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Editorial

Web-Assisted Tobacco Interventions: Empowering Change in the Global Fight for the Public's (e)Health

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Abstract

Tobacco control in the 21st century faces many of the same challenges as in the past, but in different contexts, settings and enabled by powerful new tools including those delivered by information and communication technologies via computer, videocasts, and mobile handsets to the world. Building on the power of electronic networks, Web-assisted tobacco interventions (WATI) provide a vehicle for delivering tobacco prevention, cessation, social support and training opportunities on-demand and direct to practitioners and the public alike. The Framework Convention on Tobacco Control, the world's first global public health treaty, requires that all nations develop comprehensive tobacco control strategies that include provision of health promotion information, population interventions, and decision-support services. WATI research and development has evolved to provide examples of how eHealth can address all of these needs and provide exemplars for other areas of public health to follow. This paper discusses the role of WATI in supporting tobacco control and introduces a special issue of the Journal of Medical Internet Research that broadens the evidence base and provides illustrations of how new technologies can support health promotion and population health overall, empowering change and ushering in a new era of public eHealth.

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KEYWORDS

Web-assisted tobacco intervention; public health; eHealth; tobacco control; tobacco cessation; prevention; population health; Internet

Welcome to the Theme Issue on Web-Assisted Tobacco Interventions

Tobacco control is at a crossroads. On the positive side, tobacco-related diseases are being prevented and treated better than ever. For example, in the United States, the overall cancer death rate decreased by 12% between 1991 and 2003. A significant proportion of this decline (40%) is not due to breakthroughs in molecular medicine, gene therapy, or other highly technical treatments, but to a behavioral intervention: smoking cessation [1]. This effect is evident in all cancers put together, not just lung cancer.

While positive, the gains shown in countries where tobacco use was first widespread (and where tobacco control efforts first took hold) are made less visible by the threat that tobacco continues to pose globally. Tobacco was responsible for more than 100 million deaths worldwide in the 20th century and is forecast to kill at least one billion more in the century to come.

More troubling perhaps is that 80% of such deaths are projected to occur in the developing world [2], where tobacco companies have focused their marketing efforts [3]. Half of the current smokers today (about 650 million people) will die as a result of tobacco use, with tobacco use accounting for the premature death of 4.9 million people worldwide [4].

To profile the state of tobacco and its current threat and impact on population health, the World Health Organization identified six strategies that are essential to reducing the burden of tobacco worldwide: 1) *M*onitor tobacco use and prevention policies, 2) *P*rotect people from tobacco smoke, 3) *O*ffer help to quit tobacco use, 4) *W*arn about the dangers of tobacco, 5) *E*nforce bans on tobacco advertising, promotion and sponsorship, and 6) *R*aise taxes on tobacco (MPOWER). Combined, these MPOWER strategies comprise the comprehensive tobacco control strategy that is reflected in the Framework Convention on Tobacco Control [5], the world's first global public health treaty. What the report does not articulate – indeed what tobacco control struggles with as a whole – is how strategies like these can be carried out in practice and identifying the methods that are effective, transnational in scope, efficient in their use of scarce resources, and accessible to those that need them.

It is here that technology-enabled information tools hold promise. Web-assisted tobacco interventions (WATI) represent the vanguard of a new method of engaging the public, health professionals, and researchers alike in tobacco control as part of a greater *public eHealth* strategy. Technologies such as interactive websites, wireless phones, and handheld computers have shown promise as tools to support smoking prevention and cessation [6-13], health policy development [14] and knowledge translation for health promotion [15]. To support establishment of this nascent transdisciplinary field of research and practice, the WATI Initiative was developed in 2004 to support the development, study, and implementation of technology-delivered interventions to support tobacco control [16]. The *Web* part of WATI refers not only to interventions that are accessible from a desktop and the World Wide Web, but also to other networked technologies such as wireless phones or hybrid mobile devices such as the *iPhone*, *Blackberry* or other 'smart phone' handsets. As information becomes more tightly integrated across technologies this will remain an important distinction, particularly given the blurring of technologies that allow tools to be accessed across platforms and devices.

WATI resources have focused on four key areas: 1) cessation, 2) prevention, 3) social support, and 4) professional development and training. They can be used as a stand-alone intervention, a complement to other (mostly non-Internet) resources, or as an integrated component within a larger intervention [17]. WATI-focused research has received considerable attention within the eHealth field, including many publications in this journal over the past 10 years [8, 18-26]. WATI resources are becoming popular in part because the high proximal (and rising) levels of Internet access in many countries [27] and the prospect that, with wide reaching accessibility, a small shift in behavior attributed to a Web intervention can readily translate into a large population health effect.

Never before has this been more important considering the prognosis outlined by the WHO. Yet in spite of such promise, eHealth's principal challenge is ensuring the distribution of benefits are equitable and do not simply confer advantages to those who already have resources [28]. It also means considering how eHealth tools used in a developed nation may not be the same ones we employ in the developing world to address tobacco control. For example, as anyone who has travelled widely can see, wireless phones are used for much more than talking (such as banking or ecommerce) in Africa, Asia and Europe, but much less so in North America. Likewise, penetration of smart phone technology through tools such as the Blackberry and others remain largely confined to the US, Canada and Western Europe. But in both cases, the use of technology is rapidly transforming the way people interact locally and globally.

However, these changes are providing avenues for tobacco promotion as well as control. Advertisements, such as the one depicted in Figure 1 from one of the author's recent visits to Tanzania, illustrate ways in which technology is being blended into promotions for tobacco products. Here, a phone camera is used as a technology-friendly way to accent cigarette promotions. In other areas, the Internet has provided a transnational avenue towards the establishment of 'dark markets' where the tobacco industry has sought to exploit, reaching populations that are illegal to sell to, such as youth, in places where they are otherwise legally forbidden to advertise [29-31] and where the regulations governing Internet communications are often unclear.

Figure 1. Cigarette billboard advertisement, Arusha, Tanzania, January 2007

The rise of new tools that blend photography, video, text, and voice and move information from stationary computers to mobile technologies have enabled countries that had no access to remote resources to leapfrog forward in the telecommunications evolution [32]. Where the digital divide was once great, it is now reduced considerably allowing new economies to develop and new opportunities to reach people through information and communication technologies to promote health. The rise of 'Web 2.0' technologies, itself the subject of a recent special issue of JMIR and a new annual conference[33], reduces the barriers to engagement even further. These tools combine user-created content with easy to operate programs has engaged a new participant (the public) in tobacco control like never before. Social networks like *Facebook* and *MySpace*, or media sharing sites like *YouTube* and *Flickr* are creating new conversations about how to use information technology to help people quit smoking, prevent others from starting, and influencing policy makers on a variety of health issues [34]. It is also creating a new venue for the tobacco industry to attract new customers [35].

The significance of WATI-related research transcends the domain of tobacco cessation, and should be of interest for a wide range of researchers, beyond the tobacco control community. Because of the high prevalence of tobacco abuse (thus large sample sizes), "hard" and comparably easily measurable outcomes (e.g. smoking frequency), and solid research funding for this area, WATI programs have made (and are continuing to make, as showcased by the articles published in this theme issue) important contributions to building the evidence-base for the theory and practice of developing and evaluating Web-based behaviour change programs. The lessons learned in the application of eHealth strategies in the fight against tobacco can be applied in other areas of preventive medicine. More than one third of cancer deaths are attributable to nine modifiable risk factors [36], of which smoking is only one. The other 8 factors are high body mass index, low fruit and vegetable intake, physical inactivity, alcohol use, unsafe sex, urban air pollution, indoor use of solid fuels, and injections from healthcare settings contaminated with hepatitis B or C virus, and at least the first five risk factors are modifiable and can be supported by public eHealth interventions which are very similar to WATI. Interventions addressing these risk factors - in particular those addressing obesity, which is approaching a similar state as tobacco in its threat to population health, have a vast impact on cancer and chronic conditions like diabetes and cardiovascular diseases.

This special issue of the *Journal of Medical Internet Research* presents examples of the state-of-the-art in the research and practice of interventions designed to advance tobacco control through information technology and provides exemplars to guide public health more broadly using eHealth. The collection of papers exploring a range of issues from information searches through to reviewing the state of the literature on WATI or showcasing specific examples. The method of delivery includes

traditional websites to mobile phone text messages, while the research designs include qualitative inquiries to randomized controlled trials. All together, the diversity and complexity of how technology can contribute to population health is illustrated, providing a window to how WATI can move us towards a new era of public eHealth and eTobacco control.

Acknowledgments

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Conflicts of Interest

Cameron Norman, Peter Selby, and Scott McIntosh are all principal investigators of Web-assisted tobacco intervention projects that produce smoking prevention and cessation materials, however they do not obtain financial benefit from the use and distribution of these resources.

Multimedia Appendix 1

Bibliography WATI Theme Issue (Generic)

[RTF file (Rich Text Format), 44 KB - jmir_v10i5e48_app1.rtf]

Multimedia Appendix 2

Bibliography WATI Theme Issue (for import into LaTeX and BibDesk Bibliographies)

[BIBTEX file (Bibtex Format), 52 KB - jmir_v10i5e48_app2.bibtex]

Multimedia Appendix 3

Bibliography WATI Theme Issue (for import into Endnote Libraries)

[ENW file (Endnote Format), 52 KB - jmir_v10i5e48_app3.enw]

Multimedia Appendix 4

Bibliography WATI Theme Issue (for import into Endnote, RefMan, Procite and RefWorks Libraries)

[RIS file (RIS Format), 52 KB - jmir_v10i5e48_app4.ris]

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Original Paper

Feasibility of Promoting Smoking Cessation Among Methadone Users Using Multimedia Computer-Assisted Education

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Abstract

Background: The prevalence of smoking is very high among methadone users. As a method of delivering health education, computers can be utilized effectively. However computer-assisted education in methadone users has not been evaluated systematically.

Objective: This study was aimed at assessing feasibility and patient acceptance of an interactive educational module of a multi-component smoking cessation counseling computer program for former illicit drug users treated in an outpatient methadone clinic.

Methods: The computer-mediated education for hazards of smoking utilized in this study was driven by major constructs of adult learning theories. The program interface was tailored to individuals with minimal computer experience and was implemented on a touch screen tablet PC. The number of consecutive methadone-treated current smokers enrolled in the study was 35. After providing socio-demographic and smoking profiles, the patients were asked to use the educational program for 40 minutes. The impact of the computer-mediated education was assessed by administering a pre- and post-intervention Hazards of Smoking Knowledge Survey (HSKS). An attitudinal survey and semi-structured qualitative interview were used after the educational session to assess the opinions of participants about their educational experience.

Results: The computer-mediated education resulted in significant increase of HSKS scores from 60.5 ± 16.3 to 70.4 ± 11.7 with t value 3.69 and $P < .001$. The majority of the patients (78.8%) felt the tablet PC was easy to use, and most of the patients (91.4%) rated the educational experience as good or excellent. After controlling for patient baseline characteristics, the effect of computer-mediated education remained statistically significant.

Conclusions: Computer-assisted education using tablet PCs was feasible, well-accepted, and an effective means of providing hazards of smoking education among methadone users.

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KEYWORDS

Smoking cessation; patient education; computer-assisted instruction; methadone maintenance treatment

Introduction

Tobacco smoking is one of the major causes of mortality and morbidity among former illicit drug users [1]. The prevalence of smoking among patients on methadone maintenance treatment is very high; nearly 90% of patients who visit methadone clinics smoke tobacco [2]. At the same time only 1 in 3 US methadone maintenance facilities provides smoking cessation counseling for their patients [3]. For the last decade, however, the situation in this field has improved, as more research and organizational efforts have been applied to enhance smoking cessation among methadone users [4-6].

Computers can be a powerful and cost-effective means of providing health education [7]. The necessity for some computer experience, however, was seen as one of the major obstacles to introducing more sophisticated approaches to smoking cessation, such as interactive computer programs and the Internet [8-11]. Methadone-treated patients are frequently from the low-educated, low-income strata of society. Their computer and general reading literacy is often poor, and they usually do not have access to the Internet [12]. To date, the effectiveness of computer-mediated approaches for promoting smoking cessation has not been systematically studied in this population. The potential of interactive, web-based interventions for health education and counseling in this population is unknown. In addition, little systematic information regarding the smoking decision balance of methadone tobacco users is available in the current literature. No data is available about the possible effect of methadone-treated smokers' socio-demographics, computer literacy, Internet use, and smoking-related behavioral constructs on their ability to successfully use computer-mediated hazards of smoking education. Such information is necessary for developing a targeted anti-smoking, multi-component, computer-mediated program. In this paper we describe development and assessment of an interactive educational module of a multi-component, smoking cessation, counseling computer program for former illicit drug users treated in a methadone outpatient clinic.

The main aims of this study included: (1) development of theoretical framework for computer-mediated hazards of smoking education guided by adult learning theories; (2) implementation of the interactive education program using tablet PC; (3) assessment of the feasibility and patient acceptance of the educational module in methadone-treated patients; (4) collection of systematic information on smoking profiles and attitudes of methadone tobacco users for developing a targeted multi-component, computerized, smoking cessation counseling system; and (5) establishment of possible factors facilitating or impeding successful computer-mediated education in these patients.

Methods

Learning theories have been shown to improve significantly the efficacy of educational software [13,14]. Conventional education means, such as lectures, seminars, workshops, books, and videos already incorporate, more or less successfully, practical approaches to learning developed over centuries. Computer-mediated education is an interactive tool, and many approaches that are used intuitively in other spheres may not be applied without a clear understanding and formulation. A computer program has no ability to summarize, repeat, provide feedback or give an additional example if this capacity is not specified and implemented in advance. When designing our learning program, we reviewed over 50 of the most frequently cited theories of adult learning and found that only some of them can be used for constructing a computer program, because many of the theories have no clear experimental support and are applicable only for certain subjects or could be used only under specific conditions or only for a certain part of the learning process. The reviewed theories can be grouped into 4 domains presented in the Table 1.

Table 1. Learning theories used in the design of the web-based educational program

Domains	Areas of Concentration	Examples
Cognitive theories	Process of acquisition and organization of knowledge	ACT-R (Adaptive Control of Thought—Rational) Theory [15]; Dual Coding Theory (A. Paivio) [16]
Behavioral theories	Transformation of the outer stimuli into behavior	Connectionism (E. Thorndike) [17]; Contiguity Theory (E. Guthrie) [18]; Drive Reduction Theory (C. Hull) [19]
Humanistic theories	Learning and person, motivation	Experiential Learning (C. Rogers) [20]
Instructional theories	Practical design of learning	Adult Learning Theory (P. Cross) [21]; Conditions of Learning (R. Gagne) [22]

For the purpose of this study, the most important attributes of the existing learning theories were not the general psychological assumptions underlying each theory, but their applicability to the development of interactive educational software. Our analysis of different learning theories resulted in 10 main principles in accordance with which we designed our educational program. These principles are described below.

Presenting and Explaining the Goals of Learning

Learning is a goal-directed process, as is emphasized in Sign Learning Theory by E. Tolman [23]. The goals of the whole educational program and its parts were explained to the learners on separate screens. The main goal of the program was to increase patient knowledge about the hazards of smoking, and through this, motivate them to quit smoking. This main task was divided into creating sub-goals in accordance with the program structure, into breaking a problem down into subcomponents, and into solving each of those components.

Clear General Structure of Instruction

The general structure of the educational program should be simple enough to be easily grasped by learners (Constructivist Theory by J. Bruner [24]). Our educational program was structured as a sequence of 6 sections with a final assessment. Each section contained 5 to 9 educational messages with a subsequent multiple-choice question, and had a short 3-4 multiple-choice question quiz at the end.

Information Chunking

Many theories that exist are concerned with the amount of the information in the educational unit. Chunking of information is the basis for the organization of memory according to the Soar Theory by A. Newell et al [25]. The chunk is a meaningful unit of information, united by meaning, time, location, etc. Ideally, the size of these chunks should be individualized making them suitable for each learner. The Information Processing Theory by G. Miller [26] claims that short-term memory is limited to 7 (or 5 to 9) chunks of information. Therefore, we cut down the educational curriculum into small educational tips, and organized the tips into consecutive sections containing from 5 to 9 tips.

Enhancing the Cohesion of Knowledge

The presented information for learning should be highly interconnected (Cognitive Flexibility Theory by R. Spiro, P. Feltovitch, and R. Coulson [27]). Therefore, when providing the learner with new information, we referred to facts they had already learned, thus creating links between facts and creating a system of knowledge.

Case-Based and Problem-Directed Instruction

This approach is very important in order to support learners' motivation and interest, increase knowledge cohesion, and encourage its transference into the real world. According to such theories as ACT-R (Adaptive Control of Thought—Rational) [28], a theory by J. Anderson, and the previously mentioned Cognitive Flexibility Theory [29], adult learning is better when it is provided in the context of "problem-solving" rather than just being "content-oriented." Providing short vignettes or more widespread patient cases can also serve this goal.

Presenting the Most General Ideas First

Following the Subsumption Theory (D. Ausubel) [30], general ideas about smoking were presented first and then specified. At the same time, important concepts were mentioned again in the relevant context with reference to the previously studied material.

Multiple Representation of Content

According to the Cognitive Flexibility Theory (R. Spiro, P. Feltovitch, and R. Coulson) [31], learning activities should include various representations of content, such as images, audio, and textual information. In our program we used mainly text and images; however, the text was also recorded, and patients had an option to turn the audio on or off. Multiple representation was also important because of the low literacy levels expected in this sample [32].

Minimizing Working Memory Load

We selected only essential information and presented all information relevant to 1 unit of information in 1 screen. Therefore, we avoided overloading patients with redundant information. Using our program, patients did not need to integrate physically separate sources (for example, combine information presented as series of consecutive hyperlinks or screens). Images and text in our program supplemented each other. All these approaches were used to minimize working memory load, in accordance with Cognitive Load Theory by J. Sweller [33].

Active Involvement of the Learner in the Learning Process

According to many theories, especially representing behaviorism, learners should actively respond during teaching (Drive Reduction Theory, C. Hull [34]); feedback explaining whether their answers are correct should be provided; and some kind of award or encouragement should be given for correct responses (Operant Conditioning by B. F. Skinner [35]).

Using Appropriate Socio-Cultural Context

The Triarchic Theory by R. Sternberg [36] requires training to be socioculturally relevant to the learner. The content of the hazards of smoking curriculum was made to address our group of patients who were a predominantly poor, low-educated, African-American, and urban population. The text and images were tailored in accordance to this specific group.

The interactive hazards of smoking education was implemented using the Computer-Assisted Education (CO-ED) system, which has been described in previous studies [14,37]. The CO-ED system provides multimedia, self-paced health education guided by adult learning theories [38,39]. Particular attention has been given to development of a self-explanatory, user-friendly interface oriented towards users with minimal computer skills and limited educational background. The user interface implementation was guided by usability principles for technology designed for individuals with certain limitations in cognitive, perceptual, and motor skills [40]. Overall, the user interface was required to comply with the following principles: (1) Provide equivalent alternatives to auditory and visual content; (2) Don't rely on color alone (provide redundant cues); (3) Provide context and orientation information; (4) Provide clear navigation mechanisms; (5) Ensure that documents are clear and simple; (6) Use large areas of white space and small blocks of text; (7) Provide larger graphics and click targets; (8) Use contrasting foreground and background colors; (9) Minimize blinking images and animation; and (10) Use at least 12-point size fonts and avoid using too many different fonts.

A touch-screen tablet PC was chosen as a computer platform for this project, based on our previous successful experience in using mobile devices for health education in low-income inner-city populations [39,56]. This platform allowed us to successfully implement software which was compliant with the above mentioned usability principles. The small size of the tablet PC also allowed us to minimize the space necessary for conducting the study. Since touch-screen technology has already been successfully introduced to the general population, the time required for training to use the computer and the educational program was very limited. The low reading literacy of this particular group of patients was addressed by using large fonts (36 pixels and larger), maintaining text readability at a fifth-grade level, and providing audio functionality with all text read aloud. The patients could turn this function on or off depending on their needs. Only 1 educational message was displayed per screen, allowing for both an increase in readability

and a decrease in work memory load. Each structural field of the screen was color-coded (ie, fields with educational messages, multiple choice questions, answers, and prompts each had its own color to make it easier to identify them intuitively when moving from screen to screen). Screen navigation was streamlined and tested to make it error proof. Each screen had only 1-2 options leading to another screen, and no combination of actions could possibly lead to an error. Figure 1 shows the appearance of the start screen, educational message screen, multiple-choice question screen, and feedback screen.

The study utilized quasi-experimental pre/post design [41,42]. From an outpatient methadone maintenance treatment clinic located at downtown Baltimore, 35 consecutive methadone-treated current smokers were recruited. All study protocol was carried out during a single patient visit (Figure 2). At the beginning of the study, sociodemographics and smoking profiles were collected, and a hazards of smoking knowledge survey was administered. Following the baseline interview, the patients were asked to spend 40 minutes on the hazards of smoking education program installed on a tablet PC. Immediately after completion of the educational session, the patients were asked to complete the hazards of smoking knowledge survey again. Finally, an attitudinal survey and semi-structured qualitative interview were administered to assess patient acceptance of the computer-mediated educational program.

Figure 1. Selected screens of the computer program used in the study: (1) the start screen of the program; (2) educational message; (3) multiple-choice question; and (4) correct answer screen

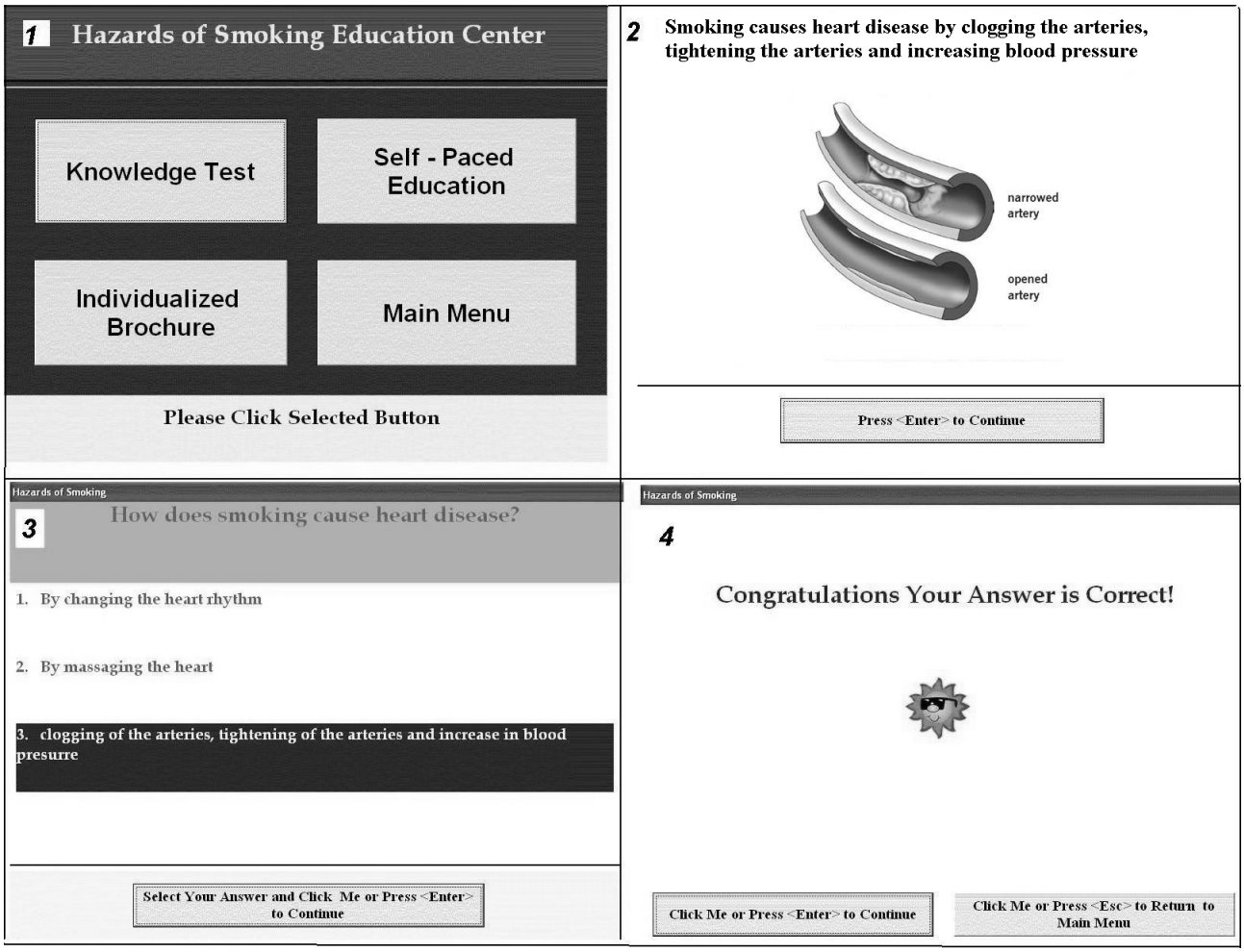
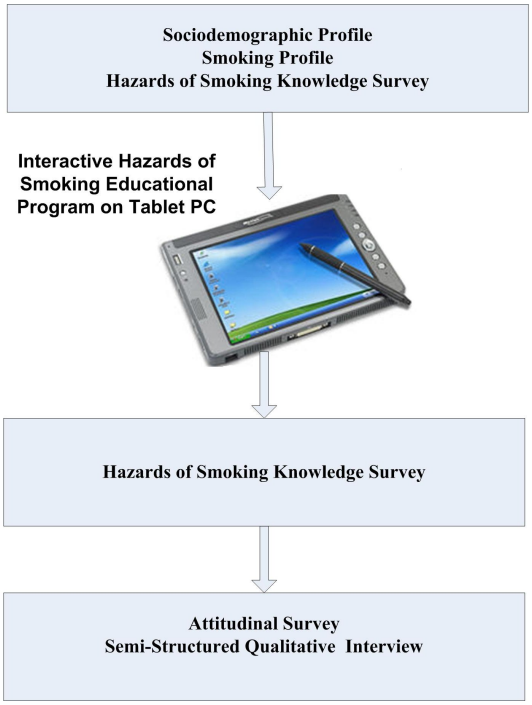


Figure 2. The design of the study



The baseline interview included information on patient socio-economic status, demographic, computer literacy, and smoking profile. The smoking profile consisted of smoking history and major behavioral factors known to affect interest in smoking cessation. The behavioral factors were assessed using the Stages of Change Scale, Smoking Self-Efficacy Questionnaire and an open-ended decision balance survey. The hazard of smoking knowledge survey was used to assess the efficacy of the computer-mediated intervention. The baseline variables were utilized to ascertain whether sociodemographic or behavioral factors affect the education program outcomes.

