhance the timely provision of follow-up counseling for smoking cessation in patients with CHD.
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Keywords: Smoking cessation; Interactive voice response; Coronary heart disease; Hospitalization

1. Introduction

Cigarette smoking is a principal causative factor in the development of coronary heart disease (CHD), the leading cause of death in North America [1]. Quitting smoking is the most effective intervention to reduce morbidity and mortality in CHD patients who smoke. Patients who quit smoking reduce their relative risk of death by 36% and non-fatal re-infarction by 32% [2]. The risk reduction achieved through quitting smoking is as great as or superior to that observed with: statins for lowering cholesterol (a 29% reduction); aspirin (15%); beta-blockers (23%); or ACE inhibitors (23%) [2].

Hospitalization for CHD provides an excellent opportunity to initiate smoking cessation treatment. Hospitalization often provides an enhanced motivation to quit smoking. It has been reported that 65% of smokers hospitalized with myocardial infarction (MI) intend to quit smoking in the next 30 days [3], compared with only 20% of non-hospitalized smokers [4]. Secondly, hospitals provide a smoke-free environment thereby reducing the triggers to smoke and supporting non-smoking behaviour. Finally, patients have access, in-hospital, to health professionals who can provide distinct assistance with nicotine withdrawal (e.g. through the provision of nicotine replacement therapy [NRT]) and deliver the specific, relevant smoking-cessation advice and support that will help patients remain smoke-free after discharge [5]. Unfortunately, while many patients may use the in-hospital smoke-free period as the stimulus for a quit attempt, many relapse to smoking after returning home. In a previous investigation conducted at our institution (the University of Ottawa Heart Institute), we found that despite an initial smoking cessation intervention, almost two-thirds of smokers resumed smoking within a year of hospitalization for CHD; half of those resumed smoking within 1 month [3].

* Corresponding author at: Prevention and Rehabilitation Centre, University of Ottawa Heart Institute, 40 Ruskin Street, Ottawa, Ontario, Canada K1Y 4W7. Tel.: +1 613 761 5058; fax: +1 613 761 5336.

E-mail address: breid@ottawaheart.ca (R.D. Reid).

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Effective treatments for smoking cessation in patients with CHD have been previously described [6,7], but they are frequently misperceived as intensive and/or expensive and institutional resources applied to smoking cessation have typically been limited or non-existent. Interventional day procedures for the treatment of CHD (e.g. percutaneous coronary intervention [PCI]) and shorter hospital stays are becoming more common, seemingly making it difficult to initiate treatment for tobacco addiction in-hospital. Consistent and ongoing patient follow-up is important to maximize smoking cessation success. Interventions in the hospital setting with less than 1-month post-discharge follow-up do not appear to significantly increase cessation [8,9]. To date, follow-up support for smoking cessation in patients with CHD has usually consisted of proactive (counselor initiated) telephone counseling, or in-person contacts. When in-hospital contact is combined with follow-up lasting more that 1-month after discharge, the odds of quitting increase substantially (OR = 1.98, 95% CI: 1.49–2.65) [8]. Most in-hospital programs fail to provide such follow-up. A survey of 12 hospitals in our region revealed that none had follow-up systems in place to assist smokers after their discharge from hospital. Innovative, cost-efficient solutions are required to address these challenges.

Interactive voice response technology is a sophisticated application of speech recognition software which when combined with automatic dialing capabilities allows calls to be made to willing patients to inquire about smoking cessation status, assess motivation and evaluate perceived competency relevant to a particular cessation attempt. The technology recognizes patient's verbal responses, documents them and thereby distinctly assists in guiding further patient follow-up. Interactive voice response (IVR) technology, therefore, has the potential to significantly improve follow-up of new non-smokers following hospitalization and to enhance the provision of clinical support during a particular, ongoing smoking cessation attempt. An IVR system can easily be programmed to generate automated telephone calls to hundreds of patients. The resulting interactions are personalized and conversational. The IVR system will record responses and store them in a database. It provides a low cost method of maintaining contact with a large number of patients, monitoring their quit progress and when necessary, transferring them to a live counselor for additional help. The counselor is able to link with the database to obtain information about the patient's smoking cessation needs and provide appropriate ongoing support.