The Hazards of Smoking Knowledge Survey (HSKS) contained questions about hazards of smoking information recommended for patient education by the Department of Health and Human Services and Centers for Disease Control and Prevention guidelines [43,44]. The knowledge survey consisted of 35 basic "true" or "false" statements about smoking and its harmful health effects. The final score of this survey was calculated as a percentage of correct answers. Separate scores were also calculated for 4 major topics of the hazards of smoking educational curriculum based on a corresponding subset of questions from the knowledge survey: (1) general information about tobacco smoking; (2) health consequences of smoking; (3) nicotine addiction; and (4) quitting smoking.

The Stages of Change Scale [45,46] has been widely used to measure readiness to quit smoking according to Prochaska and DiClemente's Transtheoretical Model [47]. The scale was shown to have good psychometric properties and external validity [48]. Its test-retest reliability (kappa) was 0.78 in a sample of 404 Australian smokers [49].

The Smoking Self-Efficacy Questionnaire (SEQ-12) measures the confidence of current and former smokers in their ability to abstain from smoking in high-risk situations [50]. Lower self-efficacy means that an individual is more tempted to smoke, and vice versa. The SEQ-12 includes 2 sub-scales which measure ability to refrain from smoking when facing internal or external stimuli. The questionnaire has excellent psychometric properties with internal consistency coefficients above 0.94 [50].

The smoking decision balance was ascertained using a patient-administered survey including open-ended questions. The smoking decision balance [51] plays an important role in smoking decision-making according to the Transtheoretical model that is widely used for smoking cessation [52]. The patients were asked (1) to describe the things about smoking that they like and do not like; (2) to explain what they would like about quitting smoking, and what would worry them or would be difficult about quitting smoking; and (3) to describe barriers, triggers, and possible coping mechanisms related to smoking cessation. The patient answers were coded and analyzed using HyperRESEARCH software. The positive and negative factors affecting the decision to quit smoking were summed up in 2 separate variables characterizing the total number of facilitating and inhibiting factors to quit.

An attitudinal survey and semi-structured qualitative interview were administered after the educational session to assess the opinions of participants about their experience. The attitudinal survey was aimed at grading patients' acceptance of the computer program, and their perceptions of its usability and user-friendliness. The semi-structured qualitative interview was used to elicit subjects' perceived limitations and concerns about the hazards of smoking program, and to identify directions for future improvements. The attitudinal survey [14,56] and qualitative interview [53-55] were used successfully in our previous studies to evaluate patient acceptance and attitudes towards new computer technology.

All statistical analyses were performed using SAS software version 9.1. Frequencies and percentages were calculated for

all categorical variables. Means, medians, SDs, and ranges were computed for continuous variables. Inferential statistics included analysis of variance (ANOVA), and *t* tests. As a 1-factor experiment, ANOVA was used to test for differences between 2 groups (before and after), controlling for education, age, income level, gender, job status, frequency of computer use at home and at work, frequency of using the Internet and ATM machines, smoking stages of change, and number of facilitating and inhibiting factors of smoking cessation. ANOVA was performed using PROC GLM in SAS for unbalanced designs. Qualitative data were transcribed, coded, and analyzed with qualitative analysis software HyperRESEARCH version 2.5.

Results

The study sample consisted of 23 women (65.7%) and 12 men, 45.4 ± 6.7 years old, with an average 11.2 ± 1.7 years of education. Most of the patients were unemployed and had income of $20,000 a year or less (Table 2). Most of the patients (21/35, 60.0%) had never used computers in their lives.

The patients had smoked, on average, for 23.2 ± 10.2 years. Those patients who had discussed their smoking at least once with their doctors numbered 20 (20/35, 57.1%), although it was not connected with their knowledge about hazards of smoking or their stages of change. More than half of the patients considered smoking to be a severe problem for them, while only 1 patient thought it was not a problem at all. The total smoking self-efficacy score was 27.3 ± 12.4, which corresponds to a low perceived ability to abstain from smoking. According to Prochaska's Stages of Change Scale, 8 patients were in the preparation stage (8/35, 22.9%), the majority were in the contemplation stage (16/35, 45.7%), and the remaining patients were in precontemplation (10/35, 28.6%).

The odor of smoke was the most frequently reported unpleasant effect of smoking (12/35, 34.3%), along with breathing and lung problems (Table 3). The main trigger to smoke was feeling nervous or depressed (25/35, 71.4%). About 20% of participants (7/35) expected to become nervous or depressed after quitting. Feeling relaxed or calm was the most frequently reported benefit of smoking (23/35, 65.7%). No desire to quit was the most frequently cited barrier to quitting, reported by 6 patients (6/35, 17.1%) (Table 3).

Table 2. Baseline characteristics of the study sample (N=35). See text for continuous variables (age, education, years of smoking).

Categorical Variables	% (N)
Sex	
Male	28.6% (10)
Female	65.7% (23)
Missing	5.7% (2)
Income level	
No Income	8.6% (3)
<20K	62.8% (22)
20K-30K	5.7% (2)
30K-40K	2.9% (1)
40K-50K	2.9% (1)
Missing	17.1% (6)
How much do you smoke?	
½ pack a week	2.9% (1)
½ pack a day	25.7% (9)
1 pack a day	57.1% (20)
2 packs a day or more	14.3% (5)
Job	
Permanent	17.1% (6)
Temporary/part-time	5.8% (2)
None	77.1% (27)
Internet Use	
Never	74.3% (26)
Once a month or less	11.4% (4)
Once a week	5.7% (2)
Once a day	8.6% (3)
Computer use	
Never	60.0% (21)
Once a month or less	20.0% (7)
Once a week	5.7% (2)
Once a day	14.3% (5)
Self-reported knowledge about quitting smoking	
None	11.4% (4)
Very limited	62.9% (22)
Good	22.8% (8)
Missing	2.9% (1)
How severe of a problem do you consider your smoking?	
Not a problem	2.9% (1)
Mild problem	14.3% (5)
Moderate problem	25.7% (9)
Severe problem	57.1% (20)

Table 3. Smoking decision balance (patients could mention as many benefits or negative consequences as they liked)

	Frequency (N = 34)
Benefits of smoking	
Relaxation, calming affect	23 (67.6%)
Pleasure	7 (20.6%)
Taste	7 (20.6%)
Helps digest food	4 (11.8%)
Appearance when you are smoking	2 (5.9%)
Feeling refreshed	2 (5.9%)
Process of smoking itself	2 (5.9%)
Being a part of the group	1 (2.9%)
Benefits of quitting	
Good for health in general	7 (20.6%)
Decreased breathing problems	7 (20.6%)
Saves money	11 (32.4%)
No odor of smoke	9 (26.5%)
Better taste of food	5 (14.7%)
Other specific health benefits	4 (11.8%)
Better appetite	3 (8.8%)
Psychological benefits	2 (5.9%)
Barriers to quitting smoking	
No desire to quit	6 (17.6%)
Expected weight gain	5 (14.7%)
Temptation to smoke	5 (14.7%)
Stressful life	4 (11.8%)
Need help to quit	3 (8.8%)
Want to be a part of the group	3 (8.8%)
Other health consequences of quitting	3 (8.8%)
Other barriers	3 (8.8%)
Strategies to cope with smoking urges	
Substitute with meals or chewing gum	17 (50.0%)
Substitute with other activities	13 (38.2%)
Not to be around smokers	7 (20.6%)
Getting help or medications	4 (11.8%)
Other coping behaviors	5 (14.7%)
Negative consequences of smoking	
Odor of smoke	12 (35.3%)
Breathing and lung problems	12 (35.3%)
Possibility of cancer	6 (17.6%)
Bad for health in general	6 (17.6%)
Expensive	6 (17.6%)
Bothers other people	5 (14.7%)
Yellow teeth color	5 (14.7%)

	Frequency (N = 34)
Bad breath	5 (14.7%)
Other health problems	3 (8.8%)
Burned clothes	3 (8.8%)
Bad taste of food	2 (5.9%)
Other	3 (8.8%)
Negative consequences of quitting	
Nervousness or depression	7 (20.6%)
Weight gain	6 (17.6%)
Urges when smelling odor of smoke	5 (14.7%)
Temptation to smoke	4 (11.8%)
Being among smokers	4 (11.8%)
Other	2 (5.9%)
Smoking triggers	
When nervous or depressed	25 (73.5%)
After eating a meal	22 (64.7%)
In the morning or after waking up	21 (61.8%)
When using bathroom	6 (17.6%)
When with friends or other people	5 (14.7%)
At night or before bed	5 (14.7%)
During relaxation or rest	4 (11.8%)
After drinking alcohol	4 (11.8%)
At noon	4 (11.8%)
Other triggers	4 (11.8%)

Although the questions asked were very basic and simple, the average knowledge score at pre-test was 60.5 ± 16.3 points (corresponding to the percentage of correct answers). Participants scored lower than the total average for questions under category of ‘Nicotine addiction,’ and ‘Quitting smoking.’ Examples of quiz statements the validity of which many patients could not assess correctly for ‘Nicotine addiction’ include ‘Nicotine is an addictive chemical’ and ‘Nicotine causes the arteries to loosen and allow more blood flow’; for ‘Quitting smoking’, examples are ‘Quitting smoking starts to benefit your health about 1-2 years after quitting’ and ‘If you smoked for more than 10 years quitting won’t help’. As a result of computer-mediated education, participant knowledge about the hazards of smoking significantly increased to 70.4 ± 11.7 points, $P < .001$. The increase in knowledge was not associated with the patients’ level of education or computer experience. In 3 major curriculum topics out of 4, the increase in knowledge scores was statistically significant (Table 4).

Table 4. Hazards of smoking knowledge scores before and after the intervention (N = 34)

Topics	Pre-test Post-test	T value (*P*)
1. General information about tobacco smoking	69.6 ± 16.7 79.9 ± 11.4	2.97 (.004)
2. Health consequences of smoking	58.8 ± 19.1 70.6 ± 14.4	2.87 (.006)
3. Nicotine addiction	41.9 ± 30.0 55.9 ± 23.9	2.13 (.04)
4. Quitting smoking	47.1 ± 28.7 58.1 ± 22.0	1.78 (.08)
Total	60.5 ± 16.3 70.4 ± 11.7	3.69 (< .001)

In order to establish factors facilitating or impeding successful computer-mediated education, analysis of variance (ANOVA) was employed. Considering the study design as a 1-factor experiment, ANOVA was used to test for differences between pre- and post-test knowledge scores controlling for sociodemographics, computer experience, smoking history, stages of change, and number of perceived inhibitors and facilitators of smoking cessation. The education was stratified into 'less than high school' and 'high school or more' groups. Age was categorized as < 45 and ≥ 45 groups. The income was divided into 3 groups: no income, < 20K, and ≥ 20K. Job status was stratified into 'employed' and 'no job' and the amount of smoking was categorized as '2 packs a day or more', '1 pack a day', '1/2 pack a day', and '1/2 pack a week.' Frequency of using the Internet or a computer was categorized into 2 groups: 'never' and 'use at least once a month'. The stages of quitting smoking were categorized into 3 groups: pre-contemplation, contemplation, and preparation. Patients were asked to list any factors that inhibit and facilitate their intentions to quit smoking. The number of these factors was introduced into the model, which were stratified into 2 groups using their median value as a dividing point (the number of inhibitors: 1-7 and > 7, the facilitators: 1-6 and > 6). After controlling for all these variables, the difference between pre- and post-test knowledge scores remained significant (P = .004). The variables which significantly affected knowledge gain were gender (males were more likely to have a higher knowledge gain than females, P = .015), age (people over 45 were less likely to have a knowledge gain, P = .02), stage of change (subjects in contemplation were more likely to have higher knowledge gain, P = .03), and the number of facilitating factors to quit smoking (patients with more facilitators were more likely to study more successfully, P = .002). Patient education level, computer experience, and Internet use did not affect the results of computer-assisted education.

Acceptance of the program interface according to the Attitudinal Survey is presented in Table 5. The program was very well accepted by the overall participants. One patient did not complete the attitudinal survey and another patient missed filling in questions #9 and #18. Therefore, percentages for questions #9 and #18 are calculated based on 33 participants and the rest are calculated based on 34 participants. For 78.8% (26) of patients, using the computer was not complicated at all. Most of the patients (32 persons, 94.0%) rated the program as good or excellent. The majority of patients had little or no problem understanding the presented information, but 27.3% (9 patients) encountered very significant amounts of unknown words. About 18% (6) of patients claimed that they encountered information which was difficult to understand, and 11.8% (4) frequently found it confusing (Table 5).

Patients' feedback about their learning experience was ascertained using semi-structured qualitative interviews. Except for a short training session (~ 10 minutes) provided by a research assistant, 28 (82.4%) participants did not need any help during the educational session. One participant did not complete the qualitative interview; therefore percentages are calculated based on 34 participants. Only 7 (20.6%) patients felt tired at the end of the educational session, and 5 (14.7%) believed the educational session was too long. Regarding ways to improve the program, 7 (20.6%) patients thought they would prefer to listen to the educational messages; 18 (52.9%) thought they would like to both read and listen to the information; and 27 (79.4%) thought that including more video clips would make the program better. For 31 (91.2%) patients it was amenable to answer a multiple choice question after each educational message; 26 (76.5%) were compliant with the conditional self-quiz design of the educational session (ie, patients had to demonstrate sufficient knowledge of a module before being allowed to move to the next one); and 24 (70.6%) patients felt "it was ok to repeat the whole section again." Finally, more than half of the patients (20, or 58.8%) preferred using a computer program to learn about smoking over more traditional types of education, such as brochures, videotapes, healthcare providers, and browsing the Internet.

Table 5. Patient satisfaction and attitudes toward different aspects of their educational experience according to the attitudinal survey

#	Question		Option[†] (%)			
		Total N	1	2	3	4
1	How complicated was it to use the computer?	34	11.8	5.9	2.9	79.4
2	Did you have any difficulty in moving from one screen to another?	35	91.3	2.9	2.9	2.9
3	How difficult was it to use the keyboard/mouse?	35	2.9	5.9	2.9	88.3
4	Did you have any difficulties in reading text from the computer screen?	35	91.2	5.9	0.0	2.9
5	Was the size of the text presented on the screen sufficient?	35	85.3	5.9	2.9	5.9
6	Did you like the colors used on the computer screen?	35	85.3	8.8	5.9	0.0
7	Did you like the audiovisual content provided by the computer?	35	91.2	5.9	0.0	2.9
8	Did you get all the necessary information about using the computer during initial practice session?	34	91.2	5.9	0.0	2.9
9	Did you come across any unknown words which were not explained by the computer?	33	27.3	6.1	12.1	54.5
10	How difficult were the sentences used in the educational materials?	34	5.9	5.9	8.8	79.4
11	How much new information did you get using the computer?	35	67.7	23.5	5.9	2.9
12	Did you get any feedback from computer about your learning progress?	35	67.6	14.7	11.8	5.9
13	How frequently did you find the information confusing?	35	11.8	17.6	14.7	55.9
14	How frequently did you find educational contents difficult to understand?	35	17.6	8.8	26.5	47.1
15	Did you have to wait for new information to come up on the screen?	35	11.8	5.8	11.8	70.6
16	Would you like to use this educational program in the future?	35	100.0	0.0	0.0	0.0
17	Would you advise other patients to use this educational program?	34	91.2	8.8	0.0	0.0
18	Overall how would you grade this educational program?	33	3.0	3.0	18.2	75.8

[†]The following options were used for the questions above (in the ascending order):
#1: Very complicated, Moderately complicated, Slightly complicated, Not complicated at all
#2, #4: Not at all, Very rarely, Frequently, All the time
#3, #10: Very difficult, Moderately difficult, Slightly difficult, Not difficult at all
#5: Fully sufficient, Sufficient almost all the time, Sufficient some of the time, Not sufficient at all
#6, #7: Certainly yes, To a large extent, To some extent, No
#8: All information, Almost all information, Partial information, Very limited information
#9: Very significant, Considerable, A few, None
#11: Very significant amount, Considerable, Little, Very little
#12, #15: All the time, Occasionally, Very rarely, Never
#13, #14: Very frequently, Occasionally, Very rarely, Never
#16, #17: Certainly yes, Maybe, Unlikely, No
#18: Needs serious improvement, Satisfactory, Good, Excellent

Discussion

Computer-assisted patient education utilizing the main concepts of adult learning theories was successfully implemented in methadone-treated smokers. The results showed statistically significant increases in the subject knowledge scores. This result remained statistically significant after adjusting for major sociodemographic factors, smoking profile, and behavioral factors. The majority of the patients were able to navigate successfully the user interface even though most of them had never used computers before. These results corroborate our previous findings in which we showed that even low-income individuals with limited education and no previous computer skills were able to navigate successfully an educational computer program after 5-15 minutes of supervised training, when specific user interface principles were implemented [38,39,56].

Former drug users on maintenance methadone treatment are quite different from other groups of patients who need smoking cessation interventions. They are often depressed and have other psychiatric problems including chemical and non-chemical dependencies. Our research team is in the process of the development of a comprehensive computerized smoking cessation program. Testing of the educational module of this program was done to get feedback from patients about its acceptability and design, and also to elicit additional information about their smoking profiles. After only a brief training session, the patients, most of whom were using computers for the first time in their lives, were able to go through the educational program. Our education intervention was successful, and the program installed on tablet PCs was very well accepted by the patients.

Learning theories cannot serve as a universal recipe or magic pill to improve patient education [57]; rather they should be

used and applied thoughtfully and selectively [13]. In designing our educational program we used a mix of ideas derived from different theories. Though this approach prevented us from assessing which particular ideas mostly contributed to outcomes, we thought that for the success of the intervention it was more important to provide a theoretical framework incorporating a broad spectrum of ideas and, therefore, allowing inclusion of a more diverse population. Other studies tested applicability and efficiency of some specific theories to patient education, such as the problem-based approach [58]. Using a combination of approaches can potentially be more effective when target users are represented by diverse clientele in various settings where education is implemented [59-61].

When constructing the program to install on tablet PCs we also took into account the low educational level of the patients in methadone outpatient clinics. Such design details as using self-explanatory error-proof navigation, large fonts, and audio support substantially improved the usability of the program and were highly valued by the patients.

Patients in our sample lacked basic knowledge about hazards of smoking and smoking cessation, and underestimated the negative health effects of smoking. Only 6 participants recollected such long-term consequences of smoking tobacco as lung cancer, and only 1 patient was worried by the possibility of heart problems caused by smoking. This supports the previous data [62] that former drug abusers frequently underestimate the risks of smoking. The odor of smoke was the most frequently reported negative side effect of being a smoker. Only 4 (11.4%) patients thought that getting help from others or taking some kind of medication could aid in coping with smoking urges.

Our data agree with Nahvi et al [6] that methadone users are interested in smoking cessation. In that study, nearly half of the smokers were in the contemplation stage, and about 20% were in the preparation stage, corroborating our results. These results are very interesting, when one considers that these people are already struggling with at least one kind of addiction, have numerous psychiatric comorbidities, are subjected to a lot of stress in their lives, and are frequently unemployed. Our data helps with understanding why it can be so difficult for these patients to decide to quit. Depression and nervousness are seen as major consequences of quitting, while at the same time these feelings are triggers for the desire to smoke.

In this study the main outcome was knowledge gain in hazards of smoking. We did not expect after only a single brief intervention to motivate patients to decide to quit smoking. We see the computer-assisted hazards of smoking education as a component of a comprehensive smoking cessation program, including computerized and/or in-person counseling. Tailoring computer-mediated smoking cessation counseling to a certain stage of change, gender, cultural background, and smoking profile can facilitate smoking cessation.

The content of our educational curriculum was simplified by adjusting the readability of the content to the fifth-grade level. Despite this, according to the attitudinal survey, reading comprehension was one of the major problem areas in this pilot study. Readability and accessibility can be an issue for a variety of consumer health applications, and there are well established approaches on how to measure and avoid this problem [63,64]. We think that this group of patients requires additional measures to facilitate learning (eg, audiovisual aids and significantly simplified grammar). Most of the patients were not used to studying and had no previous computer experience. Despite that, most of them were not tired at the end of the educational session. Our initial concerns that the ‘exam-like’ format of the program may not be the best fit for this group of patients were not supported by our findings. An absolute majority of the patients accepted multiple-choice questions and quizzes very well. When asked, patients preferred computer-assisted education to other conventional means of education.

Different computer-mediated smoking cessation approaches have been shown to be successful. These include computer-generated individually tailored letters [65] and internet-based smoking cessation programs [66-69]. Educational computer programs about the hazards of smoking can be used separately or as a part of smoking cessation computer intervention in outpatient drug treatment facilities. The same model can be applied to other types of health behaviors, such as healthy nutrition, alcohol drinking, condom use, and physical activity, all of which also constitute significant problems for former drug users [70,71]. Internet-enabled, touch-screen computers could be easily utilized for a widespread dissemination of computer-assisted health education in methadone clinics.

When analyzing which factors influence knowledge gain in the sample, we found that age, gender, stage of change, and number of facilitators (potentially beneficial consequences of quitting smoking for patients) influenced it. Neither computer/Internet experience nor the level of education was significant for patient ability to learn. We may conclude that the program was simple and effective enough for the patients independent of their education and computer skills, but patients who perceived smoking cessation more positively demonstrated a higher a knowledge gain. Our results supported the notion that adult learning theories could provide an effective framework for successful computer-mediated education in a group as challenging as methadone-treated smokers.

Conclusions

Computer-assisted education using tablet PCs was a feasible, well-accepted, and effective means of providing hazards of smoking education among methadone-treated smokers. Simplifying the content of the educational curriculum, utilizing the main concepts of adult learning theories, and using a self-explanatory multimedia user interface can make computer-assisted education more effective in this group of patients.

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Conflicts of Interest

None declared.

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Abbreviations

ACT-R Theory: Adaptive Control of Thought—Rational Theory
ANOVA: analysis of variance
CO-ED: computer-assisted education
HSKS: hazards of smoking knowledge survey
SEQ-12: smoking self-efficacy questionnaire

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Original Paper

A Multimedia Mobile Phone–Based Youth Smoking Cessation Intervention: Findings From Content Development and Piloting Studies

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Abstract

Background: While most young people who smoke want to quit, few access cessation support services. Mobile phone–based cessation programs are ideal for young people: mobile phones are the most common means of peer communication, and messages can be delivered in an anonymous manner, anywhere, anytime. Following the success of our text messaging smoking cessation program, we developed an innovative multimedia mobile phone smoking cessation intervention.

Objective: The aim of the study was to develop and pilot test a youth-oriented multimedia smoking cessation intervention delivered solely by mobile phone.

Methods: Development included creating content and building the technology platform. Content development was overseen by an expert group who advised on youth development principles, observational learning (from social cognitive theory), effective smoking cessation interventions, and social marketing. Young people participated in three content development phases (consultation via focus groups and an online survey, content pre-testing, and selection of role models). Video and text messages were then developed, incorporating the findings from this research. Information technology systems were established to support the delivery of the multimedia messages by mobile phone. A pilot study using an abbreviated 4-week program of video and text content tested the reliability of the systems and the acceptability of the intervention.

Results: Approximately 180 young people participated in the consultation phase. There was a high priority placed on music for relaxation (75%) and an interest in interacting with others in the program (40% would read messages, 36% would read a blog). Findings from the pre-testing phase (n = 41) included the importance of selecting “real” and “honest” role models with believable stories, and an interest in animations (37%). Of the 15 participants who took part in the pilot study, 13 (87%) were available for follow-up interviews at 4 weeks: 12 participants liked the program or liked it most of the time and found the role model to be believable; 7 liked the role model video messages (5 were unsure); 8 used the extra assistance for cravings; and 9 were happy with two messages per day. Nine participants (60%) stopped smoking during the program. Some technical challenges were encountered during the pilot study.