Previous studies have investigated IVR's role in the diagnosis, assessment and clinical follow-up of other conditions and have shown that information obtained by IVR is reliable and valid [10–12]. One apparent advantage of IVR is that patients may be willing to disclose more sensitive information than when speaking with a live interviewer [13]. However, IVR appears to be most successful when used in combination with human intervention [14]. IVR has been used in other smoking cessation studies, with promising results [15,16], It has not been used previously, however, in a setting involving hospitalized smokers with CHD.

The purpose of this pilot study was to determine the feasibility and potential efficacy of an IVR monitoring and follow-up system to support smoking cessation in smokers hospitalized with CHD. The pilot was conducted in the context of a busy tertiary care hospital setting. Information derived from this feasibility study will be used to refine the nature, content, and timing of the IVR intervention. Information regarding subject retention and effect size obtained from the present trial will aid in the determination of the sample size required for a definitive clinical trial to evaluate the intervention.

2. Methods

2.1. Setting

The project was completed at the University of Ottawa Heart Institute (UOHI), a tertiary care cardiac facility serving a population of 1.0 million people. Approval of the study protocol was obtained from the Research Ethics Committee at the UOHI.

2.2. Participants

Participants were current smokers ($\geq$5 cigarettes per day) over the age of 18 years, hospitalized at UOHI for acute coronary syndrome (ACS), elective PCI or diagnostic catheterization related to CHD. Patients living too far away to be available for follow-up ($>$1 h) were excluded.

2.3. Design and procedures

2.3.1. Research design

A parallel, two-group pilot study was conducted. Participants were recruited in the hospital, completed a baseline assessment and received UOHI's standard in-hospital treatment for smokers. They were then randomly assigned to receive either IVR follow-up or no additional treatment. Abstinence rates were determined during follow-up assessments 12 and 52 weeks after hospital discharge. The primary outcome of interest was the self-reported abstinence rate at 52 weeks.

2.3.2. Recruitment

All patients admitted to the UOHI complete a smoking history. Current smokers identified by their history and meeting other eligibility criteria were asked if they were interested in participating in a study of telephone follow-up. A study coordinator then explained the nature of the study and obtained informed consent. Participants were ordinarily recruited within 24 h of admission.

2.3.3. Baseline assessment

At baseline, an in-hospital questionnaire was completed that identified demographic characteristics, medical and smoking history, and confidence to quit smoking. Phone contact information was also obtained.

2.3.4. Standard in-hospital treatment for smoking cessation

All participants received the same UOHI standard in-hospital treatment, which consists of: personalized advice to quit smoking; access to NRT during hospitalization (if necessary); brief bedside counseling with a nurse-specialist; a self-help guide; and the provision of information about the UOHI outpatient smoking cessation program and other community programs. This treatment is consistent with current clinical practice guidelines for hospitalized smokers [7].

2.3.5. Random allocation to treatment

Patient randomization occurred after baseline assessment and standard in-hospital treatment for smoking cessation. Participants were randomly assigned to either a usual care (UC) control group or an IVR experimental group. Group assignment was mediated through the Clinical Epidemiology Unit's data centre, using a computer generated randomization list. The randomization was made in blocks of six. Research staff were unaware of the treatment allocation prior to randomization.

2.4. Treatments

2.4.1. Usual care group

Usual care patients received no further treatment after discharge, but were free to avail themselves of the UOHI outpatient smoking cessation program and any other community resources they chose to access.