Conclusions: A multimedia mobile phone smoking cessation program is technically feasible, and the content developed is appropriate for this medium and is acceptable to our target population. These results have informed the design of a 6-month intervention currently being evaluated for its effectiveness in increasing smoking cessation rates in young people.

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KEYWORDS

Smoking cessation; cellular phone; learning

Introduction

Many young people want to stop smoking [1-3], but few access traditional cessation services [4]. Currently available services generally do not cater to young smokers, who tend to value confidentiality and anonymity, ease of access, proven efficacy, and the use of peers in such services [5,6]. Due to the ubiquity of mobile phone use by young people, we developed a Short Message Service (SMS), or text message, smoking cessation intervention that was tested in the STOMP (STOp smoking by Mobile Phone) study in 2001 [7,8]. Short-term quit rates were doubled among the intervention group compared to the control group. This intervention is soon to be implemented in several countries, including New Zealand, where it is being provided as a government-funded and universally available program.

Since STOMP, the introduction of multimedia mobile phones has made it technically possible to expand the content of such programs. Video message technology provides an ideal opportunity for the use of role modeling, or observational learning, which involves watching others perform a task or behavior. According to social cognitive theory, individuals gain socialization information and cognitive skills from observational learning and are likely to remember and repeat the behaviors provided by a model [9,10]. There is growing evidence from nonexperimental clinical studies of the effective use of role modeling in behavioral change [11], sports medicine and injury rehabilitation [12,13], and a variety of clinical contexts [14-23]. Role modeling by parents and peers is thought to be a key factor in smoking initiation by young people [24-27].

Video-based smoking cessation “education” programs have been trialed with modest increases in quit rates [28-30]. The benefits specified by participants included seeing others quit smoking, dealing with stress and bad feelings, talking about what to do with urges to smoke, and observing ways to get peer support [31,32].

In particular, “coping role models” may be useful in smoking cessation. The observer watches a person going through a quit attempt who presents various coping strategies for dealing with the difficulties in changing behavior [33]. The observer picks up relevant cues and information that may increase self-efficacy, motivation, and problem-solving skills and therefore increase the likelihood of his or her quit attempt being successful. Model similarity, in which the observer identifies with the role model with respect to age, gender, culture, and language [34,35], is likely to be important as reflected in youth development principles [36].

Furthermore, mobile phone–based programs can easily incorporate known effective smoking cessation techniques, such as individuals setting their own quit date, goal setting, reminders and motivational messages, advice, and information on what has been shown to be effective. These messages can be sent automatically and can be received anytime, anywhere and completely independent of location.

We hypothesized that a multimedia mobile phone smoking cessation program would increase abstinence rates in young smokers who want to quit compared to a control intervention. The use of new mobile technology in itself may appeal to young people and thereby encourage participation; however, the program content must be varied, relevant, and appropriate in order to maintain interest. Therefore, input from young people into the development of the content for the program was essential. This paper describes the steps in development of the program content for this multimedia mobile phone–based smoking cessation intervention. It includes the results of a pilot study designed to test the system and obtain feedback from participants.

Methods

Figure 1 outlines the steps in the development of the program. Content development and technical development are discussed in further detail below..

Content Development

Content Advisory Group

We convened a content advisory group with members selected to provide expert advice on smoking cessation, youth health, Maori (the indigenous population of New Zealand) health, public health, psychology, social marketing, media, TV production, and mobile phones. This group met monthly and began by developing the themes of role modeling, youth development principles, and effective smoking cessation interventions. The group also reviewed the results of all assessments described below, gave input into scripts, and reviewed all videos produced.

Initial Consultation

Initial consultation included four focus groups of students (16-18 years, smokers and nonsmokers) in a metropolitan, multicultural college in order to obtain a breadth of information on current and potential uses of mobile phones among young people. Participants were randomly selected from the school roll and were invited to participate by school staff. Questions were pre-set (see Textbox 1), and the format was standard across groups. An independent survey research unit at the University of Auckland facilitated the focus groups, audiotaped and transcribed the discussions, and undertook a general thematic analysis.

Textbox 1. Examples of focus group questions

What do you use your mobile phone/s for? What sorts of things do you like to do with your mobile phone?
Prompts: Listen to music, play games, surf the Net, download ringtones, video calling, watch videos/TV, look at cartoons, text, call
What sorts of things do you like to do to relax? What would you most like to receive over your mobile phone to help you relax?
Who would you most like to watch working through similar problems to see how they cope?
Prompts: People like you (same age/circumstances)? Famous people? Someone you know? Someone older than you who has been there?
What do you do when you feel you need/want support?
Prompts: Who do you go to? (Who is most likely to provide support?)
How do they support you? What do they do to support you?
Could mobile phones be useful in getting social support? How?

The final program will target all young adults aged 16 years and over (with no upper age limit); therefore, we also consulted a slightly older age group via an online survey. Participants were recruited from the website of a popular Auckland radio station (Mai FM) oriented to young adults. The survey was open to all those aged 16 years and over who owned a mobile phone. Questions were asked about their current mobile phone use and interest in potential uses of mobile phones for health programs. A quantitative analysis of these results was undertaken.

Pre-Testing

In order to obtain a range of video material to be pre-tested, media students at tertiary media training institutions were invited to submit their own video and animated content. These students were given a 1-page brief on the smoking cessation program to be developed. However, only a small number of videos were submitted. Further videos were sought by advertising with Student Job Search, a popular service among young people seeking part-time employment, with a very brief description of what was required (a 30-second video clip to help young people who want to quit smoking).

From these, four video clips were selected by the Content Advisory Group to best represent the different styles of video that had been submitted. Young people recruited via the radio station's website were invited to complete an online survey to compare these videos (embedded in the online survey) with a professionally made video of a young quitter. Participants rated each video out of 10 according to how much they liked it, as well as answering more specific questions about each video and placing them in order of preference.

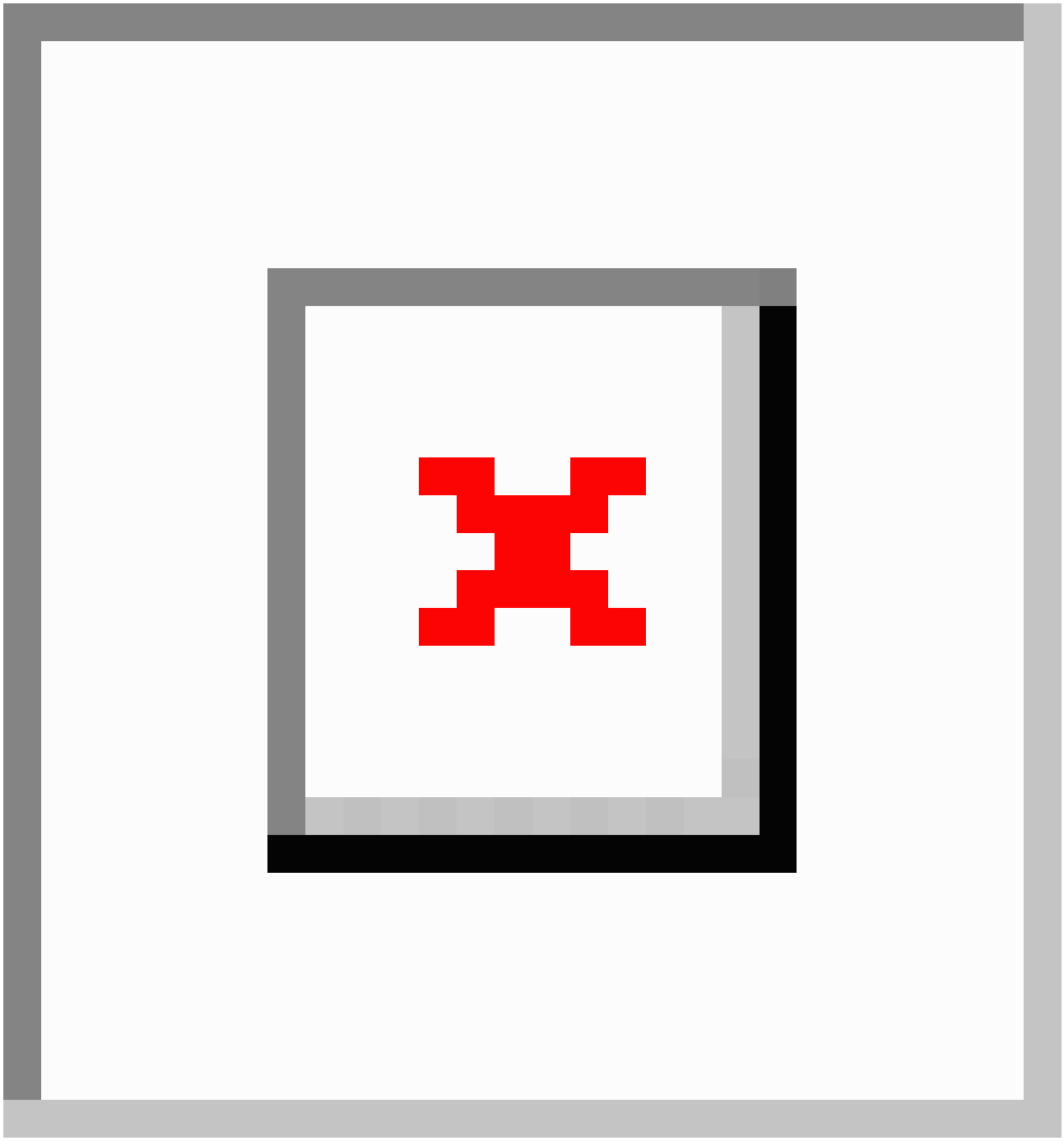
Role Model Selection

Next, potential role models (smokers or ex-smokers only) for the pilot study videos were recruited from Student Job Search. Twenty-seven audition videos in which each role model talked about smoking or quitting were shown to young people in a variety of settings (university students between classes, workers at a predominantly young adult workplace, and those who had previously expressed an interest in consulting on the program). These participants rated the role models (1-27) for credibility and whether they would want to continue watching them. They also recorded their initial impressions of each role model on paper.

The top-rated model was selected for the pilot study, and her own recent quitting experiences were converted into a chronological series of messages from a lead-up to 4 weeks after quitting. Each message was based on a particular issue associated with quitting and how the model coped with that issue, or on how to keep motivated and stay quit. These messages were recorded as approximately 30-second vignettes in a video diary style using the model's own words. They were designed to be sent to participants twice daily, starting several days prior to their quit attempt.

We also talked to two high school drama classes about the tobacco industry and the effects of smoking, in a manner consistent with the "Truth" anti-tobacco industry media campaign [37]. The students were then assisted in producing short anti-tobacco video clips, predominantly of students talking about proven ill effects of smoking and behaviors of the tobacco industry. These videos were used to add variety to the program but were not pre-tested due to time constraints.

Figure 1. Steps in program development



Technical Development

A system to deliver the program was designed in a system requirements document by the principal investigator (RW) and staff and was translated into system development by the information technology (IT) senior developer (JvR). The video clips were then arranged into a pre-set schedule to deliver two messages per day (predominantly the role model videos with some anti-tobacco clips and a small number of text messages interspersed) in a chronological sequence starting with a lead-up to Quit Day, messages for Quit Day, and then post–Quit Day.

The program began with online registration and an automated text message to those eligible to participate. An appropriate reply to this message provided evidence of informed consent to participate in the study. This system then guided the participant to select a Quit Day and two appropriate time bands (per 24-hour clock) to receive messages from the program. A schedule for program delivery to that participant would then be set by the system.

The video messages were hosted on a wireless application protocol (WAP) site. At a random time within the selected time band, a text message with the uniform resource locator (URL) for the appropriate video message was sent to each participant. By scrolling over or highlighting the URL within the text message, the video message would begin automatic download and then play on the phone. Video messages could be viewed immediately upon receipt or at a later time as appropriate.

As well as the pre-set program of messages, participants could request extra support messages on demand by texting a keyword to the program shortcode (a 4-digit number). Tips on managing cravings would then be automatically and immediately sent to the participant. This function (CRAVE) had been popular with some participants in the previous text message program [7].

Pilot Study

A pilot study was conducted from June to August 2007 to test the developed program and the delivery system and to obtain feedback from participants regarding their satisfaction with the program. Participants for the pilot phase were recruited by radio commercials (Mai FM) or via a direct link from the radio station's website. To be eligible, participants were required to have a video message–capable mobile phone on the Vodafone network (which has approximately half of the mobile phone market in New Zealand), be 16 years of age or older, be a daily smoker who wanted to quit, and be a resident in the Auckland region (population 1.2 million).

Potential participants registered online by self-completing an eligibility questionnaire and were provided with a participant information sheet and consent form (or could request to have them mailed or emailed). Eligible participants then received an automated consent text message and were required to reply "I consent." Upon receipt of the appropriate response, the system directed participants by text message to return to the website and complete registration details. All participants received two messages per day—the role model quit diary interspersed with the anti-tobacco videos and text messages (see the Multimedia Appendix for a sample role model video clip). At the end of the 4-week program, participants were called by study staff to complete a telephone questionnaire. There was no cost to participants to take part in the study.

All study procedures and documents were approved by the Ministry of Health's Ethics Committee.

Results

Content Development

Initial Consultation

Four focus groups comprised 27 college students aged 16-18 years. Groups were stratified by gender and ethnicity (Maori/Pacific and Indian/other; in New Zealand, "Indian" represents a mix of people from India and Fijian-Indians). Findings from the focus group discussions demonstrated that all of the participants used mobile phones regularly, and all groups expressed an interest in the idea of a mobile phone program to support them in dealing with any particular issues they may face. Text messaging was considered to be potentially useful for positive reinforcement messages and providing information. Listening to music or music videos was the preferred mobile phone feature for helping them to relax. Although less frequently mentioned, jokes, funny pictures, and games were also perceived to be potential tools to aid relaxation and provide distraction. Some female students also wanted to watch movies and soap operas. A consistent finding across the groups was that videos and cartoons would be useful to illustrate strategies for dealing with problems. Participants, however, clearly expressed that it would be important that the characters shared similar ethnic characteristics and be a similar age. Video calling was not perceived to be a useful component of an intervention, with some students clearly articulating a dislike for the loss of anonymity and the potential of being identified.

Of 172 online surveys submitted, 19 were excluded (four incomplete, 13 underage, two duplicates). The average age of participants was 24 years (range 16-52). Nearly half (48%, n = 74/153) were of European ethnicity, 25% (n = 38) were Maori (indigenous New Zealanders), and 15% (n = 23) were Pacific Islanders. Just over a third of participants understood that their phones were capable of viewing video messages, and of these, over half were actually sending and receiving video messages at least weekly. Table 1 summarizes the participants' preferences for program content that were expressed in the online survey.

Table 1. Online survey results of participants' preferences for program content

	% (No.)
What sort of things do you like to do on your mobile phone? (could select more than one)	
Text message (SMS)	99 (151)
Call	90 (137)
Play games	59 (91)
Enter competitions	41 (62)
Download from the Internet	40 (61)
Listen to music	38 (58)
Surf the Net	27 (41)
Watch videos	25 (38)
Look at jokes	18 (28)
Video calls	9 (14)
Watch cartoons	3 (5)
What would you most like to receive over your mobile phone to help you to relax? (could select more than one)	
Music	75 (114)
Videos	35 (53)
Games	30 (46)
Jokes	26 (40)
TV	26 (40)
Competitions	30 (46)
Cartoons	16 (24)
Nothing	12 (19)
If you were to sign up to receive video messages over your phone to help you be healthier (eg, stop smoking, exercise more), how many such messages would you want to get each day?	
One message per day	42 (64)
Less than one message per day	28 (43)
Two to five per day	20 (31)
More than five per day	9 (14)
If you were part of such a program, how would you like to interact with others going through the same program with you? (could select more than one)	
Writing a blog	27 (41)
Reading someone's blog	36 (55)
Writing messages on a message board	35 (53)
Reading messages	40 (61)
Being paired with a "buddy"	29 (45)
Prefer no contact	18 (27)

Pre-Testing

A total of 41 participants, with an average age of 24 years (range 16-45), completed the pre-testing online survey with embedded video clips (another three started but did not complete the survey): 29% were smokers, 22% were Maori, and 76% were female. Of these participants, 37% stated that they would prefer to see animated clips, 27% casual interviews, 24% a mix of music/images/videos, and 10% studio interviews. Of all the clips in the survey (including one animation), participants ranked the casual interview clip the highest. With respect to the videos, the person in the video clip was more important than the style of the clip. In particular, how "real," credible, and honest the person was perceived to be and whether the participant related to him or her personally were key factors. The technical quality of the clips (particularly the sound) was also important, and the

duration of the included videos (30-45 seconds) was seen as appropriate.

Technical Development

A significant technical challenge occurred during the pilot study when the mobile communications network inadvertently charged participants to download the video clips, meaning that those participants using prepaid cards (or "pay-as-you-go") with no credit on their phones at the time were unable to view the clips. This issue was soon rectified by the network, and all participants were reimbursed. The online registration forms also occasionally failed to open at the beginning of the pilot, and this may have resulted in two potential participants failing to complete registration. The technical challenges experienced by the participants in the pilot study are summarized in Table 2.

Table 2. Technical challenges (N = 13)

	No.
Were there any technical issues that you experienced?	
No	4
Yes	9
If yes, what were the issues?	
Couldn't open the link due to the credit issue	2
Mobile network coverage not always available	3
Couldn't open the link, didn't know how	4
What did you do about this? (if couldn't open the link)	
Emailed for advice	1
Worked it out myself	2
Gave up (until phoned by study staff)	1

Pilot Study

For the pilot study, 17 participants completed the full registration over a 5-week period; however, two participants withdrew before viewing the program (one due to the credit issue described above and one was unable to be contacted to find out the reason). Of the 15 who received the program, 13 were followed up after 4 weeks (two were unable to be contacted despite multiple attempts). Table 3 summarizes the characteristics of the pilot study participants.

Table 3. Pilot study participant characteristics (N = 17)

Characteristic	No. (%)
Age (years)	
16-19	2 (12)
20-24	9 (53)
25-29	2 (12)
30-34	2 (12)
35+	2 (12)
Sex	
Male	6 (35)
Female	11 (65)
Ethnicity	
Maori	6 (35)
New Zealand European	3 (18)
Pacific Islander	4 (24)
Indian	2 (12)
Other	2 (12)
Income (NZ $)	
Less than 15,000	5 (29)
15,000-30,000	2 (12)
30,001-45,000	7 (41)
45,001-60,000	1 (6)
Refused to answer	2 (12)
Smoking behavior	
1-10 cigarettes/day	15 (88)
11-30 cigarettes/day	2 (12)
Time to first cigarette	
0-30 minutes	5 (29)
Over 30 minutes	12 (71)
Previous quit attempts	
0	3 (18)
1	5 (29)
2	5 (29)
3-5	3 (18)
5+	1 (6)

Only one participant did not like the program. Of the 12 (92%) who stated that they liked the program or liked it most of the time, the features they liked the most were the support provided, reminders, information, encouragement, the fact that they knew messages were coming, advice, and the interesting messages and their relevance to them personally. The participants' responses to the video diary are shown in Table 4. The majority of participants said that they could relate to what the role model was saying (n = 12) and that they found the role model to be believable (n = 12).

Table 4. Participants' responses to aspects of the pilot program (N = 13)

	No.
Role model video diary messages	
Liked them (Summary of comments: relevant, honest, upfront, made it more real, felt like I was not just on my own but she was going through it too)	7
Didn't like them (Summary of comments: got bored, not professional / very basic, only good thing was a reminder, didn't know what happened to her— if she went back to smoking, really liked the CRAVE function, would like animation/music—would be more professional)	1
Unsure (Summary of comments: she was not the same as me, good that they were not too flashy or fake but were simple, liked them at start but got sick of moaning ones, just like a story, clips could have been longer—felt "cut-off," not sure if helpful, liked some of them, sounded similar/repetitive, got sick of them)	5
Did you like the other (anti-tobacco) video clips?	
Liked them	7
Liked them most of the time	1
Didn't like them	3
What did you think of the daily quantity of messages?	
About right	9
Too many	1
Not enough (suggesting three or four per day)	3
Generally speaking, when did you view the clips?	
As soon as they arrived	5
A few minutes after they arrived	2
A few hours after they arrived	3
A mixture of as soon as arrived / few hours later	3

Some participants (n = 8) said that they saved the clips they liked in order to watch them again later. None forwarded clips to other people. Five participants stated that they appreciated being able to select their own times to receive the messages; however, others were happy to receive the messages anytime but watch them later when it was more convenient. Comments about the timing of messages included the following: it was not appropriate to receive messages at work; early morning and evening were good times; morning and afternoon, when cravings are strongest, were best; it was best after dinner; best during break times at work.

The ability to request messages on demand (CRAVE) as needed to deal with cravings was popular with the eight participants who used it—the remainder didn't try it or forgot that it was available. Text messages were popular, particularly those that imparted information on smoking and quitting tips. Eight participants said that they would like more of these, and five said the amount was about right. When asked about additional components that could be included, jokes and polls/quizzes were the most popular, followed by music, then animations.

Nine participants stopped smoking during the program (Table 5), and of those who did not quit, half had cut down. All of those who quit said that they felt the program had helped them: "If I hadn't started the program, I would still be smoking."

Table 5. Smoking outcomes (N = 13)

	No.
Did you stop smoking during program?	
Yes	9
No	4
If yes, do you think the program helped you to stop smoking?	
Yes	9
What about the program helped you the most?[a]	
Setting a quit date, lead-up, role model clips	
Encouraging stuff, tips	
Text messages	
Something new	
Quitting tips	
Providing motivation	
Acted as a reminder to what you are doing, good to know others are also quitting at same time	
Regular updates, inspirational, mates tried to quit without it and failed, so felt good	

[a]Summary of comments from participants

Discussion

This study breaks new ground in the eHealth arena and adds new information about young people's interest in and perspectives on the use of new mobile phone technology as a platform for delivering health interventions. The degree of interest and support was sufficiently high for us to proceed with development of a full 6-month randomized controlled trial with greater breadth and depth of content based on the detailed feedback provided by participants so far, including the use of multiple role models and the ability to personalize the program. This trial will test the program's effectiveness in increasing smoking cessation rates in young people compared with a control program.

The pilot study identified several technical challenges. First, clear and accessible information on how to open video clips on different mobile phone handsets needs to be provided early in the sign-up process. Second, systems that rely on a third party, in this case a telecommunications company, need to be thoroughly tested to provide assurance that these will work. Participants being charged for downloading the video clips was a significant barrier to adopting the intervention in this pilot.

Strengths of our study include the use of established theory on which to construct our program elements and format, the extensive input from young people at various steps in development, the use of key youth media to recruit participants successfully from all major ethnic groups in New Zealand, and the extent to which we were able to test content and functionality in circumstances that approximated the current production version.

Limitations

Three main limitations were identified. First, technical issues with credit on prepaid phones and difficulties with the initial registration process restricted our ability to gain feedback from some potential participants. Second, this was a pilot study and numbers were small, so results may not be fully representative of the wider youth smoking population. Nevertheless, recruitment and registration processes were the same as those being used in the full trial, so there is no reason to believe that the pilot study participants would systematically differ from those in the main study. Third, the pilot was not designed to examine the effectiveness of the program with respect to smoking cessation outcomes, so no conclusions about these outcomes should be drawn from the results.

Comparison With Prior Work

This research confirms our previous experiences with the STOMP text message mobile phone smoking cessation study [7,8]; that is, mobile phones are a key medium for reaching young people with health support. Second, mobile phone–based interventions allow individualization and choice, anonymity, ease of use, timely support regardless of location, and support on demand.

Others have used mobile phones for smoking cessation [38], and, more specifically, text messaging for smoking cessation in conjunction with other modalities (eg, text messaging in conjunction with a website for college students [39] and text messaging in conjunction with information packs, email, and phone calls [40]). Text messaging has also been used in other health services for appointment reminders [41] or home monitoring (eg, of blood glucose in diabetes management [42,43]). However, to our knowledge, this is the first published account of the use of multimedia technology in this way.

Conclusions

A multimedia mobile phone smoking cessation program is feasible and acceptable to young people. We encountered relatively few technical issues, the most common being lack of

knowledge on how to open the video clips, a problem easily overcome by providing more instruction. Smoking cessation content was appropriate for incorporation in video messages delivered by mobile phone and was acceptable and helpful to participants. Role models were a key factor in the appeal of the program, but they must be perceived as real, honest, and credible. With some participants becoming tired of the same model, the ability to choose between multiple role models and to vary and personalize content by selecting or de-selecting components will be important features in future iterations of this program.

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Conflicts of Interest

Auckland UniServices Ltd has licensed the STOMP text message mobile phone program to Healthphone Solutions Ltd.

Multimedia Appendix

Example of a role model video clip

[WMV file (Windows Media Video), 972 KB - jmir_v10i5e49_app.wmv]

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Abbreviations

STOMP: STOp smoking by Mobile Phone

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Original Paper

Access and Interest: Two Important Issues in Considering the Feasibility of Web-Assisted Tobacco Interventions

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Abstract

Background: Previous research has found that current smokers are less likely to have access to the Internet than nonsmokers. As access to the Internet continues to expand, does this finding remain true? Also, how many smokers are interested in Web-assisted tobacco interventions (WATIs)? These questions are important to determine the potential role that WATIs might play in promoting tobacco cessation.

Objectives: The aims of the study were to determine whether smokers are less likely than nonsmokers to have access to the Internet and to establish the level of interest in WATIs among a representative sample of smokers.

Methods: A random digit dialing telephone survey was conducted of 8467 adult respondents, 18 years and older, in Ontario, Canada from September 2006 to August 2007. All respondents were asked their smoking status and whether they used the Internet (at home or work in the past 12 months; where; how often in the past 12 months). To assess the level of interest in WATIs, current daily smokers were asked whether they would be interested in a confidential program that they could access on the Internet, free of charge, that would allow them to check their smoking and compare it to other Canadians.

Results: Smokers were marginally less likely to have used the Internet than nonsmokers (74% vs 81% in the last year), and, of those who had access to the Internet, smokers used the Internet less often than nonsmokers. Overall, 40% of smokers said they would be interested in a WATI. The number of cigarettes smoked per day was unrelated to level of interest in the WATI, but time to first cigarette after waking was. Smokers who used the Internet were more interested in the WATI than smokers who did not use the Internet (46% vs 20%).

Conclusions: While the difference in level of Internet use between smokers and nonsmokers was greatly reduced compared to 2002 and 2004 data, smokers still remain marginally less likely to use the Internet than nonsmokers. Overall, there was a substantial level of interest in the WATI among smokers, in particular among smokers who currently use the Internet. These results indicate that WATIs have a substantial potential audience among smokers, and, given the growing body of evidence regarding their efficacy, there is growing support that WATIs have a significant role to play in promoting tobacco cessation.

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KEYWORDS

Internet access; Internet availability; cigarettes; brief interventions; self-help; epidemiological survey

Introduction

There are at least three issues of importance when considering whether Web-assisted tobacco interventions (WATIs) are a feasible way to help large numbers of people quit smoking. The first of these issues is the efficacy of the interventions. Do WATIs work? There is a growing body of research indicating that WATIs are an effective means of promoting tobacco cessation. Most notably, there have been several randomized controlled trials to date that have found that WATIs increase the rate of successful cessation from smoking cigarettes (eg, [1-3]).

The other two issues of importance are whether smokers can easily access WATIs and whether they are interested in doing so. These topics are the focus of this paper. Previous research has found that cigarette smokers were less likely to have used the Internet than nonsmokers [4]. However, this study used data from 2002 and 2004. As access to the Internet is a fast growing phenomenon, is it still the case that cigarette smokers are less likely to use the Internet?

The third issue, smokers' level of interest in WATIs, is important because interventions are unlikely to have an impact on the prevalence of smoking if only a small proportion of the population will access them. To a certain extent, this question can be addressed by looking at the volume of people who already access WATIs (reviewed in [5-7]). However, there is also benefit in asking this question more directly. That is, in a representative general population sample of smokers, how many say they would be interested in WATIs and what factors are associated with this interest?

Methods

A random digit dialing survey was conducted of 8467 respondents, 18 years and older, in Ontario, Canada. The survey employed a two-stage sampling design in which random digit dialing was used to identify eligible households and then an adult was selected within the household by choosing the resident whose birth date was closest to the date of the telephone interview. Approximately 98% of Ontario households have landline telephones. Previous research has demonstrated that telephone surveys marginally over-represent younger respondents and those with more education [8,9]. The current survey was conducted from September 2006 to the end of August 2007. The effective response rate was 51.7%. Analyses are presented using weighted data. Sample sizes are presented as unweighted data.

As part of the survey, respondents were asked their current smoking status (daily, occasional, nonsmoker), and daily smokers were asked their number of cigarettes smoked per day and time after waking to their first cigarette [10]. Daily smokers were also asked whether they would be "interested in a confidential program that you could access on the Internet, free of charge, that would allow you to check your smoking and compare it to other Canadians." At the end of the survey, respondents were asked a series of demographic questions and questions about their use of the Internet: (1) had they used the Internet in the last year; (2) if yes, where did they use it (at home only, elsewhere only, or both); and (3) how often they used the Internet in the last year (dichotomized for this analysis into daily/almost daily versus other; never is included in the "other" category).

Results

Of the entire sample, 17% were daily smokers, 5.8% were occasional smokers, and 77.2% classified themselves as nonsmokers. (Prevalence rates are similar to those reported for the 2006 Canadian Tobacco Use Monitoring Survey [11]). Table 1 compares demographic and Internet use characteristics between these three groups. As has been seen with other general population surveys (eg, [11]), there were systematic differences in demographic characteristics across the three smoking status groups. (These differences will not be described in detail here as they are not the purpose of this paper and because demographic differences between smokers and nonsmokers have been well described in other publications.) There were also differences in level of Internet use between smokers and nonsmokers. Smokers appeared marginally less likely than nonsmokers to have used the Internet in the last year (daily smokers = 74.5%, occasional smokers = 78.7%, nonsmokers = 81.0%;$\chi^2_2 = 30.8$, $P < .001$; combined sample = 79.8%). There were also significant differences in location of Internet use between smokers and nonsmokers, although the pattern of results is difficult to interpret in a meaningful fashion ($\chi^2_4 = 33.3$, $P < .001$). In addition, there were differences between smokers and nonsmokers in the proportion of respondents who used the Internet daily or almost daily. While 56.5% of the entire sample reported using the Internet daily, 47.8% of smokers, 56.2% of occasional smokers, and 58.5% of nonsmokers reported daily or almost daily use of the Internet ($\chi^2_2 = 54.7$, $P < .001$). Finally, among daily smokers, those who used the Internet daily or almost daily smoked marginally fewer cigarettes per day than those who did not use the Internet daily (mean = 14.7, SD = 7.4 vs mean = 15.7, SD = 8.1, respectively; $t_{1423} = 2.5$, $P = .01$).

Table 1. Demographic and Internet use characteristics among daily smokers, occasional smokers, and nonsmokers (N = 8454; 13 respondents did not provide smoking status.)

	Daily Smoker (N = 1433)	Occasional Smoker (N = 494)	Nonsmoker (N = 6527)	*P*
Age, mean (SD)	42.7 (13.8)	41.8 (15.3)	47.3 (16.7)	.001
Male, %	49.0	49.7	43.8	.001
Some post-secondary education, %	50.8	65.1	68.9	.001
Married/common law, %	59.5	59.4	70.2	.001
Full- or part-time employed, %	71.1	70.1	61.6	.001
Family income (thousands of Can $), %				
< 30	16.0	11.8	10.7	
30-49	15.6	14.7	13.5	
50-79	23.6	19.4	19.9	
80 or more	27.9	35.7	34.7	
Don't know/refused	16.9	18.4	21.2	.001
Any Internet use in past 12 months, %	74.5	78.7	81.0	.001
Use Internet daily/almost daily, %	47.8	56.2	58.5	.001
Location of Internet use, %				
At home only	36.2	24.2	33.1	
Elsewhere only	7.8	6.8	5.1	
Both home and elsewhere	56.0	69.0	61.8	.001

Predicting Internet Use

Table 2 displays a logistic regression predicting any Internet use in the last 12 months. Of the demographic variables, older respondents and those with family incomes less than Can $30,000 were less likely to have used the Internet. Post-secondary education, being married, and being employed were positively associated with having used the Internet in the last year. As was observed in the bivariate analyses, smoking status was also related to Internet use, with daily smokers being less likely to have used the Internet in the last year compared to other respondents (occasional and nonsmokers combined for this analysis).

Table 2. Logistic regression predicting respondents who did or did not use the Internet in the last year

Predictor	B (SE)	*P*
Age	−.063 (.003)	.001
Male	−.077 (.070)	.27
Some post-secondary education	1.462 (.069)	.001
Married	.293 (.078)	.001
Employed	.281 (.080)	.001
Household income less than Can $30,000	−.869 (.101)	.001
Daily cigarette smoker	−.547 (.190)	.001

Interest in Web-Assisted Tobacco Interventions

As a measure of level of interest in WATIs, daily smokers were asked if they would be"interested in a confidential program that you could access on the Internet, free of charge, that would allow you to check your smoking and compare it to other Canadians." Overall, 40% of daily smokers said that they would be interested in this type of WATI. Table 3 shows the demographic, smoking, and Internet use characteristics for smokers who were interested in the WATI versus those who were not. Compared to smokers who were not interested in the WATI, those who were interested were younger (t_{1401} = 5.9, P < .001), more educated (χ^2_1 = 4.3, P = .04), more likely to be employed (χ^2_1 = 11.3, P < .001), and probably had higher income (χ^2_4 = 17.5, P = .002; note that 17% of daily smokers refused to report, or did not know, family income, making this variable difficult to interpret). Number of cigarettes smoked per day was not significantly related (P = .18) to interest in the WATI. However, smokers who had their first cigarette of the day within one half hour of waking were more interested in the

WATI compared to those who had their first cigarette at a later time (χ^2_1 = 11.6, P < .001). Finally, there was a strong relationship between level of Internet use and interest in WATI. Smokers that accessed the Internet were more interested in the WATI compared to those who did not (46% vs 20%; χ^2_1 = 79.3, P < .001), or, to state it as presented in Table 3, 67% of those not interested in the WATI accessed the Internet in the past 12 months and 88% of those interested had accessed the Internet). In addition, smokers who used the Internet daily or almost daily were more likely to be interested in the WATI compared to those who used the Internet less frequently (χ^2_1= 26.4, P < .001).

Table 3. Demographic, smoking, and Internet use characteristics for daily smokers who were interested or not interested in the WATI (N = 1424; 9 daily smokers did not provide information on their interest in WATI).

	Not Interested (N = 882)	Interested (N = 542)	*P*
Age, mean (SD)	44.3 (14.4)	40.1 (12.1)	.001
Male, %	49.4	48.5	
Some post-secondary education, %	48.7	54.4	.05
Married/common law, %	59.7	59.3	
Full- or part-time employed, %	67.9	76.8	.001
Family income (thousands of Can $), %			
< 30	16.8	14.3	
30-49	15.1	16.6	
50-79	21.5	27.0	
80 or more	26.7	29.5	
Don’t know/refused	19.9	12.7	.01
Cigarettes per day, mean (SD)	15.0 (7.9)	15.5 (7.6)	
Smoke within half hour of waking, %	49.9	59.3	.001
Any Internet use in past 12 months, %	66.6	87.6	.001
Use Internet daily/almost daily, %	42.5	56.5	.001
Location of Internet use, %			
At home only	35.1	37.4	
Elsewhere only	10.7	7.7	
Both home and elsewhere	54.2	55.0	.001

Table 4 displays the results of a logistic regression predicting interest in the WATI among daily smokers. Of the demographic characteristics, only age remained significantly related to interest in the WATI when all other variables were entered simultaneously—younger smokers were marginally more interested in the WATI compared to older smokers. Smokers who had used the Internet in the last year were more likely to be interested in the WATI compared to those who had not used the Internet. However, daily use of the Internet was not significantly related. Finally, number of cigarettes smoked per day was not related to interest in the WATI, but smokers who had their first cigarette within half an hour of waking were more likely to be interested in the WATI compared to those who had their first cigarette later in the day.

Table 4. Logistic regression predicting daily smoking respondents who were interested or not interested in WATI

Predictor	B (SE)	*P*
Age	−.013 (.005)	.02
Male	−.155 (.127)	.22
Some post-secondary education	−.146 (.130)	.26
Married	.152 (.132)	.25
Employed	.217 (.149)	.14
Household income less than Can $30,000	.057 (.196)	.77
Used Internet in past 12 months	1.101 (.190)	.001
Used Internet daily	.115 (.141)	.41
Cigarettes smoked per day	.014 (.009)	.14
Smoke within half hour of waking	.428 (.137)	.002

Discussion

While many more smokers used the Internet in 2007 compared to that observed in 2002 [4], smokers were still less likely to use the Internet compared to nonsmokers. (In 2002, 65% of daily smokers in Ontario had accessed the Internet in the past 12 months [8].) However, as almost three-quarters of smokers report using the Internet, at least in Ontario, Canada, it can safely be said that the majority of smokers do not experience lack of Internet access as a barrier to using WATIs. It is likely that more smokers and nonsmokers will use the Internet in the years to come as access to the Internet is growing in all subsections of the population [12].

One issue to consider is that there does not appear to be any theoretical reason why smoking cigarettes per se is causally related to Internet access. It is likely that smoking is a marker for other demographic characteristics that are related to Internet access (eg, socioeconomic status). However, while interesting, this issue is not of practical relevance to the current paper as this study examines whether smokers have access to the Internet and not the reasons why smokers might have less access than nonsmokers.

Many smokers say that they would be interested in one type of WATI, with 40% of daily smokers saying that they would be interested in an Internet-based program that would allow them to compare their smoking to other Canadians. A clear limitation of this question as a means of assessing level of interest in WATIs is that normative comparison programs (ie, comparing own smoking to that of others) are just one type of WATI available. It is possible that smokers might be more (or less) interested in other types of WATI, just as smokers indicate variation in interest in WATIs versus other types of services (eg, telephone counseling) [13]. Another limitation is that stating an interest in WATIs on a general population telephone survey does not necessarily mean that the smoker would actually access such a program. Nevertheless, it is encouraging that so many smokers say that they would be interested in this type of WATI.

Other factors related to interest in WATIs were younger age and having used the Internet in the last year. Smokers who had their first cigarette within half an hour of waking were more interested in WATIs compared to those who waited a longer time until smoking, perhaps indicating that smokers with greater dependency are more likely to be interested in WATIs. Further research could test the relationship between level of dependence and interest in WATIs. Also of relevance would be whether smokers' readiness to change is related to interest in WATIs. Finally, while reports of the number of smokers using WATIs are impressive [6,14], it is clear that far less than 40% of smokers are actually using them. What keeps the remaining smokers from accessing these services? This is an issue of importance for further research as WATIs take their place as an important component in tobacco cessation efforts worldwide.

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Conflicts of Interest

None declared.

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Abbreviations

WATI: Web-assisted tobacco intervention

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Original Paper

The Role of Engagement in a Tailored Web-Based Smoking Cessation Program: Randomized Controlled Trial

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Abstract

Background: Web-based programs for health promotion, disease prevention, and disease management often experience high rates of attrition. There are 3 questions which are particularly relevant to this issue. First, does engagement with program content predict long-term outcomes? Second, which users are most likely to drop out or disengage from the program? Third, do particular intervention strategies enhance engagement?

Objective: To determine: (1) whether engagement (defined by the number of Web sections opened) in a Web-based smoking cessation intervention predicts 6-month abstinence, (2) whether particular sociodemographic and psychographic groups are more likely to have lower engagement, and (3) whether particular components of a Web-based smoking cessation program influence engagement.

Methods: A randomized trial of 1866 smokers was used to examine the efficacy of 5 different treatment components of a Web-based smoking cessation intervention. The components were: high- versus low-personalized message source, high- versus low-tailored outcome expectation, efficacy expectation, and success story messages. Moreover, the timing of exposure to these sections was manipulated, with participants randomized to either a single unified Web program with all sections available at once, or sequential exposure to each section over a 5-week period of time. Participants from 2 large health plans enrolled to receive the online behavioral smoking cessation program and a free course of nicotine replacement therapy (patch). The program included: an introduction section, a section focusing on outcome expectations, 2 sections focusing on efficacy expectations, and a section with a narrative success story (5 sections altogether, each with multiple screens). Most of the analyses were conducted with a stratification of the 2 exposure types. Measures included: sociodemographic and psychosocial characteristics, Web sections opened, perceived message relevance, and smoking cessation 6-months following quit date.

Results: The total number of Web sections opened was related to subsequent smoking cessation. Participants who were younger, were male, or had less formal education were more likely to disengage from the Web-based cessation program, particularly when the program sections were delivered sequentially over time. More personalized source and high-depth tailored self-efficacy components were related to a greater number of Web sections opened. A path analysis model suggested that the impact of high-depth message tailoring on engagement in the sequentially delivered Web program was mediated by perceived message relevance.

Conclusions: Results of this study suggest that one of the mechanisms underlying the impact of Web-based smoking cessation interventions is engagement with the program. The source of the message, the degree of message tailoring, and the timing of exposure appear to influence Web-based program engagement.

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KEYWORDS

Internet, World Wide Web; smoking cessation; engagement

Introduction

Web-based programming for smoking cessation is now reaching millions at a relatively low cost [1,2]. Moreover, some Web-based cessation programming has been tested in randomized trials and found to produce cessation rates that are similar to other far more expensive channels [3-6]. These early results are reflected by similar findings in eHealth programming for other health-related behaviors and disease conditions [1].

A consistently troubling finding, however, is the relatively low rate of long-term engagement produced by many Web-based programs [7]. Brief engagement with a Web-based program may not necessarily be an indication of failure. Participants may disengage from a program after successful behavior change. For example, in an effort to solidify a non-smoking identity, a successful quitter may disengage from a program so as not to be reminded of their previous smoking behavior. In a previous trial of a Web-based smoking cessation program [6], the number of cessation program Web pages opened was not a good predictor of 12-week cessation.

Eysenbach [7] discusses the need for developing a "science of attrition", calling for studies examining the degree to which attrition is associated with program failure and the predictors of attrition. If program attrition is, indeed, related to failure, it makes sense to study participant characteristics that predict disengagement, and the impact of specific program components that encourage long-term engagement (ie, "stickiness").

Operational definitions for "engagement" must also be defined. Danaher and colleagues [8] identify a number of ways in which exposure and engagement in Web-based health behavior change programs may be determined, including the number, duration, and pattern of visits to the site, and the number and types of pages viewed. The authors also point out that no single, universally accepted, measure exists.

This study, which uses a fractional factorial design with multiple treatment components [9,10], focuses on 3 questions: First, does engagement in Web-based smoking cessation program content influence long-term outcomes? Second, do user characteristics predict disengagement from the program? Third, do particular intervention strategies enhance engagement? These questions are addressed among smokers enrolled in a Web-based smoking cessation program within 2 large Health Maintenance Organizations (HMOs). The measure of engagement used in this study is the number of program sections opened.

Methods

Participants

Participants were recruited from the memberships of 2 Health Maintenance Organizations participating in the National Cancer Institute's (NCI) Cancer Research Network (CRN): Group Health (GH) of Seattle, Washington, and the Henry Ford Health System's Health Alliance Plan (HFHS) of Detroit, Michigan. Both GH and HFHS are not-for-profit health care delivery systems. Individuals were eligible to participate if: (1) they had smoked at least 100 cigarettes in their lifetime, currently smoked at least 10 cigarettes per day, and had smoked in the past 7 days; (2) were seriously considering quitting in the next 30 days; (3) were 21 to 70 years old; (4) were a member of GH or HFHS; (5) had home or work access to the Internet and an email account that they used at least twice weekly; (6) were not currently enrolled in another formal smoking cessation program or currently using pharmacotherapy for smoking cessation; and (7) had no medical contraindications for nicotine replacement therapy (NRT).

All participants in the study received access, free of charge, to an individually tailored smoking cessation program delivered via the Web, although specific intervention components received by participants varied by the experimental group to which they were assigned. All participants also received, free of charge, a 10-week supply of NRT patches. The purpose of the NRT provision was to minimize the potential confounding effects of adventitious differences in physiological addiction and to allow participants to focus on the cognitive-behavioral aspects of smoking cessation. A previous trial combining a Web-based behaviorally-tailored smoking cessation program with NRT demonstrated positive and relatively high rates of cessation 3 months post quit date [6]. The study protocol was reviewed and approved by the Institutional Review Board (IRB) of each collaborating institution and of the University of Michigan by January, 2004.

Recruitment

Participants were recruited through a combination of individual- and population-level strategies between September, 2004 and July, 2005. Each of the 2 health care organizations identified likely current smokers via automated smoking status data collected during recent medical appointments, documentation of smoking in electronic medical charts, an internal list of smokers collected during prior research, or lists of patients with smoking-related conditions who had previously been prescribed cessation medications. Thus, all invitees were likely to have been recent smokers with a high probability of being current smokers. These likely smokers were prescreened using records of the health care organizations for minimal inclusion criteria (eg, age) and were sent a study invitation letter. Recruitment information informed the likely smokers that they would receive a free Web-based smoking cessation program and a free 10-week course of nicotine replacement therapy (NRT). Provision of NRT was predicated on eligibility and completion of the baseline assessment, but not continued participation in the program. Individuals who had not opted out of further contact or had not begun enrolling in the program at least 4 weeks after their initial invitation were sent a second 'reminder' mailing. Several population-level enrollment strategies were also utilized, including promotion of the study in the HMO newsletter and

to HMO staff. Further description of participant recruitment procedures and the results of these procedures are presented in McClure et al [11].

Data Collection, Randomization, and Follow-Up Procedures

Those invited to participate in the study were given a Web address (URL) and an identification code to enter a personalized website. After logging in, invitees were administered an eligibility survey, online consent, and baseline questionnaire. The intervention delivery system controlled the interaction with the participant by running a software script that collected data from the participant via an assessment and immediately produced appropriate (ie, tailored) cessation feedback based on those data. The baseline assessment assessed, and stored in a database, the participant's smoking history, psychosocial, health, and demographic characteristics relevant to smoking cessation programming. A quit date within 3 weeks of the baseline assessment was also required. Immediately after the assessment, randomization was stratified by the HMO site automatically by the computer, invisible to the participant. Follow-up interviews administered 6 months post quit date were conducted using a computer-assisted telephone interview (CATI).

Intervention Factors

The overall Web-based program and each experimental factor within the program were developed at the University of Michigan's Center for Health Communications Research (UM-CHCR). The content of the program was based on cognitive-behavioral methods of smoking cessation and relapse prevention, including an appeal to motives for quitting, stimulus control, self-efficacy enhancement, and suggestions for coping with tempting situations and emotions. The intervention components selected for testing within this overall paradigm included outcome expectations, efficacy expectations, use of hypothetical success stories, personalization of the message source, and the timing of message exposure.

For 3 of these factors (outcome and efficacy expectations, success stories), the depth of tailoring was experimentally manipulated. By the term "tailoring" we refer to a process consisting of: (a) an assessment of individual characteristics relevant to smoking cessation, (b) algorithms that use the assessment data to generate intervention messages relevant to the specific needs of the user, and (c) a feedback protocol that delivers these messages to the smoker in a clear, vivid format. The Web-based program includes integrated cessation messages from multiple assessment responses to develop sentences and paragraphs written specifically for the user. For further description of the UM-CHCR's tailoring process and examples of tailored feedback, the reader is referred to the UM-CHCR website [12].

Study participants received a variation of each of the 5 two-level intervention factors (1) depth of tailored outcome expectation feedback; (2) depth of efficacy expectations; (3) depth of success stories; (4) personalization of source; and (5) exposure schedule. Each of these factors is described in turn below.

Depth of Outcome Expectations

In this factor, the depth of tailored outcome expectation feedback was manipulated. Messages included statements tailored to personal and family health history, perceived health status, functional health status, monetary savings, and appearance, among other outcomes. Participants randomized to the high-depth tailored group received feedback and advice related to their specific motives for quitting. In addition, these participants received an overview of the balance between their intrinsic versus their extrinsic reasons for quitting. Participants in the low-depth tailored group received feedback related to their motives for quitting but did not make as many connections with existing health or lifestyle characteristics, nor was feedback regarding the balance between intrinsic and extrinsic motives provided.

Depth of Efficacy Expectations

Tailored efficacy messages addressed relevant barriers to quitting. Responses to high-risk situations, existing skills, and attributions for previous failures in quitting, along with smoking history and current smoking behavior were used to help build self-efficacy feedback. Those with previous cessation attempts, for example, were asked to consider these experiences in developing coping strategies for specific perceived cessation barriers. Participants randomized to the high-depth tailored group received feedback and advice focusing attention on their 2 most problematic individual barriers to quitting (for example, wanting to smoke when drinking coffee, when feeling stressed, or when spending time with friends and family who smoke). Highly tailored feedback also used information about the participant's home environment, family life, stress and coping levels, coping skills, and level of physical activity, among other unique characteristic traits to provide enhanced advice in dealing with the barriers addressed. Participants in the low-depth tailored group received less tailored content addressing 2 broader barrier topics cited by the smoker (for example, daily routines, negative emotion control, or social settings).

Depth of Success Stories

As part of the intervention, participants received a hypothetical story about an individual who successfully quit smoking. Low-depth success stories were tailored only to the participant's name (ie, personalized) and gender. Participants randomized to high-depth success stories received a story that was tailored not only to their name and gender, but also to their age, ethnicity, marital status, smoking status of the spouse, number of cigarettes, biggest barrier to quitting, reason for wanting to quit, degree and type of social support, as well as whether the participant had children in the home, was physically active, and was working outside of the home.

Personalization of Source

In the introductory section welcoming a participant to the program, the highly personalized source condition included a photograph of, and supportive text from, the smoking cessation team of the HMO. It was written in a friendly manner, using words like "we" and "our team", and ended with a signature from the team. The low-personalized version included a photograph of a building representing the HMO institution, was

written using words like "this organization", and did not include a closing signature.