2.4.2. IVR group

Participants in the IVR group were registered in an IVR system (TelASK Technologies Inc., Ottawa, Canada), which automatically contacted patients via telephone on days 3, 14 and 30 post-hospital discharge to check the patient's smoking status and assess the risk of relapse. During the calls, the IVR system posed a series of questions concerning current smoking status, confidence in staying smoke-free over the time period until the next planned call, and the use of pharmacotherapy, self-help materials and other forms of cessation support. The complete IVR algorithm detailing the questions posed and the responses generated by the IVR system is provided in Appendix A. If patients identified that they had resumed smoking but wanted to make another quit attempt soon or indicated that their confidence in remaining smoke-free was low (less than 7 on a 10-point scale), the IVR system flagged the patient in the software interface in order to ensure that they would be contacted by the nurse-specialist who then provided additional assistance, consisting of counselor-led telephone sessions.

Telephone counseling consisted of up to three 20-min telephone counseling sessions over an 8-week period. For participants who had returned to smoking but wished to make another quit attempt, the nurse-specialist provided encouragement, reviewed problems encountered during the initial quit attempt, and helped identify possible solutions. They also assisted participants to set a new quit date, make preparations for quitting, access pharmacotherapy (if necessary), and recruit social support. For participants who were not smoking but whose confidence in remaining smoke-free was low, the nurse-specialist provided encouragement and assisted them to identify tempting situations that were undermining confidence. The nurse-specialist and the participant then worked to develop strategies to deal with these situations using cue control, healthful alternatives, pharmacotherapy and/or social support.

2.5. Follow-up assessment

Participants were contacted by telephone 12 and 52 weeks after hospital discharge. Patients completed a structured interview about the use of cigarettes, quit attempts, use of other nicotine containing products, and other products/programs for smoking cessation in the last 7 days and since the last contact (during hospitalization or telephone call).

2.6. Measures

2.6.1. Abstinence from smoking

Smoking status was assessed at baseline and at follow-up contacts 12 and 52 weeks post-discharge. Abstinence was defined as a self-report of no smoking (not even a puff) in the preceding 7 days [17], i.e. point prevalence abstinence.

2.6.2. Demographic, smoking and medical history questionnaire

Socio-demographic factors (age, gender, education level) and smoking history (years smoking, cigarettes per day) and past quit attempts were assessed using a written questionnaire at baseline. We also used two questions from the Fagerstrom Tolerance Questionnaire [18]. Participants were asked "How soon after waking do you smoke your first cigarette?" Potential responses included: within 30 min, or after 30 min. They were also asked "How many cigarettes per day do you smoke?" Potential responses included: 1–15 cigarettes, 16–25 cigarettes, or 26 or more cigarettes. To provide an indication of confidence to quit smoking, participants were asked to rate their confidence on a 10-point scale (1 = not at all confident, 10 = completely confident).

Reason for hospitalization and length of hospitalization were obtained from the medical chart. Reason for hospitalization was categorized as elective coronary artery catheterization/PCI or ACS because patients presenting for an *elective* coronary artery catheterization/PCI have stable disease while patients presenting with ACS represent people with an emergent, potentially life threatening cardiac condition (i.e. unstable angina or an evolving myocardial infarction). It is known that depending on the nature of clinical presentation cardiac patients have differing rates of smoking cessation potential [19].

2.7. Data analysis

We compared baseline characteristics between the groups using independent '*t*-tests" for continuous variables and chi-square tests for categorical variables. The primary endpoint for the study was the point prevalence abstinence rate in each of the

groups at 52 weeks. In studies of tobacco cessation treatments, the recommended standard is the use of an 'intention-to-treat' approach in which data from all randomized smokers are included in the analysis unless they have died or moved to an untraceable address. Participants who are included in the analysis are counted as smokers if their smoking status at the final follow-up cannot be determined [20]. An unadjusted analysis was first conducted using logistic regression with point prevalence smoking status (abstinent or not abstinent) as the dependent variable and treatment group assignment as a covariate. Other univariate predictors of abstinence at 52 weeks were evaluated next using logistic regression, including age, gender, education level, reason for hospitalization, length of hospitalization, use of NRT during hospitalization, years smoked, number of quit attempts lasting 24 h or more in the past year, timing of first cigarette of the day, number of cigarettes smoked per day, and confidence in quitting. Predictors significant at a P-value $\leq .15$ were considered potentially important and included in an adjusted analysis of results. For the adjusted analysis, multivariate logistic regression was used with smoking status as the dependent variable and treatment group assignment, baseline differences ($P \leq .15$) and other important predictors ($P \leq .15$) as covariates.