Exposure Schedule

This manipulation compared the impact of providing the smoking cessation content in a single, large set of materials (equivalent to roughly 16 pages of text in a printed self-help guide) to that of breaking the materials into a series of weekly installations. Participants received the efficacy, outcome, success story, and source materials all at one time online or distributed over 5 weeks (efficacy messages were separated into 2 weeks) with email reminders to revisit the site when new content was made available. In both exposures, once content was available, it remained available throughout the study period.

Experimental Design

This study was designed to identify the most active intervention components or "factors" from a large number of potentially relevant components [9,10]. A fractional factorial design with 16 arms allowed us to estimate all main effects and several pre-specified 2-factor interactions among the 5 intervention components. The study was intended primarily to test the impact of the 5 treatment components on 6-month smoking cessation outcomes. The results of this analysis are being presented in a separate paper (under review). However, the ongoing measurement of engagement in the program allows the determination of: (a) whether engagement with the program is associated with 6-month cessation, (b) characteristics of participants likely to disengage in the program, and (c) whether the treatment components tested in the study are related to engagement.

Measures

Engagement

Engagement was determined through an automated assessment of the number of sections of the Web-based smoking cessation program opened. The sections of the program, described in the previous section, focused on particular treatment components, including outcome expectations, efficacy expectations, success stories, and message source. There were 2 efficacy expectation sections, creating a total of 5 sections that could have been opened by the participant. Program engagement was measured by the cumulative number of Web-based smoking cessation sections opened by the participant.

Tailoring Depth

To determine the impact of increasing tailoring depth on engagement, a score was created representing the number of high-depth tailored components received by the participant. Randomization of the 3 tailoring depth factors (outcome expectation, efficacy expectation, and success stories) allowed participants to receive a range of 0-3 high-depth tailored components.

Perceived Message Relevance

At the 6-month follow-up, a single-item measure, the degree to which the materials were found to be "written personally for me", was asked. Messages tailored to specific needs and interests of the individual are often evaluated using this measure [13,14]. In recent research, Strecher, Shiffman, and West [15] found that the influence of Web-based tailored smoking cessation materials on subsequent abstinence was partially mediated by the participant's perception that the messages were written for them.

Abstinence

The abstinence measure used in this study, collected 6 months following the participant's self-identified quit date, is 7-day point prevalence abstinence ("Did you smoke a tobacco cigarette, even a puff, in the past 7 days?"). Abstinence was assessed by self-report during a telephone interview at 6 months post-quit date. Biochemical verification was not collected since it was considered impractical in this population-based study [16]. Moreover, there is general consensus that self-report is adequate in minimal-contact treatment studies when low demands exist to misrepresent one's smoking status [17,18].

Data Analysis

Logistic regression and analysis of variance (ANOVA) procedures were used to address the 3 questions of this study: (a) whether engagement with the program is associated with 6-month cessation, (b) characteristics of participants that predict engagement in the program, and (c) treatment components that predict engagement in the program.

The analysis examining engagement by 6-month cessation was conducted in 2 ways: a complete respondent (CR) analysis, and an intent-to-treat (ITT) analysis. The CR analysis focused on participants who answered the smoking cessation-related questions at 6-month follow-up. In the ITT analysis, all participants who were randomized to treatment, including those who failed to provide abstinence data for any reason, were included in the analysis. Non-respondents at follow-up in this case were considered treatment failures (ie, current smokers). The two remaining research questions were examined using baseline participant data and engagement data, which were collected from all baseline participants.

Exposure schedule, whether the programming was delivered over weekly installments or as a single grouping of sections, was considered a fundamental, structural feature of the Web-based programming. Therefore, in addition to examining this factor as a predictor of engagement, analyses were also stratified by this factor.

Results

Project Quit Recruitment and Follow-Up Response

During an 11-month recruitment period, 3256 people from both HMOs visited the website; 2651 (81% of website visitors) were screened for eligibility; 2011 (62% of website visitors) were eligible; and 1866 enrolled and were randomized to 1 of the 16 study arms (57% of website visitors). The primary reasons for ineligibility to the study were: did not smoke enough (26%), medical contraindications for NRT (23%), already enrolled in another smoking cessation program (16%), lack of adequate Internet/email access (14%), not currently enrolled in the HMO (10%), and currently using pharmacotherapy to quit smoking (8%).

Of these participants, 1415 (76%) responded to the 6-month follow-up computer-assisted telephone interview (CATI) and were included in the complete respondent (CR) analyses. A chi-square test was used to assess whether the non-response rate to the 6-month follow-up varied among the 16 treatment arms (cells of the fractional factorial design). No significant differences in non-response rates between intervention arms were found ($P = .75$).

Participant Characteristics

Demographic, smoking, and psychosocial characteristics of enrolled participants by HMO are presented in Table 1. Possible differences in each of these baseline characteristics across the 5 experimental conditions were examined using analysis of variance (ANOVA). Of the 40 comparisons, significant differences at the $P < .05$ level (unadjusted for multiple comparisons) were found only for 2 baseline characteristics, motivation and self-efficacy, which were higher in the low- than in the high-tailored success story condition.

Table 1. Participant characteristics by HMO (blinded)

Participant characteristic	Site 1 (n = 986)	Site 2 (n = 880)	Total (n = 1866)
Age (mean years)	46.5	46.1	46.3
Gender (women)	59.4%	59.6%	59.5%
Race [a]			
African-American	3.2%	19.7%7.4%	11.0%
White	84.2%	72.9%	78.9%
Other	12.6%	7.4%	10.1%
Education			
≤ High school[b]	35.2%	37.3%	36.2%
> High school	64.8%	62.7%	63.8%
# cigarettes smoked/day (mean)[a]	21.1	22.7	21.8
Motivation (mean on 1-10 scale)	8.3	8.3	8.3
Self-efficacy (mean on 1-10 scale)	7.3	7.4	7.4

[a]ANOVA significant ($P < .05$) between HMOs

[b]This category includes vocational training

Program Engagement and 6-Month Cessation

Using intent-to-treat criteria (treating 6-month non-respondents as smokers), the cumulative number of Web sections opened was related to subsequent smoking cessation (OR = 2.26; CI = 1.72-2.97) across the entire 0-5 range of sections opened. Each section opened, on average, contributed to an 18% higher likelihood of quitting smoking (OR = 1.18; CI = 1.11-1.24). Dichotomizing usage into “heavy” (3-5 sections opened) versus “light” (0-2 sections opened), a significant effect was also found: participants heavily engaged in the Web program had an average 6-month cessation rate of 37.4% while participants lightly engaged had an 27.3% cessation rate ($X^2 = 16.1$; $P < .001$). Respondent-only analyses found similar, statistically significant effects. Including baseline levels of motivation and self-efficacy in the regression model did not influence the results.

Participant Characteristics Predicting Program Engagement

Linear regression was used to analyze the relationship between participant characteristics and the number of sections opened (Table 2). Smokers who opened fewer sections tended to have less formal education, were younger, and were male. With the exception of HMO affiliation, these differences in engagement were found only in the weekly exposure condition.

Table 2. Program engagement[a] of each intervention component by participant characteristics (n = 1866)

			Exposure Schedule			
			Single Exposure		Weekly Exposure	
Participant characteristic	# sections opened	F (*P* value)	# sections opened	F (*P* value)	# sections opened	F (*P* value)
HMO						
1	2.9	14.0 (*P* < .001)	3.2	6.5 (*P* = .01)	2.6	9.9 (*P* = .002)
2	2.2		2.9		2.2	
Age						
<40 yrs	2.5	11.4 (*P* < .001)	2.9	2.1 (*P* = .13)	2.0	14.4 (*P* < .001)
40-49 yrs	2.6		2.9		2.3	
>50 yrs	3.0		3.2		2.8	
Gender						
Female	2.8	5.9 (*P* = .02)	3.1	1.6 (*P* = .21)	2.5	7.2 (*P* = .008)
Male	2.6		3.0		2.2	
Race						
African-American	2.6	0.9 (*P* = .42)	2.9	0.3 (*P* = .71)	2.2	0.4 (*P* = .69)
White	1.7		3.1		2.4	
Other	1.8		3.1		2.5	
Education						
≤ High school	2.6	9.8 (*P* = .002)	2.9	2.5 (*P* = .11)	2.2	6.7 (*P* = .01)
> High school	2.9		3.2		2.5	
# cigarettes/day						
<20	2.8	0.6 (*P* = .56)	3.0	1.0 (*P* = .36)	2.5	2.1 (*P* = .12)
20	2.6		2.9		2.4	
>20	2.7		3.2		2.2	
Motivation[b]						
Low	2.8	2.3 (*P* = .13)	3.1	0.8 (*P* = .36)	2.5	2.9 (*P* = .09)
High	2.6		3.0		2.3	
Self-efficacy[b]						
Low	2.7	0.6 (*P* = .44)	3.2	2.3 (*P* = .13)	2.3	1.1 (*P* = .30)
High	2.7		2.9		2.4	

[a]Number of sections opened adjusted for baseline characteristics in the Table.

[b]Motivation and Self-efficacy measures were split at their means.

Treatment Components Predicting Program Engagement

Table 3 presents the effects of each intervention component on program engagement. In this model, program engagement was regressed on each intervention component and the baseline variables of Table 1. More personalized source and high-depth tailored self-efficacy components were related to a greater number of Web sections opened. In addition, the single exposure that included all intervention components had the highest number of sections opened.

Stratifying by exposure schedule, 2 regression models were run, examining predictors of engagement with a Web program that included all intervention components simultaneously presented ("single") versus a Web program that broke the materials into weekly installments ("multiple"). In the single condition, personalized source and highly tailored efficacy expectation messages were related to a higher number of sections opened. In the weekly exposure condition, no intervention components were related to the number of sections opened.

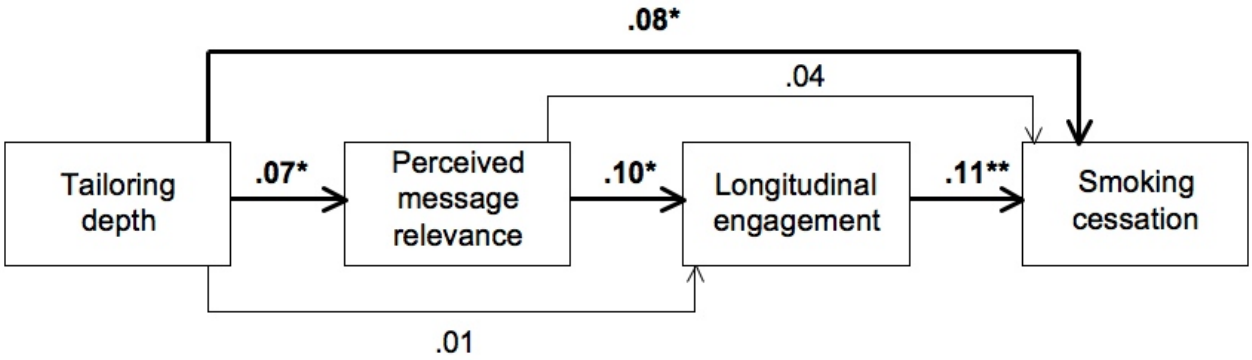
Table 3. Program engagement[a] of each intervention component by intervention components (n=1866)

	Exposure Schedule					
	Single Exposure				Weekly Exposure	
Factor	# sections opened	F (*P* value)	# sections opened	F (*P* value)	# sections opened	F (*P* value)
Source	2.9	10.2 (*P* = .002)	3.2	7.5 (*P* < .007)	2.6	2.4 (*P* = .12)
High depth	2.6		2.9		2.5	
Low depth						
Success story	2.7	0.0 (*P* = .97)	3.1	0.1 (*P* = .79)	2.5	0.1 (*P* = .76)
High depth	2.7		3.0		2.6	
Low depth						
Outcome expectations	2.7	3.2 (*P* = .07)	2.9	3.7 (*P* = .06)	2.5	0.3 (*P* = .60)
High depth	2.8		3.2		2.6	
Low depth						
Efficacy expectations	2.9	10.2 (*P* = .001)	3.2	6.6 (*P* = .01)	2.7	3.6 (*P* = .06)
High depth	2.6		2.9		2.4	
Low depth						
Exposure	3.0	41.8 (*P* < .001)				
Single	2.5					
Multiple						

[a]Number of sections opened adjusted for baseline characteristics of Table 1.

In a related study focused on smoking cessation outcomes [3], a significant relationship between tailoring depth, measured by the cumulative administration of high-depth success story, outcome expectation, and efficacy expectation components, and 6-month smoking cessation outcomes was found. Using this same tailoring depth measure, a path analysis model using linear regression was constructed for participants receiving the longitudinal exposure of intervention components. This path model includes tailoring depth, message relevance, engagement in the longitudinal program, and 6-month smoking cessation (Figure 1).

Figure 1. Path analysis of tailoring depth, perceived message relevance, longitudinal engagement, and smoking cessation. Numbers indicate standardized beta coefficients. Participants assigned to the weekly exposure condition (Complete Respondent analysis, n=725; *P < .05;**P < .01)



In this path model, the tailoring depth influenced perception of message relevance, which in turn, influenced longitudinal engagement in the sequentially delivered Web program. Engagement was related to smoking cessation. Tailoring depth also influenced smoking cessation outside of the hypothesized engagement pathway.

Discussion

This research used a randomized trial to address 3 issues relevant to engagement in Web-based programming for health-related behavior change: (1) the degree to which engagement in program content influences 6-month smoking cessation outcomes; (2) characteristics of participants most likely to disengage with the program; and (3) intervention strategies that enhance engagement. These analyses found an average 18% increase in likelihood of quitting smoking for every Web section opened. The finding that engagement was associated with subsequent smoking cessation may not seem particularly surprising, though a null or even reverse result was possible if smokers who had successfully quit during the course of treatment decided to disengage from the program.

Identifying characteristics of participants more likely to disengage from the program offers targets for engagement efforts. Participants who were younger, were male, or had less formal education were more likely to disengage from the Web-based cessation program, particularly when the program sections were delivered sequentially over time. These sub-groups could, in the future, receive programming more specifically related to their needs and interests. In another recent study examining determinants of engagement in a Dutch Web-based weight management and lifestyle program, Verheijden and colleagues [19] found significantly lower engagement among younger users but not among less educated or male users. Together, these findings suggest that engagement patterns might vary by participant matter of the programming or perhaps by culture or other characteristics of the participants. The finding that older participants from both studies were more likely to remain engaged in the Web-based programming is interesting and relevant to programming targeted to seniors.

Particular components of the intervention influenced engagement with the Web-based programming. Both a more personalized source and highly tailored efficacy expectation messages were related to engagement when the Web program offered all content in a single large package. While message source is a classic focus in communications research, it is rarely examined in smoking cessation research. In this study, the source of the message was the participant's health maintenance organization. While members of health maintenance organizations may perceive these organizations as untrustworthy due to a lack of openness and accountability [20], it is possible that a more personable message source may convey greater trustworthiness, leading to greater interest in the program. Further analyses showed that highly tailored messages related to self-efficacy and coping strategies for cessation may have promoted greater interim success or confidence, resulting in greater program engagement.

None of the individual intervention components influenced engagement when the sections of the program were distributed sequentially over a 5-week period. Since many Web-based programs are designed around a longitudinal engagement pattern, we wanted to focus further analysis on this issue, exploring the possibility that higher-depth tailoring might influence extended engagement. In a recent Web-based smoking cessation study, we found that message relevance partially mediated the influence of message tailoring on smoking cessation [6]. In other words, smokers receiving tailored versus untailored cessation materials were more likely to perceive the materials as personally relevant (ie, "written for me"), which in turn influenced greater cessation rates. In another recent study using functional magnetic resonance imaging (fMRI), we found that higher-depth tailored smoking cessation messages were associated with greater activation of a portion of the brain (medial prefrontal cortex) often associated with self-relevant activity [21].

In a path model constructed to explore this issue, perceived message relevance was associated with longitudinal program engagement. Message relevance, in turn, was influenced by greater depth of message tailoring. While other intervention strategies to influence longitudinal engagement exist (eg, email, IVR prompts), tailoring the message to specific needs and interests of the user appears to enhance perceived relevance, which in turn, appears to enhance engagement.

This study has a number of limitations. First, our measure of engagement was rudimentary. The number of Web sections opened does not describe the time, quality, or other aspects of engagement [8]. Second, our measure of personal relevance was based on a single questionnaire item and therefore participant to measurement error. Third, the sample of HMO members enrolling in a Web-based smoking cessation program is not generalizable to many other populations of smokers, including those unmotivated to quit and those who are uninsured.

In summary, this study found that: (1) engagement with a Web-based smoking cessation program was associated with subsequent cessation; (2) engagement was lower among younger, male, and less educated participants; and (3) engagement may be improved by including specific components to the intervention, particularly a more personalized source, and highly tailored messaging. Future research, with more detailed measures of engagement (eg, amount of time engaged with specific program components) and other engagement strategies (eg, email or IVR reminders to use the program) are likely to further our understanding of this issue. We believe that collecting multiple measures of engagement should be a routine part of all online interventions. A clear advantage of online interventions is the ability to measure engagement with relatively little effort, giving us greater insight into the process of program engagement and behavior change.

Conflicts of Interest

Dr. Strecher is founder and chairman of HealthMedia, Inc., a company that makes computer-tailored behavior change programs. No other authors reported conflicts of interest.

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Abbreviations

ANOVA: analysis of variance
CATI: computer-assisted telephone interview
CR: Complete Respondent
CRN: Cancer Research Network
fMRI: functional magnetic resonance imaging
GH: group health
HMO: health maintenance organization
HFHS: Henry Ford Health System
IRB: Institutional Review Board
ITT: intent-to-treat
IVR: interactive voice response
NCI: National Cancer Institute

NRT: nicotine replacement therapy
URL: uniform resource locator
UM-CHCR: University of Michigan's Center for Health Communications Research

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Original Paper

Internet Delivered Support for Tobacco Control in Dental Practice: Randomized Controlled Trial

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Abstract

Background: The dental visit is a unique opportunity for tobacco control. Despite evidence of effectiveness in dental settings, brief provider-delivered cessation advice is underutilized.

Objective: To evaluate an Internet-delivered intervention designed to increase implementation of brief provider advice for tobacco cessation in dental practice settings.

Methods: Dental practices (N = 190) were randomized to the intervention website or wait-list control. Pre-intervention and after 8 months of follow-up, each practice distributed exit cards (brief patient surveys assessing provider performance, completed immediately after the dental visit) to 100 patients. Based on these exit cards, we assessed: whether patients were asked about tobacco use (ASK) and, among tobacco users, whether they were advised to quit tobacco (ADVISE). All intervention practices with follow-up exit card data were analyzed as randomized regardless of whether they participated in the Internet-delivered intervention.

Results: Of the 190 practices randomized, 143 (75%) dental practices provided follow-up data. Intervention practices' mean performance improved post-intervention by 4% on ASK (29% baseline, adjusted odds ratio = 1.29 [95% CI 1.17-1.42]), and by 11% on ADVISE (44% baseline, OR = 1.55 [95% CI 1.28-1.87]). Control practices improved by 3% on ASK (Adj. OR 1.18 [95% CI 1.07-1.29]) and did not significantly improve in ADVISE. A significant group-by-time interaction effect indicated that intervention practices improved more over the study period than control practices for ADVISE (P = 0.042) but not for ASK.

Conclusion: This low-intensity, easily disseminated intervention was successful in improving provider performance on advice to quit.

Trial Registration: clinicaltrials.gov NCT00627185; http://clinicaltrials.gov/ct2/show/NCT00627185 (Archived by WebCite at http://www.webcitation.org/5c5Kugvzj)

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KEYWORDS

Smoking cessation; Internet; general practice, dental; randomized controlled trial; health services research

Introduction

Despite widespread acceptance of the evidence that tobacco use is the primary preventable cause of death, rates of this risky behavior have not substantially declined in the past 10 years [1]. A recent state of the science conference on tobacco cessation noted that several interventions to enhance tobacco cessation are underutilized [2].

Brief provider-delivered interventions, applied during clinical visits, are effective in increasing cessation. A recent meta-analysis of brief provider-delivered cessation advice reported a pooled odds of patient cessation of 1.74 (95% CI 1.48, 2.05), comparing intervention to control [3]. Studies included in this synthesis of brief cessation advice were frequently based on the current "5A's" approach. The 5A's (Ask, Advise, Assess, Assist, and Arrange follow-up) are recommended in the *Treating Tobacco Use and Dependence* guideline [4].

The dental visit is a unique but underused opportunity for tobacco control, despite evidence that brief provider advice delivered in the dental setting is effective in increasing tobacco cessation [5]. Block et al surveyed healthcare providers in 1999 and found that 69% of physicians report consistently assessing tobacco use among patients, compared with 32% of dentists [6]. Only 13% of physicians reported never intervening with tobacco users, but nearly half (49%) of dentists never intervened. In a more recent survey, dentists again did not routinely incorporate the assessment of tobacco smoking into their practices, with half of dentists reporting providing cessation advice at least 41% of the time [7]. Only 20% of dentists in a recent community survey were aware of the tobacco guideline [8]. Increasing diffusion and uptake of guideline-adherent approaches to reducing tobacco use, especially in dentistry, is essential.

Prior studies of guideline implementation strategies, such as educational outreach and didactic continuing medical education, have resulted in median absolute improvements ranging from 6 to 8% for a variety of processes of care [9,10]. Implementation strategies including videos, self-study materials, educational outreach, and workshops have been documented to improve cessation advice in dentistry [11-14]. Improvements in care have resulted from interventions which were at times quite costly to deploy [9] and had considerable marginal costs for material, personnel, and travel per practice. To maximize the reach of guideline implementation, educational and behavioral interventions designed to be readily available, consistently used, and deployed with minimal cost per practice are needed.

Recently, the Internet has been used to deliver educational interventions to increase guideline compliance [15-18] at low costs [19,20]. We developed an interactive, Internet-delivered intervention designed to educate providers in dental practices and to provide motivation and resources for increasing tobacco control. OralCancerPrevention.org, the resulting practice improvement intervention, was evaluated using a randomized trial to measure changes in guideline-adherent tobacco control practices [21]. We hypothesized that access to the interactive, Internet-delivered intervention would increase rates of tobacco-use screening and cessation advice for tobacco users, comparing intervention and control.

Methods

Study Design Overview, Setting, and Sample of Participating Dental Practices

We conducted a randomized trial among dental practices from Alabama, Georgia, Florida, and North Carolina, identified using mailing lists from dental licensure and the Dental PBRN, a dental practice-based research network [22]. PBRNs are "groups of primary care clinicians and practices working together to answer community-based health care questions and translate research findings into practice. PBRNs engage clinicians in quality improvement activities and an evidence-based culture in primary care practice" (Agency for Healthcare Research and Quality). The community-based dental practices have a varying number of providers and are based in a variety of settings (rural and urban). Beginning in January 2005 through February 2006, dental practices were recruited using a letter addressed to the dentist which advertised the study. For blinding purposes the letter did not mention tobacco control but identified the study as an evaluation of an "Online Study Club for Oral Cancer Prevention". Face-to-face study clubs are frequent in dentistry and usually refer to a group of dental providers who gather to discuss clinical practice and the dental literature [23-25]. Eligible practices included general dentistry or periodontal practices which reported having Internet access in their practice (requirement of the study) and indicated an interest in participating.

Accounting for clustering of patients within practices, we calculated a sample size of 130 practices (65 per arm) would be needed to detect a difference of 10%, comparing intervention and control. Anticipating an attrition rate of 30%, our targeted recruitment goal was 190 practices. Dental practices which initially agreed to participate were required to complete a run-in phase of baseline data collection, including patient and practice data, and then they were randomized. From our initial recruitment pool, we randomized the first 190 practices which returned the baseline data. Practices were randomized to the intervention described below, or a control group using a permuted block randomization sequence generated by our biostatistician. As practices returned baseline data, allocation to intervention or control was performed using the predetermined randomization sequence by an analyst blinded to the results of the baseline data. The protocol was approved by the University of Alabama at Birmingham Institutional Review Board.

After the run-in phase and randomization, the dentist and staff of intervention practices were sent a letter with information about the website and log-on instructions. We then tracked each practice to determine who from the practice logged on, when

they logged on, and the amount of time they spent visiting the site. To encourage participation, emails were sent to the intervention participants alerting them about new website content and updates in the field of dental tobacco control. Once a practice logged on to the website, patient education materials about tobacco use were mailed to the practice for in-office use.

We used a delayed-intervention control group. Control practices continued to provide the usual care that they delivered to patients during the intervention period while still completing baseline and follow-up data collection. Control practices did not receive access to the intervention until all data collection was complete.

Development of OralCancerPrevention.org—The Practice Improvement Intervention

We developed an Internet-delivered educational intervention designed to support oral cancer prevention in dentistry. The development team included a hygienist, dentist, and tobacco control and health informatics experts. Prior to the development of the website, we conducted 3 Nominal Group Technique (NGT) meetings, 2 with a total of 13 dentists, and 1 with 10 hygienists participating. The NGT is a structured approach to collecting and prioritizing input from stakeholders [26]. The question for NGT discussion ("What sorts of things could be done to ensure that as a routine part of every dental visit all patients are asked about their tobacco use and/or advised to quit using tobacco?") was identified through numerous brainstorming sessions with the investigative team. The dentists and hygienists identified 76 potential strategies for promoting tobacco control, including 9 distinct educational issues. Based on the NGT findings, the investigative team along with programmers met weekly for 12 months to develop both the content and format of the Internet intervention, which resulted in an interactive, multi-component website with supporting emails. Usability testing was conducted to confirm ease of navigation. The site was designed to be accessed longitudinally over 8 months and be frequently updated with new content.

OralCancerPrevention.org Content

The final Oral Cancer Prevention product was comprised of 3 educational cases, patient education and practice tools, a forum for chatting, opportunities to ask questions, and presentation of headlines (see Multimedia Appendix 1 for sitemap and screenshots). The dentist could spend from as little as a few minutes up to hours on the website. All course materials were updated as needed and the 3 cases were released at 2-month intervals.

The interactive educational cases were interspersed at key decision points with questions, and we provided targeted feedback based on user responses. In addition, references and literature were available at critical points to support the course material. Dentists and hygienists could access downloadable, patient education materials and practice tools, including brochures and posters. A discussion forum allowed the dentists and dental staff to post questions and receive feedback/responses from other dental staff and practitioners. The "ask a question" feature allowed any participant to submit a question related to oral cancer prevention and receive a direct response from the investigative team. In addition, we emailed all participants bi-weekly with "headlines" presenting new research findings to the group and/or with "questions of the week" asking challenging questions related to tobacco control.

Participants received one continuing education unit for each of the cases completed. As cues to log on, we provided the practices with calendars, pens, and squeeze balls that had the website address and the project name. The intervention was available over an 8-month period for each practice.

Baseline Practice Variables and Longitudinal Tracking of Participation

Data were collected from the practices at baseline before randomization. The baseline practice survey included an assessment of the number of dentists, hygienists, and dental assistants in the practice; the number of years employed at that practice; and current oral cancer prevention-related activities.

Once randomized, user authentication was required for all providers as they logged onto the intervention. This allowed use of server tracking logs linked to site visits to measure participation. The administrative portal of the study website tracked type of page visited, volume of pages, number of visits by practice and individual, date of access, time of access, name, and practice identification of each participant who logged onto the site [27]. We used the total number of pages of website content accessed as a marker for overall participation.

Measuring Provider Performance of Tobacco Control Activities (Main Outcome)

Our main outcome measures were based on the patient reports of guideline-compliant provider performance of tobacco control for the first 2 components of the 5A's (ASK and ADVISE) [4]. The 2 main outcomes were the proportion of patients asked if they were tobacco users (ASK), and among the tobacco users, the proportion who were advised to quit (ADVISE). Accordingly, we collected patient reports of provider behaviors using patient exit cards.

After completing the practice survey, practices were provided a set of 100 patient exit cards. The patient exit cards, brief post-card sized surveys, were completed by adult patients at the end of their appointments prior to leaving the office. The exit cards were developed using principles of ecological momentary assessment (EMA) [28-30]. First, EMA is completed as close in time to the exposure as possible to avoid faulty recall. Second, EMA is designed to be brief and unobtrusive to maximize participation rates and diffusion.

The exit cards were designed to be completed in 1 to 2 minutes while the patient was awaiting follow-up instructions and completing payment. Each practice was provided with instructions to hand out these exit cards to 100 consecutive adult patients after their visit. Each patient was provided a pen to complete the survey, and they were allowed to take the pen as a gift. Patients completing cards then deposited them in a sealed collection box. When all 100 cards were distributed, the dental practice returned the collection box to our coordinating center.

We used the patient exit card to assess patient tobacco use, age, and gender. Patients indicated whether they had been asked about tobacco use and, if a tobacco user, whether they had been

advised to quit. To blind the patient and practice to the outcome of interest, the exit card also included questions related to alcohol use and counseling, as well as dietary intake and counseling, received at the practice. Patients indicated on the card if they were willing to be contacted for a follow-up call and, if so, provided their name and telephone number. A sample of 150 patients from 6 practices was called to evaluate the reliability of the patient exit card data [31]. Agreement between card and telephone interview responses on whether the patient was a tobacco user was high (99%), with only 2 disagreements. Agreement rates for patient age and gender comparing immediate and delayed were also high (97% and 100%, respectively).

Statistical Analysis

In this trial, the unit of randomization was the dental practice, and both dentists and their staff were the targets of the intervention. Our analysis used an intent-to-treat design including all practices with follow-up data available. Intervention practices were analyzed as randomized regardless of whether they actually used the intervention. As noted, dependent variables for this study are patient-reported provider performance measures (ASK and ADVISE) collected as binary variables at the patient level. As patients were clustered within practices and the unit of randomization was at the practice level, we used a modeling approach appropriate to hierarchical data. Common approaches to clustered data include generalized estimating equations and generalized linear mixed models [32,33]. As the number of smokers per practice varied, we chose to use a generalized linear mixed model approach with adaptive quadrature with a logit link for binary outcomes because this approach is more robust to variations in intra-class correlation coefficient and cluster size [34,35]. This analysis was implemented using the Generalized Linear Latent and Mixed Models (GLLAMM) procedure in the STATA software package and verified using the SAS software package.

To assess the impact of the intervention, we first calculated the unadjusted proportion of patients who were asked and smokers who were advised pre- and post-intervention. Then, separately for intervention and control, we assessed the difference pre- versus post-intervention. For each indicator (ASK and ADVISE), we developed 2 models (1 for intervention, 1 for control). Finally, significance of differences (pre- versus post-intervention) in the odds of patient reports of ASK or ADVISE in intervention versus control practices were determined. For each indicator (ASK, ADVISE), 1 overall model, including both control and intervention patients, was developed. We included a term for Group (intervention versus control) and Time (pre- versus post-intervention), as well as a group-by-time interaction term. Significance of differences in improvement over time, by group, was determined by the statistical significance of the group-by-time interaction term in these overall models.

As a secondary analysis, we conducted a “per protocol” analysis excluding intervention-arm practices that did not participate in the intervention to further estimate what the optimal effects might be for this Internet-delivered intervention.

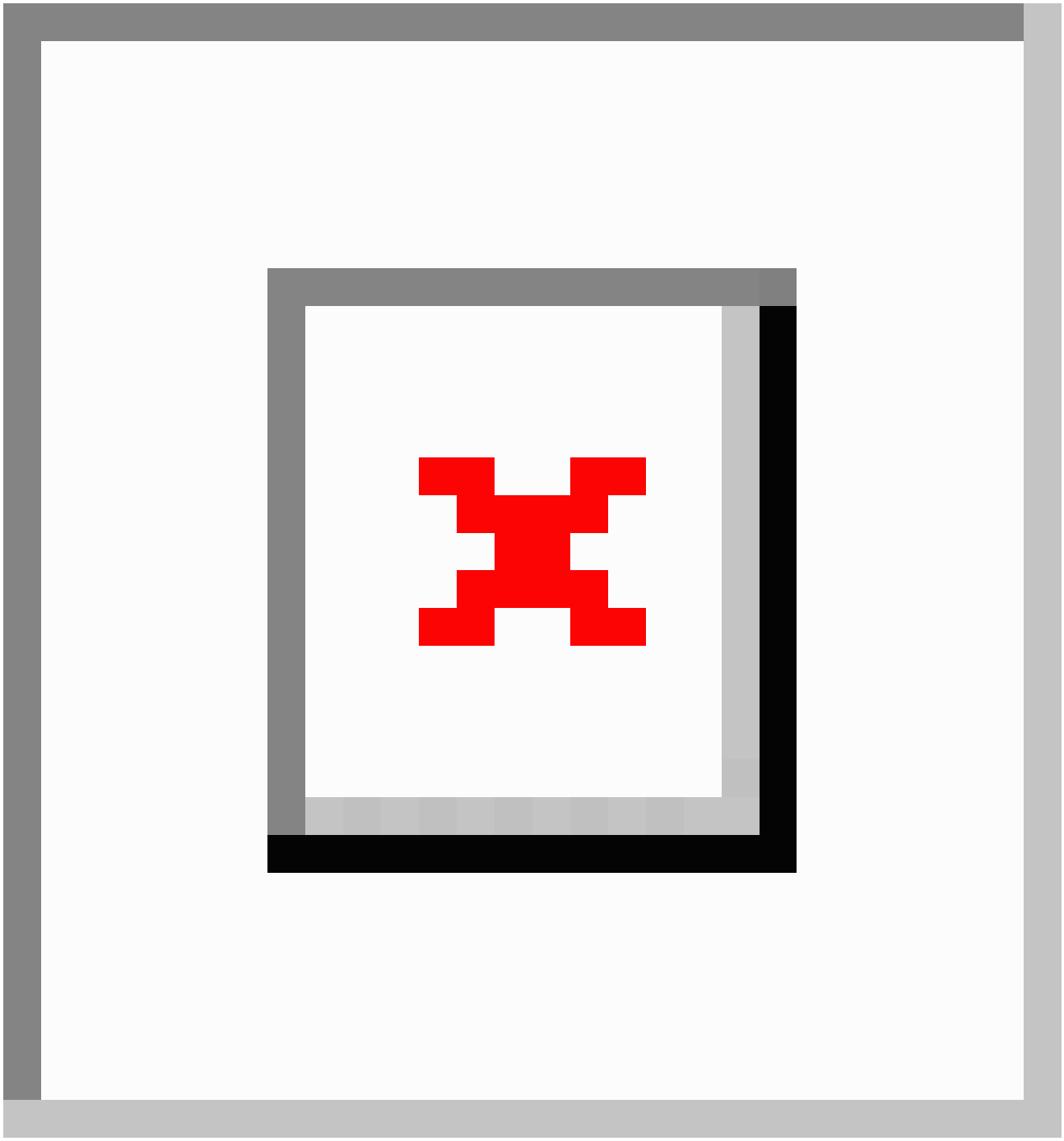
Because participation in Internet-delivered interventions such as this is inherently variable, we further assessed a dose-response by level of participation among intervention practices.

Results

Participating Practices

From a group of 1346 practices initially expressing interest, we randomized the first 190 practices that completed data collection. Of the 190 dental practices randomized, 75% (143) completed follow-up data collection (see Figure 1).

Figure 1. CONSORT Flowdiagram: Recruitment and retention of dental practices



Most of the 143 practices were general dentistry practices (92%) and solo practices (79%). Practices were located in Alabama (25%), Florida (34%), Georgia (27%), and North Carolina (14%). Overall, these 143 practices included 185 dentists (89 intervention and 96 control) and 274 hygienist participants (137 intervention and 137 control). Practices varied in the number of support staff, with most having 3 or more dental hygienists and dental assistants (Table 1). Overall, these were fairly established practices. In 83%, the primary dentist had practiced there for over 5 years. Control practices had a mean of 4.5 (SD 3.7) Internet-accessible computers, and intervention practices had 4.3 (SD 3.9) ($P = 0.41$). Comparing intervention and control practices, we found no differences in these characteristics at the $P < 0.05$ level. Providers also reported the overall characteristics of their patients, including the proportion of patients who were minorities (mean = 32%, SD 24), the proportion who had dental insurance (mean = 31%, SD 19), and the proportion who were on public assistance (mean = 11%, SD 21). Practices characteristics' and baseline provider performance were similar among those that completed follow-up and those that did not (summary data available in Multimedia Appendix 2).

Table 1. Characteristics of 143 dental practices randomized to intervention or control with completed follow-up[a]

	Control		Intervention	
	n/N[b]	%	n/N[b]	%
Practice Type				
General Practice	69/73	94.5	63/70	90.0
Periodontal	4/73	5.5	7/70	10.0
Solo/Group Practice				
Solo Dental Practice	57/72	79.2	53/68	77.9
Group Dental Practice	15/72	20.8	15/68	22.1
Number of Hygienists and Assistants				
0 staff	1/73	1.4	3/70	4.3
1-2 staff	17/73	23.3	20/70	28.6
3-4 staff	39/73	53.4	26/70	37.1
>4 staff	16/73	21.9	21/70	30.0
Number of Years at this practice(Dentist)				
<5 years	11/66	16.7	12/66	18.2
5-10 years	13/66	19.7	12/66	18.2
>10 years	42/66	63.6	42/66	63.6
Urban or Non-urban				
Urban over 1 million	26/73	35.6	22/70	31.4
Other metro	35/73	48.0	36/70	51.4
Non-metro	12/73	16.4	12/70	17.1
Practice busyness				
Too busy to treat all	6/72	8.3	9/70	12.9
Overburdened	7/72	9.7	6/70	8.6
Not overburdened	50/72	69.4	45/70	64.3
Not busy enough	9/72	12.5	10/70	14.3
State				
AL	25/73	34.3	11/70	15.7
FL	20/73	27.4	28/70	40.0
GA	18/73	24.7	21/70	30.0
NC	10/73	13.7	10/70	14.3
Number of Patients Visits Per Week				
<=40 patients/week	8/73	11.0	4/70	5.7
40-100 patients/week	47/73	64.4	47/70	67.1
>100 patients/week	18/73	24.7	19/70	27.1

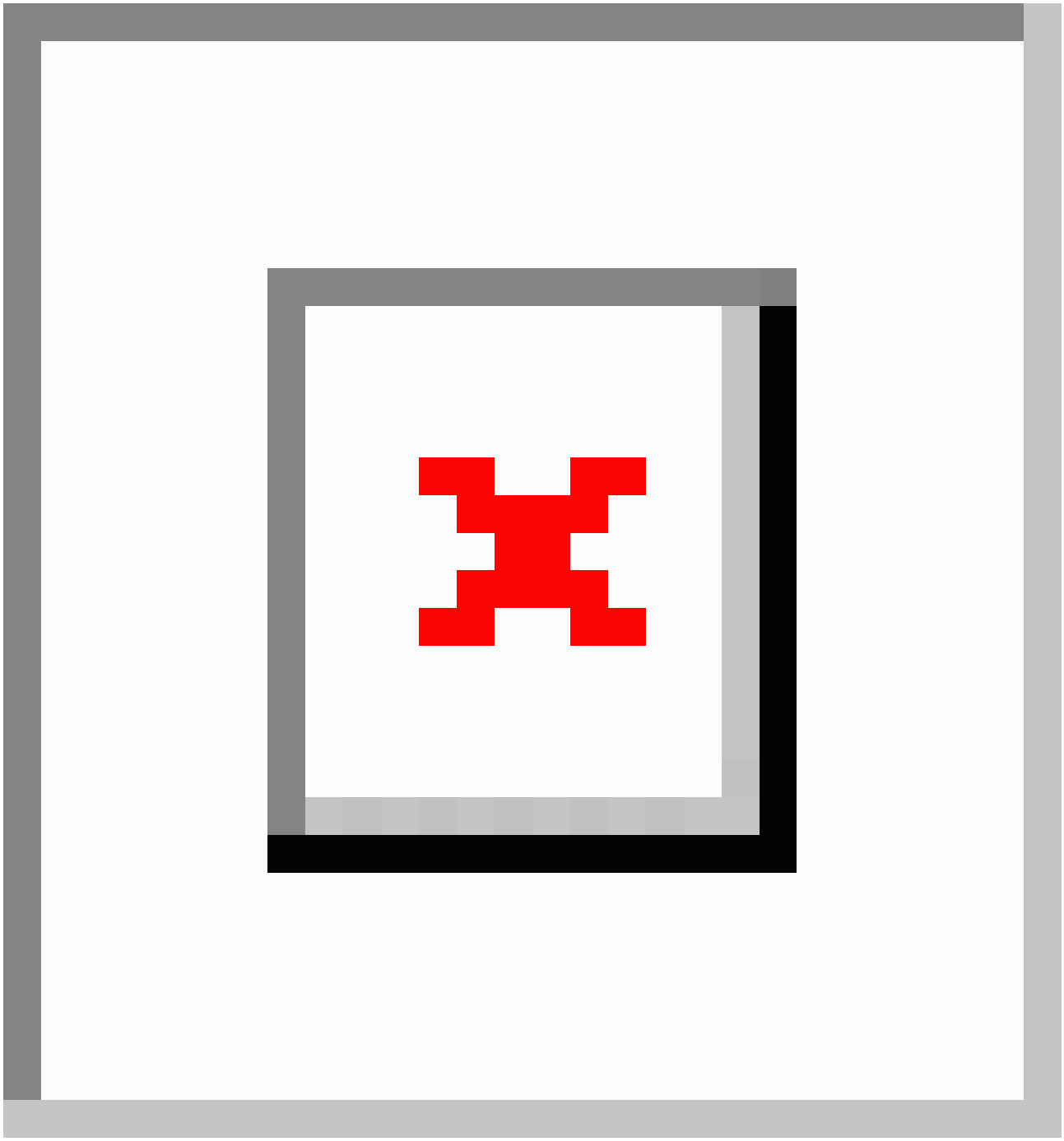
[a] No significant differences in practice characteristics between intervention and control were found (all P >0.05)

[b] Denominator varies slightly due to small number of missing data

Participation in the Internet-Delivered Intervention

Of the 70 intervention practices that participated in follow-up, 56 (80%) had at least 1 provider who actually participated in the intervention. In the 56 participating practices, 53 of the 56 dentists (95%) and 38 of the 56 hygienists (68%) logged on to the intervention website. The mean number of tracked pages per practice was 50 (SD 40), and these ranged from 1 to 157. The mean number of visits to the intervention per practice that logged on was 5.8 (SD 4.6), and the mean number of unique participants was 1.9 (SD 1.2), ranging as high as 6 participants (dentists and hygienists) in a single practice. Figure 2 displays the number of unique providers visiting the website per week of intervention time. The spikes in activity centered at weeks 12 and 18 correspond to the initial release of additional interactive cases. Other smaller spikes represent response to headlines and questions-of-the-week updates. For the 3 cases, 75% (42/56) of practices had at least 1 provider complete Case 1, 55% (31/56) had at least 1 provider complete Case 2, and 21% (12/56) completed Case 3.

Figure 2. Number of unique providers visiting the website per week over 8 months



Patient-Reported Provider Performance on "ASK" and "ADVISE" Before Intervention

Of the 14,300 pre-intervention exit cards distributed to these 143 practices, 11,898 (84%) were returned completed. Intervention patients completing the cards had a mean age of 48 (SD 14), and control patients had a mean age of 49 (SD 16). Both groups were 61% female. Of the 11,898, 21.3% were tobacco users.

At the patient level, of the 11,898 patients, 3421 (28.8%) reported being asked about tobacco use at their current visit. Among the 2386 tobacco users, 43% reported being advised to quit. At the practice level (Table 2), pre-intervention performance, as measured by mean proportion of patients reporting ASK and ADVISE, was similar between intervention and control practices and was not significantly different after accounting for clustering using GLLAMM.

Patient Reported Provider Performance After Intervention (Intent to Treat)

At the patient level, for these 143 post-intervention practices, the exit-card response rate was 81.6% (11,678/14,300). Patient characteristics for this cohort were similar to the pre-intervention group, with a mean age of 47.5 years (SD 16), 59.3% being female, and 22.6% being smokers.

In adjusted analysis, accounting for clustering of patients within practices, both intervention and control improved slightly for ASK, but their rates of change over time, as measured by the

group-by-time interaction term, did not differ significantly (Table 2). Intervention practices improved on ADVISE significantly more than control practices (*P*-value for the interaction term = 0.01).

Table 2. Odds of receiving screening and advice to quit smoking among patients in 143 intervention and control practices, comparing pre- and post-intervention

	Control (N = 73 practices)						Intervention (N = 70 practices)						Intervention Versus Control
Provider Performance	Pre-Intervention		Post-Intervention		Adj. Odds Ratio[a] (95% CI) [ICC] [b]		Pre-Intervention		Post-Intervention		Adj. Odds Ratio[a] (95% CI) [ICC] [b]		Group X Time *P* value[c]
	n/Total N	(%)	n/Total N	(%)			n/Total N	(%)	n/Total N	(%)			
ASK (Tobacco Use Screening)	1,693/ 6,080	27.8	1,794/ 5,759	31.2	1.18 [0.21]	(1.07-1.29)	1,728/ 5,818	29.7	1,957/ 5,744	34.0	1.29 [0.30]	(1.17-1.42)	0.19
ADVISE (Tobacco Use Counseling)	488/ 1,169	41.8	545/1210	45.0	1.13 [0.09]	(0.89-1.43)	529/ 1,190	44.5	748/ 1,361	55.0	1.55 [0.22]	(1.28-1.87)	0.01

[a] Odds ratios for post-intervention versus pre-intervention with clustering of patients within practices modeled with a generalized linear mixed effects model with a logit link and adaptive quadrature implemented in STATA using GLLAMM and confirmed in SAS.

[b] ICC = Intraclass Correlation Coefficient for practice-level effect.

[c] *P* value from group-time interaction term included in a generalized linear mixed effects model with a logit link and adaptive quadrature implemented in STATA including intervention at control data from pre- and post-intervention. Results confirmed in SAS.

Per-Protocol and Dose-Response Analyses

In our per-protocol analysis we kept only the intervention practices with follow-up data that actually logged on to the website at least once (N = 56) and compared them to the control practices. In this model, the effect of the intervention was strengthened with the cluster-adjusted odds ratios of receiving advice to quit post- versus pre-intervention being 1.74 (95% CI 1.42-2.12) for the intervention group (*P* for group by time interaction term = 0.004). Again, ASK was not significantly different when comparing intervention and control.

Within the intervention group, we found that greater participation in the intervention resulted in greater improvement, with increases in ADVISE of 4% among those who did not log on, 9% in those practices who viewed less than the median number of pages viewed, and 14% in those with the highest level of participation (above median). The cluster-adjusted odds ratios of patients receiving advice to quit post-intervention versus pre-intervention were 1.31 (0.88-1.34) for those intervention practices that did not log on, 1.59 (1.21-2.09) for those with less than the median number of pages viewed, and 1.92 (1.43 – 2.56) in those with the highest level of participation. Higher levels of participation were not associated with greater improvement in ASK.

Discussion

The intervention had a strong effect, a 10% increase, on practice behavior related to delivery of advice to quit tobacco among tobacco users. Our study is the first to demonstrate that a multimodal, Internet-delivered intervention designed to promote and support tobacco control in dental practices can be effective. As with most Internet-delivered interventions, the website required a considerable start-up effort in terms of content development (intellectual content), web programming, and usability testing to ensure consistent navigation. However, the marginal server demands to disseminate the intervention to each additional practice were low.

For some online interventions directed at changing provider behavior, the evaluations have ended at changes in knowledge and attitudes [17,36-40]. Our goal was to directly assess changes in provider behavior as measured by patients. When provider performance outcomes have been assessed, results of Internet-delivered interventions for providers have been mixed [15,16,41,42]. In some of these interventions, baseline rates of provider behavior have been higher than anticipated, reducing the ability to affect change [16]. Our intervention clearly benefited from the fact that there was clear room for improvement in targeted behaviors.

Baseline rates of ASK in our sample were less than 30%, and ADVISE was 42% in control and 44% in intervention. In prior studies, rates of ADVISE in dental practices varied from 30% to 50%, depending on the setting, sample, and respondent (patient or provider) [6,7,31,43-45]. In a randomized trial, Andrews et al reported that patient-reported control group rates of dental provider advice to quit were 42.4%, which is similar to our findings [43].

We were successful in engaging 80% of the intervention practices in the website activities, and among those practices that did participate, a high proportion of dentists and hygienists logged on. Low rates of participation have been sighted as a reason for limited success in some Internet-delivered interventions targeting providers [41]. Of note, our intent-to-treat analysis demonstrated an impact of the intervention even though 20% of the intervention practices did not use the website cases

and supportive tools. Among those practices that did participate, we were moderately successful in sustaining activity over 8 months. Previous research in online professional development suggests that a "spaced education" approach, where content is distributed, repeated, and reinforced over time, has a stronger impact on knowledge and subsequent behavior than a one-time education [46]. We used automated reminders and frequent content updates that served as hooks to encourage repeated participation over the 8 months.

Our study has several limitations. As noted, we recruited our 190 dental practices from a large pool of practices. We required a run-in phase and enrolled the first 190 practices who completed the baseline data collection. Although not uncommon in randomized trials, the low enrollment to recruitment ratio suggests that our practices may be somewhat different than the average dental practice. Specifically, these practices may be more computer-oriented and more Internet-savvy than the average practice. Attrition was also a limitation. In terms of the outcome of interest, a direct measurement of provider behavior, such as audiotapes of visits or direct observation, was not accomplished nor was it feasible in a study of this size. We demonstrated that distribution and collection of exit cards from patients was feasible, and that the office staff was willing to support the study with a small incentive for data collection. As discussed above, we validated the results of the exit cards with patient phone calls in a subset.

In our study, rates of advice to quit smoking increased 10% in intervention practices with only marginal increases in patient reports of being asked about tobacco use by a provider. Tobacco control guidelines emphasize the need for systematic screening as a first step in tobacco control that leads to increasing advice [4]. Some studies in medical practice suggest that screening increases advice [47,48]. In preliminary nominal group technique meetings, dentists reported that they could often "tell" that patients were tobacco users without asking. It may be that through the oral exam and having a working space that is close to the patient's face, dental providers are able to more accurately diagnose tobacco use in the absence of screening than medical providers [49]. The oral exam itself may provide a strong cue to delivering quit tobacco advice. If active screening had been implemented by the dental providers, we may have seen an even greater increase in cessation advice.