Quit rates at the secondary time point (12 weeks post-hospitalization) were compared between group using chi-square tests. Descriptive statistics were used to summarize the use of evidence-based cessation resources over the follow-up period.

3. Results

3.1. Recruitment

Between November 2004 and May 2005, 186 patient charts were reviewed for eligibility. Seventy-seven patients were excluded because they did not meet the eligibility criteria (i.e. hospitalization for something other than ACS, elective PCI, or diagnostic catheterization related to CHD; smoking fewer than five cigarettes per day; or living too far away). The remaining 111 patients were invited to participate and 100 agreed (90.1% participation rate of eligible patients). The main reasons for refusal to participate included lack of interest and inability to speak English. Participants were randomly assigned to the intervention groups – 50 to Usual Care (UC) and 50 to the IVR group – following baseline assessment and standard in-hospital smoking cessation treatment.

3.2. Participant flow and follow-up

The IVR system was able to establish contact with 35/50, 36/50, and 34/50 participants 3, 14 and 30 days following hospital discharge, respectively (70%, 72% and 68% of the IVR group). Eighteen patients received all three calls, 21 received two, 9 received one call and 2 patients received none. The mean number of calls completed per participant was 2.1. As a result of flagging by the IVR system, 23/50 participants in the IVR

Table 1
Baseline characteristics for cardiac in-patients participating in smoking cessation study ($n = 99$)

Variable	IVR group ($n = 50$)	Control group ($n = 49$)	P value
Age (mean ± S.D.)	54.0 ± 8.8	53.9 ± 9.0	.97
Men (%)	61	74	.17
Education level, last level completed (%)			
Up to high school completion	91	70	.05
At least some post-secondary education	9	30	
Reason for hospitalization (%)			
Elective diagnostic catheterization or PCI	20	14	.45
Acute coronary syndrome	80	86	
Length of hospitalization (mean days ± S.D.)	3.0 ± 2.9	3.6 ± 3.7	.38
Number of years smoked (mean ± S.D.)	33.1 ± 11.9	34.0 ± 9.7	.68
Number of cigarettes per day (%)			
1–15	36	37	.51
16–25	32	41	
26+	32	22	
Timing of first cigarette (%)			
Within 30 min of awakening	82	84	.75
After 30 min	18	16	
Quit attempts lasting >24 h in past year (%)			
None	48	57	.36
One of more	52	43	
Confidence to quit smoking, mean ± S.D. (1 = not at all confident, 10 = extremely confident)	7.4 ± 2.1	7.8 ± 2.6	.38
NRT use in-hospital (%)			
No	30	41	.26
Yes	70	59	

IVR, interactive voice response; S.D., standard deviation; PCI, percutaneous coronary intervention; NRT, nicotine replacement therapy.

group received at least one telephone counseling-call from the nurse-specialist; the mean number of counseling-calls for those receiving at least one call was 1.8 (S.D. = 0.7).

Loss to follow up was relatively low; it did not differ significantly between groups. There was no significant difference between the UC and IVR groups as to the proportion of participants completing follow-up measures at 12 weeks (100% versus 96.0%) or 52 weeks (83.7% versus 86.0%). One patient in the UC group died during the follow-up period and was not included in analysis. Thus 99 patients were available for analysis at 52 weeks.