We chose to assess provider performance based on patient reports collected immediately after the visit. Assessments of provider delivery of tobacco control services are increasing [50-58]. Patient reports of provider behavior have been used for outcome assessments such as ours [51-55,57,58]. Compared to the gold standard of audio-tapes of doctor-patient encounters, immediate surveys of patients are more accurate than provider reports or chart abstraction [51,52,57]. The Health Plan Employer Data and Information Set (HEDIS), a set of standardized performance measures collected by the National Committee for Quality Assurance, adopted patient-report of provider tobacco cessation advice as a national standard [59].

In conclusion, the intervention was successful, but success was somewhat limited by initial participation in the intervention and waning activity over time. Future intervention activities should include additional marketing and persuasive techniques to encourage and sustain participation. We interpret the results of this study to suggest that dental practices are settings where low-intensity interventions to support tobacco control can be effective. The Internet-delivered intervention in this study was more successful than some prior interventions in medical practice, also supporting the potential of the Internet for outreach in dentistry.

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Conflicts of Interest

All authors declare they have no conflict of interest or personal financial interests in relation to this manuscript.

Multimedia Appendix 1

Sitemap and screenshots of www.oralcancerprevention.org [21]

[PDF file (Adobe PDF), 1.3 MB - jmir_v10i5e38_app1.pdf]

Multimedia Appendix 2

Supplemental data tables

[PDF file (Adobe PDF), 48 KB - jmir_v10i5e38_app2.pdf]

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Original Paper

A Review of Web-Assisted Tobacco Interventions (WATIs)

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Abstract

Background: The Internet has great potential to provide assistance to millions of smokers who seek help with quitting smoking.

Objective: The goals of this study were to assess the content and the quality of smoking cessation treatments most likely to be encountered by smokers seeking treatment on the Internet and to examine differences in quality between current websites and those reviewed in 2004.

Methods: Internet searches for smoking cessation were designed to mimic the search patterns of most Internet users. PhD-level specialists in tobacco cessation treatments used standardized procedures to review the content of each website, assess the degree to which each site covered key components of evidence-based treatment as described in US national guidelines, determine the accuracy of information presented, and evaluate the use of website interactivity. Results of the current study were compared to results obtained in a prior review.

Results: Most websites retrieved in the search met exclusion criteria and were not included in the final analyses in both the current (74%, 65/88) and the prior study (77%, 156/202). In both studies, the majority of websites were excluded because they sold cessation-related products but did not provide treatment recommended by the Public Health Service guidelines. Of the 23 websites included in the current study, 26% (n = 6) provided only minimal coverage (brief mention) of key components of tobacco treatment. However, compared to the earlier study, websites included in the present study scored significantly higher in quality ratings in four areas: providing advice to quit (P = .05), practical counseling (P = .02), and enhancing motivation to quit smoking through personal relevance (P = .05) and risks (P < .001). Most Web-assisted tobacco intervention (WATI) sites (69%, 16/23) contained no inaccurate information. When observed, inaccuracies primarily occurred in content related to pharmacotherapy. The percentage of sites offering at least one interactive feature increased from 39% (18/46) in 2004 to 56% (13/23) in the present study. Despite this improvement, there was a notable underutilization of the interactive capabilities of the Internet to personalize treatment, to connect users with a virtual support system, and to provide follow-up treatment contacts.

Conclusions: While the quality of treatment offered in WATIs has improved since our previous review in 2004, there is substantial room for further improvement to ensure that smokers are offered high-quality, evidence-based treatments. It is not clear what degree of informational detail and interactivity is optimal for Web-based smoking cessation treatments. Additional research is needed to understand how to maximize the interactive capabilities of the Internet to produce and sustain population-based health behavior change.

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KEYWORDS

Smoking cessation; Internet interventions; tobacco dependence

Introduction

The most recent national data show that 20.9% of US adults are current smokers [1]. Although this is down slightly from the 2001 prevalence of 22%, this rate of decline is not sufficient to meet national health objectives for 2010 [2]. This slow decline, however, should not be interpreted as a lack of interest among smokers in stopping smoking; over 42% of smokers try to quit smoking each year [1]. To impact the population prevalence of smoking, it is critical that smokers be provided with the highest quality, accessible, evidence-based cessation interventions.

The Internet is a widely accessible delivery channel that has great potential to reach millions of smokers with evidence-based treatments. Increasingly, smokers are using the Internet for cessation assistance; recent reports estimate that, annually, over 10 million Americans search the Internet for information and support to quit smoking [3,4]. The Internet is an appealing resource for many smokers who are trying to quit because of its 24/7 "around-the-clock" availability, ease of access, and potential availability of support and encouragement from professional counselors and/or peers.

In response to this demand, there are now hundreds of smoking cessation websites. Several earlier reviews have found that most sites were of mediocre quality [5-7] and that the highest quality websites attract few visitors [7]. In our earlier review, published in 2004, we found that the majority (> 77%) of websites likely to be encountered by smokers searching the Internet did not provide directed guidance or assistance in quitting. We also found that more than 80% of the sites that did provide treatment did not cover one or more of the key components of cessation treatment as recommended by national guidelines [8]. Since our original review, a growing number of randomized trials have been conducted or are currently underway to examine the efficacy of several government, for-profit, and academic cessation websites [9-16]. There has also been increased attention to the development and dissemination of quality standards for health-related websites [17,18]. However, the vast majority of cessation sites remain untested with regard to both efficacy and quality [5-7].

Based on these developments, we were interested in determining whether the landscape of smoking cessation websites had changed since our previous review. Our goals in this study were (1) to assess the content and the quality of Web-assisted tobacco interventions (WATIs) most likely to be encountered by smokers and (2) to determine the extent to which WATIs have changed since our earlier review [5]. Specifically, we were interested in examining whether sites had become more sophisticated in using the interactive capabilities of the Internet and whether the content provided by current WATIs was more consistent with national cessation treatment guidelines [8].

Methods

Searches

The first step was to locate WATI websites. Our approach was designed to mimic the search patterns of most Internet users. Several reports have shown that the majority of Internet users tend to use only one search engine and stop at the first page of search returns [19,20]. The most commonly used Web search engines (with number of annual unique visits in parentheses) are Google (89.9 million), Yahoo! (68 million), MSN (49.7 million), Ask Jeeves (43.7 million), and AOL (36.1 million) [20,21]. Therefore, we restricted our review of WATI websites to those that appeared on the first page of a cessation-related search engine query using one of these five search engines. This approach differed from our earlier review, which used a comprehensive search pattern comprising the first 10 pages of search returns obtained using multiple meta-search engines.

Standardized Internet searches were conducted by entering "smoking," "smoking cessation," "quit smoking," and "stop smoking" as the Boolean text string into each of the selected search engines. We compiled a list of all websites retrieved within the first page of search results for each search engine into a list of potential WATI sites for review. Redundant sites returned by more than one search were eliminated from the list, resulting in a final list of 88 unique websites. Using a standardized form, trained coders reviewed the content of each website to determine whether it should be included in this review. Coders reviewed the website's home page and first level and second level content pages. If relevant content was not detected within these three levels of exploration, the site was excluded from our review. Websites that did not provide direct tobacco treatment services via the Internet were excluded from analysis. For the purposes of this study, "treatment" was operationally defined as the provision of organized, directive information and support services relevant to the process of quitting smoking. Websites were excluded from analysis if they met one or more of the following criteria: (1) product sales only (no treatment components as recommended by the Public Health Service [PHS] guidelines were available on the website itself), (2) libraries (sites that contained articles about smoking, smoking cessation, tobacco policy, advocacy, addiction, or other related topics, but which provided no clear organization or guidance for the smoker who wished to quit), (3) links (sites that only contained links to other sites, including website links and references to hotline phone numbers and bookstores [eg, Amazon.com]), (4) clinics and practitioners advertising face-to-face services, (5) advocacy and political action sites, (6) professional education and information sites designed for health care providers, (7) dead or abandoned websites (eg, a return of "404 file not found" or similar), and/or (8) site content was not smoking-related. The 23 websites reviewed in the current study and the websites reviewed in the 2004 study are presented in Table 1. As is evident from the table, of the 46 sites reviewed in 2004 and the 23 sites included in the present review, 9 were reviewed at both time points.

Table 1. Websites reviewed

2004	2007
1. QuitNet.com[a]	1. QuitNet.com[a]
2. SurgeonGeneral.gov/tobacco	2. SurgeonGeneral.gov/tobacco
3. Quitsmoking.about.com	3. Quitsmoking.about.com[a]
4. TryToStop.org	4. TryToStop.org
5. Cancer.org/tobacco	5. Cancer.org/tobacco
6. LungUSA.org[a]	6. LungUSA.org
7. CDC.gov/tobacco	7. CDC.gov/tobacco
8. http://equinox.unr.edu/ homepage/shubinsk	8. http://equinox.unr.edu/ homepage/shubinsk
9. Quit.org.au	9. Quit.org.au
10. stop-tabac.ch[a]	10. Smoking-cessation.org[a]
11. Cancer.ca/tobacco[a]	11. GivingUpSmoking.co.uk[a]
12. ashline.org[a]	12. StopSmokingCenter.net[a]
13. QuitSmokingSupport.com	13. WebMD.com
14. MindFocus.com	14. N/A[b]
15. QuitSmokingUK.com	15. Best-StopSmokingProducts.org
16. Nicotine-Anonymous.org	16. Quit-smoking-guide.com
17. QuitSmokingIn7Days.com	17. RealOvercoming.com
18. Habitrol.com	18. WhyQuit.com
19. DrKoop.com	19. Quit-smoking-review.com
20. QuitSmoking.com	20. SmokeFree.gov
21. nicorette.com	21. Quit.com
22. Zyban.com	22. MostImportantGift.com
23. LifeSign.com	23. SmokingTown.com
24. Smokehelp.org	
25. TobaccoFree.com	
26. HeliosHealth.com/quit_smoking	
27. 123-quit-smoking.com	
28. Smokestoppers.com	
29. LifeClinic.com/focus/smoking	
30. Quit4life.com/html	
31. QuitSmokingHelper.com	
32. HeartScreen.com/smoking_info.html	
33. SmokingHealthLine.com	
34. QuitCommit.com	
35. QuitSmokingOnLine.com	
36. QuitTobacco.org	
37. UCanQuit.com	
38. QuitTobacco.com	
39. WellMD.com/QuitSmokingMD.htm	
40. AHCPR.gov /consumer/helpsmok.htm	
41. MedUMich.edu/1libr/primry/life04.htm	

2004	2007
42. Worldzone.net/health/quitsmoking	
43. InfoTobacco.com	
44. Hoptechno.com/book43.htm	
45. SmokeFreeVirginia.org	
46. MiddlesexHealth.org/health/smoking	

[a]Five highest ranked websites for coverage of key topic areas.

[b]No longer a smoking cessation website as of March 2008.

STS-C: Assessment of Content

The first assessment instrument used in this study was the Smoking Treatment Scale - Content (STS-C). Details of the development of the STS-C are described elsewhere [5]. In brief, the STS-C is a 12-item checklist on which website reviewers documented the extent to which each website covered material related to key components of treatment as described in the US PHS guidelines for the treatment of tobacco dependence [8]. Key components of the guidelines are codified into operationally defined units and, where appropriate, are subdivided into separate topic areas when the guidelines specified more than one type of action or intervention within the relevant key component. The resulting 12 items on the STS-C are (1-2) advise every smoker to quit smoking (subdivided into two categories: clear/strong and personalized), (3) assess readiness to quit, (4-5) assist with a quit plan (subdivided into three actions related to setting a quit date and seven topics for providing practical counseling), (6) provide intra-treatment social support, (7) recommend use of approved pharmacotherapy, (8) arrange follow-up, and four areas aimed at enhancing motivation to quit by discussing the (9) relevance of quitting smoking, (10) the risks of continued smoking, (11) the rewards of quitting, and (12) the potential roadblocks or barriers to quitting smoking. Reviewers also used the STS-C to document specific examples from each website relevant to the key components being rated.

STS-R: Rating Website Content

The second assessment instrument used was the Smoking Treatment Scale - Rating (STS-R), which was developed to provide numeric ratings of quality of coverage for each of the key components of treatment documented in the STS-C. Development of the STS-R is described in detail elsewhere [5]. Each website received ratings for (1) coverage, (2) accuracy, and (3) interactivity. Coverage ratings were used to indicate the relative depth and breadth of the information provided in each topic area. Ratings use a 5-point scale. If the treatment component was not mentioned, it received a rating of 1. If the topic was mentioned very briefly, it received a 2. Key components covered briefly but with sufficient detail to be adequately helpful to smokers seeking to quit were given a rating of 3. Sites that provided more detail and more extensive information were given ratings of either 4 or 5 depending on the extent of the information provided. This method is similar to those of Berland et al [22] and was used in our prior review [5]. The overall interrater reliability of the STS-R kappa obtained in the previous study was .77 or greater for all items, ranging from .77 to .93.

Accuracy was rated on a 3-point scale: 3 = “totally correct,” 2 = “mostly correct,” and 1 = “significant misinformation or potentially dangerous errors.” When no inaccurate information was observed, the website received a 3 for that specific component. Where inaccurate information was detected, a rating of 2 was given if the rater judged that the discrepancy was minor and would be unlikely to have harmful effects on site users. In cases where inaccurate information could be potentially dangerous to users (eg, suggesting only palliative remedies for symptoms that could be indicative of nicotine toxicity), a rating of 1 was given.

Reviewers also rated (“yes/no”) whether the website incorporated a user-interactive feature for key treatment components. Interactive features include any content-related user input that results in feedback from the website. Examples of interactive features include entering a target quit date that subsequently generates a quitting calendar or follow-up contact via email; quizzes and assessments that generate individually tailored feedback; chat rooms, bulletin boards, or other interactive community features; interactive recommendations for pharmacotherapy; or the availability of an online pharmacy where medicine could be purchased.

Procedures

All reviewers were PhD specialists in smoking cessation research and treatment. Reviewers were selected for their clinical or scientific experience, familiarity with the PHS guidelines for the treatment of tobacco dependence, and current research interests or clinical specialization in tobacco dependence treatment. No reviewer had consulted for or had any financial interest or involvement with any of the websites they were assigned to review. Four additional websites (not included in the 23 sites in the analyses) were reviewed for training purposes. After each training review, panel members met to discuss the review process, compare outcomes, and resolve discrepancies. Reviews of each site were conducted independently by two reviewers assigned to each website. Each reviewer used the standardized assessment instruments, which were provided with detailed instructions. Websites were first assessed for content using the STS-C. Results of the content review were used to assign numerical ratings of content quality using the STS-R.

Analytic Methods

All data were analyzed using SPSS 13.0 statistical software for the PC (SPSS Inc, Chicago, IL, USA). The unit of analysis was the specific URL for all assessments. Interrater reliability was computed for all items on the STS-R. A standard measure of

reliability was calculated, computed as the correlation in ratings between reviewers assigned to the same website. Two reviews were included in each calculation of interrater reliability. The overall interrater reliability of the STS-R kappa was .76 or greater for all items, ranging from .76 to .89. Frequency distributions were calculated for each item on both assessment instruments. To examine changes in the quality of WATIs over time, data from the current analyses were compared to the database used in our prior study [5]. Chi-square and analysis of variance (ANOVA) tests were used to assess changes in website quality from our earlier review to the present study.

Results

Search Results

Of the original 88 websites returned from the searches, 65 (74%) were excluded from the review. The most common reasons for exclusion were product sales without smoking cessation treatment available directly on the website (66.2% of excluded sites, 43/65), unguided library of articles (21.5%, 14/65), and websites that only provided links to other websites (16.9%, 11/65). Twenty-three percent of websites met more than one exclusion criteria.

STS-C: Content Coverage

Using the PHS clinical practice guideline [8] as a framework, we examined the degree of coverage for subtopics within each key treatment component area using frequency distributions. Among sites that provided assistance with a quit plan (91%, 21/23), 90% (19/21) encouraged setting a target quit date, 80% (17/21) discussed the notion of planning to quit, and 90% (19/21) discussed making behavioral changes in preparation for quitting. All reviewed websites provided some form of practical counseling; however, there was wide variability in the degree of coverage for each topic within this key component. Nearly all sites (91%, 21/23) included content about the importance of telling family, friends, and/or coworkers about quit attempts and obtaining social support. Less well covered were the following: removing tobacco products from the environment and avoiding alcohol consumption (each 66%, 14/21), the importance of maintaining complete abstinence after quit day (39%, 8/21), and dealing with other smokers in the household (39%, 8/21). Relatively few websites (26%) prompted users to reflect back on lessons learned from prior quit attempts.

While a large majority (87%, 20/23) of websites recommended the use of pharmacotherapy for smoking cessation, two sites warned users against using nicotine replacement therapy (NRT), and one site suggested that while NRT was useful, herbal preparations were preferable (ie, “equally effective with fewer side effects”). Among sites recommending medications, only 55% (11/20) provided explanations of how these medications worked, 45% (9/20) gave instructions on how to use these products, and only 35% (7/20) assessed nicotine dependence. Approximately, one-quarter of websites (6/23) asked users to identify negative consequences of smoking and benefits of quitting that were personally relevant.

STS-R: Rating Website Content

Coverage

Of the 23 websites reviewed that provided smoking cessation treatment, 26% (6/23) did not score above 2 (minimal) for any of the key treatment components. Areas most likely to be covered included “provide practical counseling” (100%), “assist with a quit plan” (91%, 21/23), and “recommend pharmacotherapy” (87%, 20/23). Only 47% of sites (11/23) provided more than adequate or extensive coverage (score of 4 or 5) for any key component. The key components most likely to be given extensive coverage were “assist with a quit plan” (22%, 5/23), “provide practical counseling” (26%, 6/23), and “enhance motivation” (relevance = 22%, 5/23; risks = 26%, 6/23). In contrast, providing clear, strong, and personalized advice to quit (0%) and arranging follow-up contact (4%, 1/23) were least likely to be treated extensively across websites. These results are presented in Table 2.

Accuracy

Overall, the accuracy of information provided by most websites was generally high. Reviewers noted no inaccurate information in 69% of websites (16/23). Minor errors were noted in about 30% of websites (7/23) and were most likely to be found for these key components: “assist with a quit plan” (22%, 5/23), “provide practical counseling” (30%, 7/23), and “recommend pharmacotherapy” (35%, 8/23). For example, in the area of “assist with a quit plan,” one site recommended against setting a target quit day or planning ahead. In “provide practical counseling,” some sites provided links to unproven treatments or offered advice that minimized the risk of drinking alcohol while quitting. Inaccurate information regarding pharmacotherapy included recommending hypnosis as “proven to be more than three times more effective than nicotine replacement,” recommending unproven (typically “herbal” or “laser”) remedies, and advising against using nicotine replacement (eg, referring to NRT as a “natural poison” while endorsing herbal remedies). More than 17% of websites (4/23) contained serious or potentially dangerous errors with regard to pharmacotherapy guidance. For example, one website recommended the use of relaxation techniques to reduce symptoms that could indicate nicotine toxicity; this recommendation made no mention of modifying the dosage of NRT or consulting a physician. In assisting with a quit plan, one website advised against making any specific plans to quit and advised that “cold turkey” was the only way to quit.

Interactivity

We examined data across all key treatment components, regardless of whether any coverage was provided for that key component, and found that 56% of websites (13/23) provided at least one interactive feature, and 39% (9/23) provided two or more interactive features. Among websites that provided coverage for the relevant key treatment content area, the topics most likely to have interactive features were in the areas of “provide social support” (78%, 15/19), “recommend pharmacotherapy” (45%, 9/20), and “enhance motivation - risks” (47%, 8/17). Only one-third of websites (8/23) used interactive features to assess readiness to quit smoking. The remaining sites

asked users to select content based on perceived readiness to quit smoking. Approximately one-third (35%, 8/23) of websites contained links to online pharmacies.

Table 2. Website coverage, accuracy, and interactivity for key components of tobacco dependence treatment; percentages of all sites reviewed (n = 23) within each category

	Coverage (Does site cover the essential elements of key topics?)					Accuracy (How accurate is the information?)			Interactive (Is feature Interactive?)
	None	Minimal	Adequate	More Than Adequate	Extensive	Incorrect or Potentially Dangerous	Mostly Correct/Small Errors	Totally Correct/No Errors	Yes
1. Advise every tobacco user to quit: strong	61	17	13	9	0	0	0	100	0
2. Advise every tobacco user to quit: personalized	65	9	9	17	0	0	5	95	14
3. Assess readiness to quit	65	13	9	13	0	0	5	95	15
4. Assist with quit plan	9	35	17	17	22	4	17	78	13
5. Provide practical counseling	0	30	30	13	26	0	30	70	22
6. Provide intra-treatment social support	18	27	27	9	18	0	0	100	40
7. Recommend pharmacotherapy	13	44	22	17	4	17	17	65	30
8. Arrange follow-up	78	4	4	4	9	0	0	100	19
Enhance Motivation:									
9. Relevance	22	26	13	17	22	0	0	100	17
10. Risks	26	22	9	17	26	0	5	95	27
11. Rewards	26	13	17	30	13	0	5	95	9
12. Roadblocks	13	30	22	22	13	0	0	100	9

Table 3. Differences in mean coverage rating scores of websites between 2004 and 2007 review[a]

	2004 (N = 45), Mean (SD)	2007 (N = 23), Mean (SD)	Difference in Score	*P*
1. Advise every tobacco user to quit: strong	1.41 (.68)	1.70 (1.0)	0.29	.15
2. Advise every tobacco user to quit: personalized	1.33 (.59)	1.78 (1.2)	0.45	.05
3. Assess readiness to quit	1.63 (.77)	1.70 (1.1)	0.07	.48
4. Assist with quit plan	2.74 (.65)	3.09 (1.3)	0.35	.24
5. Provide practical counseling	2.74 (.58)	3.30 (1.1)	0.56	.02
6. Provide intra-treatment social support	2.65 (.58)	2.74 (1.3)	0.09	.49
7. Recommend pharmacotherapy	2.41 (.70)	2.57 (1.0)	0.16	.35
8. Arrange follow-up	1.30 (.71)	1.61 (1.2)	0.31	.74
Enhance Motivation:				
9. Relevance	2.30 (.73)	2.91 (1.5)	0.61	.05
10. Risks	2.13 (.71)	2.96 (1.6)	0.83	< .001
11. Rewards	2.41 (.68)	2.91 (1.4)	0.50	.11
12. Roadblocks	2.57 (.69)	2.91 (1.2)	0.34	.29

[a]Rating scale: 1 = None; 2 = Minimal; 3 = Adequate; 4 = More than adequate; 5 = Extensive.

Changes in Content and Quality Between 2004 and 2007

ANOVA comparing mean scores on website content ratings between the two datasets showed improvements in providing personalized advice to quit smoking ($F_{1,68}$ = 3.82, P = .05), providing practical counseling ($F_{1,68}$ = 5.5, P = .02), and enhancing motivation through a discussion of the relevance of quitting ($F_{1,68}$ = 3.8, P = .05) and the risks of continued smoking ($F_{1,68}$ = 7.1, P < .001). These results are shown in Table 3. No comparisons showed any significant decrease in intervention quality between the two reviews. We also examined changes in the percentage of websites providing in-depth coverage (rated 4 "more than adequate" or 5 "extensive") for key content areas. Compared to 2004, significantly more websites in the present dataset provided in-depth coverage in the areas of "assist with a quit plan" (χ^2_1 = 3.9, P = .04), "provide practical counseling" (χ^2_1 = 6.1, P = .01), "arrange follow-up" (χ^2_1 = 6.4, P = .01), and "enhance motivation" by discussing the risks of continued smoking (χ^2_1 = 9.6, P < .001) and rewards of quitting (χ^2_1 = 5.4, P = .02). These data are shown in Table 4.

Table 4. Percentage of websites offering "more than adequate" or "extensive" coverage of key topic areas in 2004 and 2007 review

	2004	2007	χ^2_1	P
1. Advise every tobacco user to quit: strong	2	9	1.6	.25
2. Advise every tobacco user to quit: personalized	4	17	3.3	.08
3. Assess readiness to quit	9	13	.32	.67
4. Assist with quit plan	17	39	3.9	.04
5. Provide practical counseling	13	39	6.1	.01
6. Provide intra-treatment social support	15	27	1.2	.30
7. Recommend pharmacotherapy	13	22	.87	.42
8. Arrange follow-up	0	13	6.4	.01
Enhance Motivation:				
9. Relevance	15	39	4.9	.07
10. Risks	11	44	9.6	< .001
11. Rewards	17	44	5.4	.02
12. Roadblocks	17	35	2.6	.19

Discussion

The goal of this study was to examine the content and quality of WATIs that are most likely to be encountered by smokers looking for online cessation assistance. We were also interested to see whether there were changes in quality between websites reviewed in the current study and those of our previous review, published in 2004 [5]. Both studies used standardized procedures and assessment instruments when evaluating websites, and, in general, findings were similar for both reviews. For example, the percentage of websites meeting exclusion criteria was very similar between studies (77%, 156/202 in 2004 and 74%, 65/88 in 2007). In both cases, the most common reasons for exclusion were sites offering only product sales and undirected libraries of articles about smoking, smoking cessation, tobacco advocacy, and other tobacco-related topics. Results from both studies indicate that individuals searching for help with quitting smoking are most likely to encounter websites that do not offer smoking cessation treatment. Web-based interventions should include a clear organizational structure that actively guides users through the treatment process.