3.3. Baseline characteristics

Participants' baseline characteristics are presented in Table 1. The groups were balanced on all factors except education level. Participants in the UC group were more likely to have completed some post-secondary education. Overall, participants were middle-aged (mean age of 54 years), predominantly male (68%), and had long smoking careers (30+ years). The majority (81.8%) were hospitalized for ACS (as opposed to undergoing diagnostic catheterization or elective PCI). Participants were hospitalized for a mean of 3.4 days (S.D. = 3.3), but hospital stays ranged from 0 (i.e. same-day procedure) to 19 days. Patients in both groups received the same in-hospital care for smoking cessation and there was no significant difference in use of NRT: 29 patients in the UC group and 35 patients in the IVR group used NRT in the hospital (59.2% versus 70%, $P = .260$). Though the majority of the sample showed several signs of higher nicotine dependence – 64% smoked $\geq$16 cigarettes per day and 83% smoked their first cigarette within 30 min of waking – the group's mean confidence to quit was high: 7.6 (S.D. = 2.4). Less than half the group, 47.5%, had made at least one attempt to quit smoking in the previous year.

3.4. Effect of IVR intervention on abstinence rates

The unadjusted analysis of results is shown in Table 2. At the primary endpoint (52 weeks), 23 patients in the IVR group (46.0%) and 17 patients in the UC group (34.7%) were abstinent from smoking (OR = 1.60, 95% CI: 0.71–3.60; $P = .25$). Other potentially important (i.e. $P \leq .15$) predictors of abstinence at 52 weeks are also shown in Table 2. They included age, reason for hospitalization, length of hospitalization, and quit attempts in the past year. After adjustment for these predictors and baseline differences (education level), the odds ratio for abstinence in the IVR group was 2.34 (95% CI: 0.92–5.92; $P = .07$). The adjusted results are shown in Table 3.

At the secondary endpoint (12 weeks), 21 patients in the IVR group (42%) and 18 patients in the UC group (35%) were abstinent from smoking (chi-square P-value = 0.59).

In an exploratory analysis, we examined how counseling from the nurse-specialist in the IVR group related to smoking status at 12 and 52 weeks. The 12-week quit rate for those receiving at least one telephone counseling-call after flagging by the IVR system was 21.7% versus 59.3% for those not receiving any telephone counseling (chi-square P-value = .007). The 52-week quit rates were 30.4% and 59.3% for the counseling versus no-counseling subgroups, respectively (chi-square P-value = .04).

Patients were asked about their use of evidence-based therapies (pharmacotherapy and counseling) during the follow-up period. The reported use of NRT was 14.0% and 14.3% in the IVR and UC group, respectively ($P = .85$); the use of Zyban

Table 3
Predictors of point prevalence abstinence at 52 weeks adjusted for baseline differences, covariates and group allocation

Variable	β	S.E.	Odds ratio	P
Experimental IVR (1) vs. control (0) group allocation	0.85	0.48	2.34	.07
Age	0.03	0.03	1.03	.20
Education level, up to high school completion (1) vs. higher education (0)	−0.66	0.63	0.52	.29
Reason for hospitalization, elective diagnostic catheterization or PCI (1) vs. acute coronary syndrome (0)	−1.20	0.71	0.30	.09
Mean length of hospitalization	0.06	0.07	1.06	.40
Quit attempts lasting >24 h in past year, one of more (1) vs. none (0)	−0.79	0.47	0.45	.09

IVR, interactive voice response; PCI, percutaneous coronary intervention.

Table 2
Univariate predictors of point prevalent abstinence at 52 weeks ($n = 99$)

Variable	β	S.E.	Odds ratio	P
Experimental IVR (1) vs. control (0) group allocation	0.47	0.41	1.60	.25
Age	0.04	0.02	1.04	.10
Gender, female (1) vs. male (0)	−0.38	0.45	0.69	.40
Education level, up to high school completion (1) vs. higher education (0)	−0.33	0.54	0.72	.54
Reason for hospitalization, elective diagnostic catheterization or PCI (1) vs. acute coronary syndrome (0)	−1.35	0.67	0.26	.05
Mean length of hospitalization	0.09	0.06	1.10	.15
Mean number of years smoked	0.01	0.02	1.01	.67
Number of cigarettes per day, 26+ (1) vs. 1–25 (0)	0.23	0.46	1.26	.62
Timing of first cigarette, within 30 min of awakening (1) vs. after 30 min (0)	−0.62	0.54	0.54	.25
Quit attempts lasting >24 h in past year, one of more (1) vs. none (0)	−0.68	0.42	0.51	.10
Mean confidence to quit smoking (1–10)	0.03	0.09	1.03	.73
NRT use in-hospital, NRT used (1) vs. no NRT (0)	−0.52	0.43	0.59	.22

IVR, interactive voice response; PCI, percutaneous coronary intervention; NRT, nicotine replacement therapy.

was 8.0% and 4.1% ($P = .60$); the use of other (extra study) counseling was 32.0% and 32.0% ($P = .95$).

4. Discussion and conclusions

4.1. Discussion

Smoking cessation is by far the most effective intervention to reduce morbidity and mortality among patients with CHD who smoke. Quitting is a difficult process, which is substantially aided by effective follow-up care. The purpose of this pilot study was to determine the feasibility and potential efficacy of an IVR monitoring and follow-up system to support smoking cessation in smokers hospitalized with CHD. Our data suggest the IVR system is feasible for use in this population and when combined with appropriate follow-up care results in an 11% increase in point prevalence abstinence 52 weeks after hospital discharge. This improvement in quit rate was not statistically significant, however, this pilot study was not powered to provide statistically conclusive results. The association between the IVR intervention and cessation outcomes was strengthened by adjustment for baseline differences between groups and covariates such as age, reason for hospitalization, length of hospitalization, and quit attempts lasting more than 24 h in the past year. Caution is appropriate in interpreting these findings. Nonetheless, the magnitude of the effect size (odds of quitting in the IVR intervention group 1.6 times greater than usual care; a relative 32% increase in cessation at one year) is potentially clinically important given its similarity with effect sizes noted in meta-analyses of interventions for smoking cessation in patients with CHD [8] and hospitalized smokers [9]. These analyses concluded that smoking cessation interventions are effective in promoting abstinence in these populations. We believe the IVR-based intervention warrants further evaluation in a larger, more definitive clinical trial.

Possible mechanisms through which the IVR system might improve cessation outcomes were also suggested by our pilot data. The improvement in quit rates between 12 and 52 weeks (from 21.7% to 30.4%) among participants receiving telephone counseling triggered by the IVR calls suggests the supplementary counseling was effective in helping participants in the IVR group recover from a relapse. The beneficial effect of the IVR intervention does not appear to be explained by the increased use of evidenced-based interventions during the follow-up period. Zyban use was slightly higher in the IVR group, but the use of both NRT and other (extra-study) counseling was similar in both groups. This small difference in Zyban usage is unlikely to account for the difference observed in abstinence.

Our quit rate 52 weeks after hospital discharge was 46% in the intervention group. This rate is better than the 1-year cessation rate of 36% we observed in a previous intervention trial for a similar population at the UOHI [3], but somewhat lower than those reported in other clinical trials of smoking interventions in cardiac patients, which range from 50% to 60% [6]. A possible explanation for this difference is that our sample was more representative of cardiac smokers than previous clinical trials. Our participation rate of eligible patients was 91% compared with the 30–50% rates reported in most clinical trials of smoking interventions in this population [21]. Another explanation for our lower quit rate is the declining prevalence of smoking in the population, which leaves only the most dependent, and thus the more difficult-to-treat, smokers. This is consistent with evidence suggesting that the efficacy of behavioural and pharmacological smoking interventions have declined over time because of the more deeply embedded dependency of today's smokers [22,23].

This pilot study had a number of strengths and limitations. The randomized design permitted the control of potentially confounding variables in order to better evaluate the effects of IVR follow-up on long-term abstinence. We achieved a high participation rate (100/111, 90.1%) and successfully contacted >85% of patients for follow-up at 52 weeks. As discussed previously, the small sample size included in this pilot study was insufficient to provide statistically conclusive results regarding the efficacy of the intervention. The other main limitation was the absence of biological verification of self-reported smoking status. We recognize that the gold standard for assessing outcomes in smoking cessation trials includes biological verification of abstinence at 12 months [20]. These procedures will be incorporated in future trials of the intervention.

Results of this study apply to smokers hospitalized with CHD, who are typically more motivated to quit than other smokers. At the same time, there is no reason to believe that the IVR system would not also benefit smokers hospitalized for causes other than CHD.

4.2. Conclusions

IVR is a promising technology for following and triaging CHD patients who are attempting to quit smoking following discharge from hospital. This pilot study has shown it to have a potentially important effect on cessation rates 52 weeks after hospital discharge. A larger trial is required to confirm the efficacy of this follow-up intervention.

4.3. Practice implications

IVR uses very few resources and is widely accepted by patients following their discharge from hospital. It has the potential to enhance the timely provision of follow-up counseling, a critical component of successful smoking cessation. Further investigations are required to definitively assess its impact. It may also be effective for other behaviour modifying interventions in a variety of clinical settings.

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Appendix A. IVR questions and responses

"This is the Heart Institute Smoking Cessation Program calling. Thank you again for participating in our smoking cessation program. We're calling to see how you are progressing. Please answer the following questions by answering yes or no."

1a.) "Are you (patient's name)?"

If "yes" to 1a:

2a.) "Have you smoked any cigarettes, even a puff, since you left the hospital?"

If "no" to 2a:

3a.) "On a scale of 1-10, with 10 being the most confident, how confident are you that you will remain a non-smoker?"

If self-efficacy 7 or >:

4. "What quit method are you using?
   a.) Nicotine patch, gum or inhaler?
   b.) Zyban
   c.) Self-help books.
   d.) Counseling, such as *telephone Quit lines* or web sites?
   e) Any other method.

5. "Thank you and congratulations. Remaining smoke-free is the most important thing you can do to positively affect your heart health! We will be calling again in 11 days. If you need any assistance, please feel free to call the Smoking Cessation Nurse Counselor at 798-5555 ext. 19517"

If self-efficacy < 7:

3b.) "Thank you. We know how difficult it can be to remain smoke-free. The Smoking Cessation Nurse Counselor will be calling you within the next 48 hours to help you deal with any difficulties you may be experiencing. If you would like to speak with the Smoking Cessation Nurse Counselor earlier, please call 798-5555 extension 19517."

If "no" to 1a:

1b.) "Thank you. We would like to reach (patient's name). We will try again _____. If (patient's name)should like to contact us, we can be reached at _____."

If "yes" to 2a:

2b.) "How many cigarettes per day are you smoking?"

2c.) "Do you want to quit?"

If "no" to 2c:

2d.) "We understand that you are not ready to quit right now. Things can change and should you need any information on how to quit or support during this process, please do not hesitate to call the Smoking Cessation Nurse Counselor at 798-5555 extension 19517. We will be calling again in 11 days."

If "yes" to 2c:

2e.) "Do you want to quit within the next month?"

If "yes" to 2e:

2f.) "Great! Quitting smoking is the most important thing you can do to positively affect your heart health! Our Smoking Cessation Nurse Counselor will be calling you within 48 hours to help you develop a plan. Please don't hesitate to call should you wish to speak with the Smoking Cessation Nurse Counselor at any time. The number to call is 798-5555 extension 19517."

If "no" to 2e:

2g.) "We understand you are not ready right now. Please do not increase the number of cigarettes you are now smoking. We will be calling again in 11 days to see how you are doing. Please don't hesitate to call the Smoking Cessation Nurse Counselor at any time should you feel you need support or information at 798-5555 extension 19517."

References

[1] Heart and Stroke Foundation of Canada. The growing burden of heart disease and stroke in Canada 2003. Ottawa: Heart and Stroke Foundation of Canada; 2003.

[2] Critchley JA, Capewell S. Mortality risk reduction associated with smoking cessation in patients with coronary heart disease: a systematic review. JAMA 2003;290:86–97.

[3] Reid R, Pipe A, Higginson L, Johnson K, D'Angelo MS, Cooke D, Dafoe W. Stepped care approach to smoking cessation in patients hospitalized for coronary artery disease. J Cardiopul Rehab 2003;23: 176–82.

[4] Health Canada. Canadian tobacco use monitoring survey 2003. Ottawa: Health Canada; 2004.

[5] Thomson CC, Rigotti NA. Hospital- and clinic-based smoking cessation interventions for smokers with cardiovascular disease. Prog Cardiovasc Dis 2003;45:459–79.

[6] van Berkel TF, Boersma H, Roos-Hesselink JW, Erdman RA, Simoons ML. Impact of smoking cessation and smoking interventions in patients with coronary heart disease. Eur Heart J 1999;20: 1773–82.

[7] Fiore MC. US public health service clinical practice guideline: treating tobacco use and dependence. Respir Care 2000;45:1200–62.

[8] Barth J, Critchley J, Bengel J. Efficacy of psychosocial interventions for smoking cessation in patients with coronary heart disease: a systematic review and meta-analysis. Ann Behav Med 2006;32:10–20.

[9] Rigotti NA, Munafo MR, Murphy MF, Stead LF. Interventions for smoking cessation in hospitalised patients. Cochrane Database Syst Rev 2003. CD001837.

[10] Friedman RH, Kazis LE, Jette A, Smith MB, Stollerman J, Torgerson J, Carey K. A telecommunications system for monitoring and counseling patients with hypertension. Impact on medication adherence and blood pressure control. Am J Hypertens 1996;9:285–92.

[11] Kobak KA, Greist JH, Jefferson JW, Mundt JC, Katzelnick DJ. Computerized assessment of depression and anxiety over the telephone using interactive voice response. MD Comput 1999;16:64–8.

[12] Piette JD, McPhee SJ, Weinberger M, Mah CA, Kraemer FB. Use of automated telephone disease management calls in an ethnically diverse sample of low-income patients with diabetes. Diabetes Care 1999;22: 1302–9.

[13] Corkrey R, Parkinson L. A comparison of four computer-based telephone interviewing methods: getting answers to sensitive questions. Behav Res Meth Instrum Comput 2002;34:354–63.

[14] Corkrey R, Parkinson L. Interactive voice response: review of studies. Behav Res Meth Instrum Comput 2002;34:342–53.

[15] Hudson D. Using interactive voice response technology to enhance relapse prevention. In: Proceedings of the national conference on tobacco or health; 2003.

[16] Schneider SJ, Schwartz MD, Fast J. Computerzied, telephone-based health promotion: smoking cessation program. Comput Hum Behav 1995;11:135–48.

[17] Ossip-Klein DJ, Bigelow G, Parker SR, Curry S, Hall S, Kirkland S. Classification and assessment of smoking behavior. Health Psychol 1986;5(Suppl.):3–11.

[18] Fagerstrom KO. Measuring degree of physical dependence to tobacco smoking with reference to individualization of treatment. Addict Behav 1978;3:235–41.

[19] Ockene J, Kristeller JL, Goldberg R, Ockene I, Merriam P, Barrett S, Pekow P, Hosmer D, Gianelly R. Smoking cessation and severity of disease: the Coronary Artery Smoking Intervention Study. Health Psychol 1992;11:119–26.

[20] West R, Hajek P, Stead L, Stapleton J. Outcome criteria in smoking cessation trials: proposal for a common standard. Addiction 2005;100: 299–303.

[21] France EK, Glasgow RE, Marcus AC. Smoking cessation interventions among hospitalized patients: what have we learned? Prev Med 2001;32:376–88.

[22] Irvin JE, Brandon TH. The increasing recalcitrance of smokers in clinical trials. Nicotine Tob Res 2000;2:79–84.

[23] Irvin JE, Hendricks PS, Brandon TH. The increasing recalcitrance of smokers in clinical trials II: pharmacotherapy trials. Nicotine Tob Res 2003;5:27–35.