Results of this study indicate that while the majority of reviewed websites provide coverage for most key content areas identified as the core of smoking cessation treatment [8], the depth of coverage for key topics was most often minimal. While there are no empirical studies demonstrating how much detail is needed to help smokers quit, it is likely that providing more than a brief mention of important content areas would result in better treatment outcomes. It may be particularly useful for websites to be designed in such a way as to allow users to drill down to their desired level of detail on any given topic. Sites that provide only minimal coverage of important information may do a disservice to smokers who are seeking to quit and need additional information to enhance the quit attempt. However, it is also likely that websites that present too much detailed information on each page may result in users missing important content. Thus, it is not sufficient to consider only general standards of usability [23,24] when designing a behavior change website; it is also critical to understand the ways in which individuals use websites to make behavioral changes (ie, behavioral informatics). For example, some users may prefer to read science-based resources such as quitting guides or published manuscripts, while others may prefer to connect with other smokers in a community forum. Some may feel comfortable using interactive features that yield individually tailored information, while others may have concerns about privacy. Understanding the ways in which users interact with a cessation website and the relative contributions of various treatment components will help advance the science of Web-based behavior change.

Providing practical counseling was the key content area that received the most coverage: all websites provided at least minimal coverage of this topic. This is not surprising given that providing practical counseling and information could be described as the core content area of tobacco dependence treatment. However, within this topic, few websites prompted users to reflect back on prior quit attempts. Such reflection is important as it helps smokers to identify triggers, situations that are high risk for relapse, and techniques they found useful and could employ again [8]. Likewise, while most sites recommended the use of pharmacotherapy, most often NRT, the information provided tended to be superficial and was limited by a lack of explanation regarding instructions for use, contraindications, and potential side effects. This problem was noted in our earlier study and has been discussed in other reviews [6,7]. Content relevant to medication use was also the most likely of all content areas to contain serious errors. In some cases, the error was implicit in that NRT was included in a list of other unproven or unsafe alternatives, which lends a halo of legitimacy to those alternative treatments while also reducing the relative strength of the recommendation for established efficacious treatments such as NRT. In other cases, errors were more explicit, such as stating that using NRT is dangerous and should be avoided.

There was a notable lack in using the capacity of the Internet for personalization of treatment. An important part of motivating smokers to quit is to personalize information relevant to quitting. Reasons for quitting, perceived risks of continued smoking, as well as perceived benefits and barriers to quitting should all be identified by the individual to have maximal impact [25]. The PHS guideline specifies that smoking cessation interventions should encourage smokers to discuss their reasons for wanting to quit and should provide personalized information about the risks of smoking and rewards of quitting. While the majority of websites provided information about the risks and rewards of quitting smoking, these key components were usually treated only with generic lists of benefits and health risks rather than personally relevant messages as specified by the PHS guideline. Approximately one-quarter of websites asked users to identify consequences of tobacco use and benefits of quitting that were personally relevant. Few websites took advantage of the Internet's unique ability to provide individually tailored feedback. In the current study, benefits of quitting and risks of continued smoking were most often presented as generic lists, with no attempt at personalization.

Related to this issue, the interactive capability of WATIs was generally underutilized. Across all of the key treatment components, only a minority of websites provided interactive features. The most common use of interactivity was in the area of providing intra-treatment social support, frequently in the form of chat rooms, buddy lists, and emailed support. Recommendations for pharmacotherapy were frequently interactive in nature, although limited to the administration and scoring of assessments of nicotine dependence. Perhaps the most glaring failure to leverage the capabilities of the Internet was in providing follow-up contact. Follow-up contacts can be used to motivate smokers to make a quit attempt or to reconsider cessation following slip/relapse and to provide support during difficult times while quitting [8]. Providing follow-up was one of the least used key treatment components observed in WATI sites. In the present study, just over one-fifth of websites provided any sort of treatment follow-up.

Compared with our earlier review, the current results indicate modest improvement in the quality of coverage in key content areas. Areas showing the most improvement were giving personalized advice to quit, providing practical counseling, recommending medications to aid quitting, and enhancing motivation (discussing personal relevance of quitting, perceived risks, and roadblocks to quitting). In no case did we observe a significant decline in the quality of website content. It is encouraging that the quality of some content areas may be improving. However, there remains substantial room for further improvements. Most often, the reviewed websites provided only minimal coverage of key component areas. Only in discussions of risks and roadblocks did most websites provide more than adequate or extensive coverage, and even in these areas, few websites took advantage of the interactive capacity of the Internet to truly personalize treatment.

Limitations

Results of this study should be considered in the context of several limitations. First, this review should not be considered an exhaustive analysis. In the present study, we reviewed only English-language websites. Thus, the quality of websites available in other languages remains unknown. Given that much of the world is non-English-speaking, we encourage researchers with fluency in other languages to conduct similar reviews of non-English websites. Second, comparisons between the 2004 and current review are made with a notable caveat. The search procedure used in the 2004 paper was comprehensive, including all websites retrieved in the first 10 pages of search returns. The current review used a search strategy that was designed to mimic the search pattern of most Internet users. That is, we included only those websites retrieved on the first page of search returns. It is possible that higher quality websites are more likely to be retrieved in the first page of search returns. If true, the increases in quality observed between the 2004 and current dataset may be an artifact of the search procedures rather than a reflection of a real improvement in the quality of smoking cessation websites. In a review of popular smoking cessation websites identified by survey respondents, Etter [7] concluded that users had difficulty finding the highest quality websites: the three highest rated websites in that review attracted only 7% of visitors. The sites that were most commonly used (ie, the most popular) were not the highest quality. Third, the present study was designed to address the quality of content presented in the websites. Elements of usability such as navigation, layout, and accessibility are also important to a user's experience and likely play an important role in the effectiveness of a behavior change website. These elements should be examined in future studies.

Conclusions

Results of this study indicate that the content and quality of information contained in smoking cessation websites may be improving. However, more often that not, smokers looking for assistance online will find websites that do not provide evidence-based guidance and assistance. Moreover, numerous

questions remain to be answered about WATIs. Research needs to move beyond quantitative assessments of the amount and accuracy of information provided via the Web and begin to examine the qualitative nature of WATI sites and the relationships that exist between these sites and their users. For example, research is needed to determine whether there are intrapersonal (eg, age, education, health literacy, need/preference for social support) or environmental characteristics (eg, support/incentives from a health maintenance organization or employer, presence of smoking policy restrictions) that predict better or worse outcomes when using Internet-delivered cessation interventions. The Internet holds great potential to reach millions of smokers who may not otherwise seek cessation treatment. Efforts are needed to ensure that the content of Internet interventions is sound so that we can begin to understand how, for whom, and by what mechanism(s) WATIs may be effective.

Conflicts of Interest

Drs. Bock and Graham have worked with QuitNet.com as consultants and co-investigators on research. Therefore, the rating of the QuitNet.com website was performed by Drs. Whiteley and Stoddard.

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Abbreviations

NRT: nicotine replacement therapy
PHS: Public Health Service
STS-C: Smoking Treatment Scale - Content
STS-R: Smoking Treatment Scale - Rating
WATI: Web-assisted tobacco intervention

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Original Paper

Phone and Web-Based Tobacco Cessation Treatment: Real-World Utilization Patterns and Outcomes for 11,000 Tobacco Users

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Abstract

Background: Phone-based tobacco cessation programs have been proven effective and widely adopted. Web-based solutions exist; however, the evidence base is not yet well established. Many cessation treatments are commercially available, but few integrate the phone and Web for delivery and no published studies exist for integrated programs.

Objective: This paper describes a comprehensive integrated phone/Web tobacco cessation program and the characteristics, experience, and outcomes of smokers enrolled in this program from a real-world evaluation.

Methods: We tracked program utilization (calls completed, Web log-ins), quit status, satisfaction, and demographics of 11,143 participants who enrolled in the Free & Clear Quit For Life Program between May 2006 and October 2007. All participants received up to five proactive phone counseling sessions with Quit Coaches, unlimited access to an interactive website, up to 20 tailored emails, printed Quit Guides, and cessation medication information. The program was designed to encourage use of all program components rather than asking participants to choose which components they wanted to use while quitting.

Results: We found that participants tended to use phone services more than Web services. On average, participants completed 2-2.5 counseling calls and logged in to the online program 1-2 times. Women were more adherent to the overall program; women utilized Web and phone services significantly (P = .003) more than men. Older smokers (> 26 years) and moderate smokers (15-20 cigarettes/day) utilized services more (P < .001) than younger (< 26 years) and light or heavy smokers. Satisfaction with services was high (92% to 95%) and varied somewhat with Web utilization. Thirty-day quit rates at the 6-month follow-up were 41% using responder analysis and 21% using intent-to-treat analysis. Web utilization was significantly associated with increased call completion and tobacco abstinence rates at the 6-month follow-up evaluation.

Conclusions: This paper expands our understanding of a real-world treatment program combining two mediums, phone and Web. Greater adherence to the program, as defined by using both the phone and Web components, is associated with higher quit rates. This study has implications for reaching and treating tobacco users with an integrated phone/Web program and offers evidence regarding the effectiveness of integrated cessation programs.

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KEYWORDS

Tobacco cessation; Internet; telephone; smoking

Introduction

Telephone and Web-based cessation programs are widely available and used. Each year, approximately 1.1% to 1.7% of adult smokers receive tobacco cessation services via state quitlines across the United States [1] and many more receive services through their health plans and/or employers. Phone-based counseling has many benefits and has proliferated in availability since the 1990s. Currently, quitlines provide services in all of North America as well as many other countries across the world (including China, Taiwan, Hong Kong, Singapore, Thailand, South Korea, Australia, New Zealand, Brazil, and most countries in the European Union). Services

range from mailed materials, referral to community resources, reactive and/or proactive counseling, medication information, and, in some cases, subsidized or free medication [2].

There is a large, high-quality evidence base for phone-based cessation counseling. Effectiveness has been established in dozens of large randomized trials and summarized in three meta-analyses published during the past decade [3-5]. The Cochrane Collaboration [5] published a systematic review that concluded that proactive phone counseling helps smokers who are trying to quit, improving quit rates by over 50%. Ossip-Klein and McIntosh offer a comprehensive review of this literature [1].

According to the updated Online Health Search Report [6] in 2006, 9% of Internet users searched for information on how to quit smoking. While vast quantities of information on tobacco cessation are available online, not all online information is designed for treatment [7]. In 2002, one in five websites related to cessation provided treatment information and only one-third of those that focused on treatment provided minimal coverage of the recommended components of the Public Health Services (PHS) Clinical Practice Guideline [3].

Several real-world evaluations of QuitNet, one of the most widely used online cessation services in the United States, have been conducted. Quit rates (7-day point prevalence rates) range from 7% to 30% at 3 months (intent-to-treat [ITT] and responder rates, respectively) among a population of general users (N = 1501) [8], to 13.2% to 17% at 6 months (ITT and responder rates, respectively) among a state population (Minnesota; N = 607) [9], to 12.8% to 42.9% at 12 months (ITT and responder rates, respectively) among an employee population (N = 1776) [10]. Furthermore, two of these evaluations found better outcomes associated with greater website use [8,10].

There are minimal data from randomized trials examining online cessation services. To date, results from four trials have been published. Three randomized trials have demonstrated effectiveness of online cessation approaches [11-13], and one study found no improved outcomes above individual counseling [14]. The quit rates from these studies are fairly comparable to those from the real-world evaluations reported above; however, the follow-up periods were often shorter (eg, 6 and 11 weeks).

In the one study [14] incorporating an online intervention with standard treatment that included three in-person 20-minute counseling sessions and medication (bupropion SR), there were no differences in outcomes (7-day point prevalence) between groups at 3 or 6 months. However, among those participants randomized to the online intervention, average log-ins per week and abstinence status were significantly related at 3 and 6 months (odds ratio [OR] ranged from 1.6-1.8). That is, greater use of the online intervention per week was associated with greater quit outcomes.

To date, there are no studies that describe the efficacy or effectiveness of integrated tobacco cessation treatment including telephone counseling and online services. The purpose of the current study is to present results of an evaluation of the Quit For Life integrated phone/Web program, which is widely available through state quitlines, health plans, and employers across the United States. The Free & Clear Quit For Life phone program has been commercially available for nearly 20 years. In 2006, an interactive online program was integrated into the standard program. The integration of phone and Web modalities is a critical aspect of this novel program. The approach is that all participants are provided with a comprehensive program that includes counseling calls, online services, and printed materials. Participants do not choose between these services but receive all of them over the course of the program.

The potential advantage of an integrated phone/Web program is that it offers individualized one-on-one counseling with a cessation expert in addition to the dynamic online support that can be available at any time. While phone-only and Web-only programs have their advantages, a combined program has the potential to improve outcomes and efficiency by providing tools and integrated services that appeal to a wide variety of tobacco users with different needs and learning styles. In this paper we describe (1) the characteristics of the participants using the program, (2) the phone and Web utilization rates, and (3) quit outcomes and satisfaction.

Methods

This study examined the experience of 11,143 enrollees in the Free & Clear Quit For Life Program, a smoking cessation program including proactive phone-based counseling, an interactive website, and printed Quit Guides. To be eligible for this study, a participant had to be a tobacco user who spoke English, be 18 years or older, be enrolled in the program through his or her health plan or employer between May 2006 and October 2007, have access to an email account, and consent to follow-up at 6 months. State participants were excluded due to lack of systematic follow-up.

Description of the Intervention

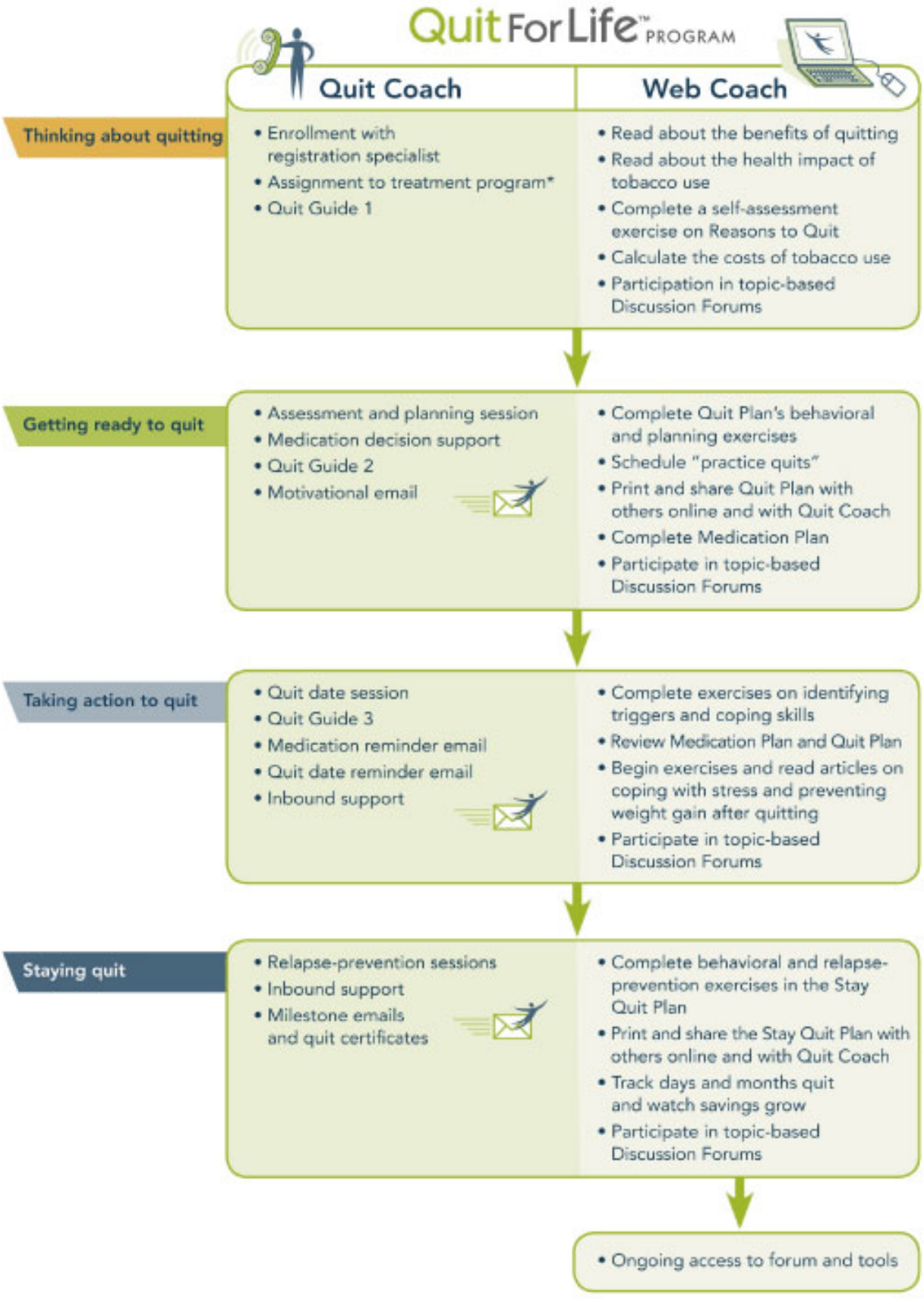
The Free & Clear Quit For Life phone program has been commercially available for nearly 20 years. The program is grounded in social cognitive theory [15,16] and incorporates the strategies for effective tobacco dependence treatment outlined in the US PHS Clinical Practice Guideline. The effectiveness of the program has been demonstrated in three randomized trials [17-19] and in several real-world evaluations (published evaluations include [20-22]). From its inception, the Quit For Life Program has included individualized telephone counseling sessions and printed Quit Guides. In 2006, the interactive online program (Web Coach) designed to complement the phone-based treatment sessions was added.

The Quit For Life Program is available to participants through their employer or health plan. Participants enroll in the program directly by phone or online. Once registered, participants receive up to five one-on-one proactive phone counseling sessions, access to the interactive website (Web Coach), and printed self-help materials (Quit Guides). Phone counseling sessions are with an intensively trained tobacco treatment specialist (Quit Coach). The counseling calls are designed to provide practical expert support to help participants develop problem-solving and coping skills, secure social support, and design a plan for successful cessation and long-term abstinence. Calls are

scheduled at times convenient for the caller and at relapse-sensitive intervals. Participants can also call a 1-800 number as many times as they want for additional support between calls. For all proactive counseling calls, we make up to three attempts to reach a participant for each of the ongoing, proactive calls. The number of calls completed may vary due participants declining a call or not being available to complete all calls.

During each call, the Quit Coach encourages participants to use the Web program and Quit Guides to document their quit plan and track their progress. Quit Coaches have real-time access to information that participants enter on the website. This information, along with information gathered during calls, is used by Quit Coaches to frame the focus of the counseling call. The interaction between the participant, Quit Coach, and Web program is shown in Figure 1.

Figure 1. Interaction between the participant, Quit Coach, and Web Coach



The online component of the program (Web Coach) contains interactive tools and tailored content based on participants' readiness to quit. As described in Table 1, key features of Web Coach include an interactive quit plan (Figure 2), educational content in an online library (Figure 3), quit calendar (Figure 4), cost calculator and progress tracker (Figure 5), tool to email friends, family, and other participants for support (Figure 6), and active discussion forums to interact with other members and the Quit Coaches (Figure 7). Participants can use the Web tools to gain greater awareness of their tobacco triggers, learn from past quit attempts, and develop their plan to cope with cravings, stress, and triggers. Participants build social networks with other smokers and ex-smokers enrolled in the program through the discussion forums and messaging functions available on the website. Quit Coaches moderate the forums and provide feedback to participants on a daily basis. Once a participant reports quitting tobacco, the website changes in its look, feel, and content to reflect that the participant has now quit and is actively working to prevent relapse (see Figure 8). This "Staying Quit" phase includes exercises and educational content for relapse prevention. When participants achieve quitting milestones (having quit for 1 month, 6 months, and 12 months), they are sent e-certificates recognizing their achievement.

Table 1. Key Web Coach features

Feature	Description
My Quit Plan	Includes tailored activities to help the participant discover his or her triggers to smoke, pinpoint effective coping strategies, and build a personalized quit plan. The plan is shared with the Quit Coach. Planning activities and content are tailored to the participant's readiness to quit.
My Library	Contains educational articles on a variety of cessation-related topics including nicotine replacement therapy, over-the-counter cessation medications, tobacco use and chronic diseases, pregnancy and tobacco use, and weight gain and stress management and tobacco use.
My Quit Calendar	An interactive calendar that links to the participant's overall program schedule and helps track the quit date.
My Discussion Forums	Discussion board with specific topics of interest related to cessation. Each group has hundreds of subtopics and thousands of postings from participants. Quit Coaches moderate the forums and post responses to participants' questions.
My Quit Stats	Progress graph that displays the amount of money spent based on cigarettes consumed per day as well as money saved as participant decreases consumption.
My Reasons to Quit	Interactive exercise for participant to identify his or her reasons to quit, commit those to the Quit Plan, and share them with the Quit Coach.
Friends and Allies	Built-in email capability so participants may email friends, family, and coworkers who support them in their quit attempt.

Figure 2. Quit plan

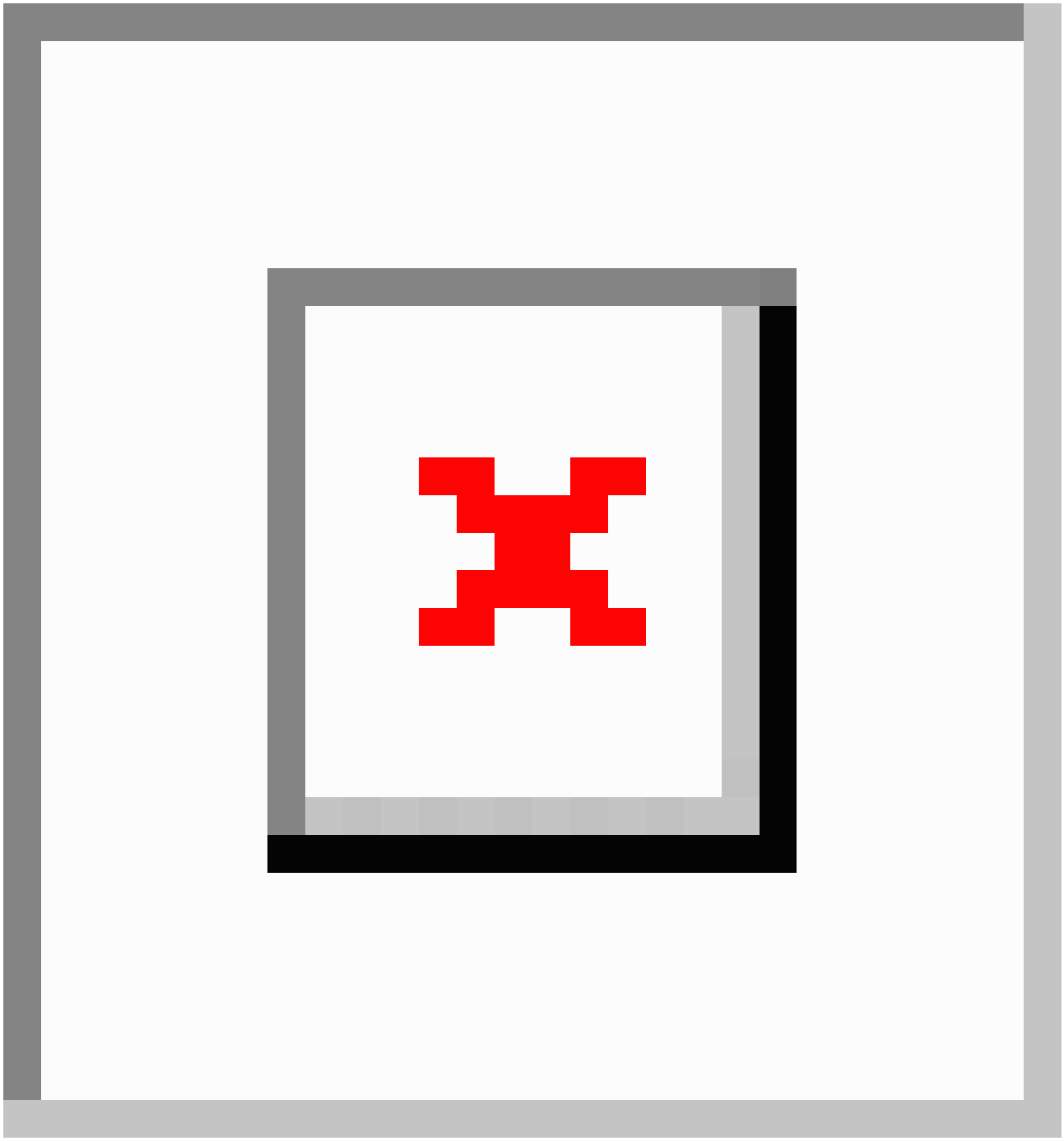


Figure 3. Library

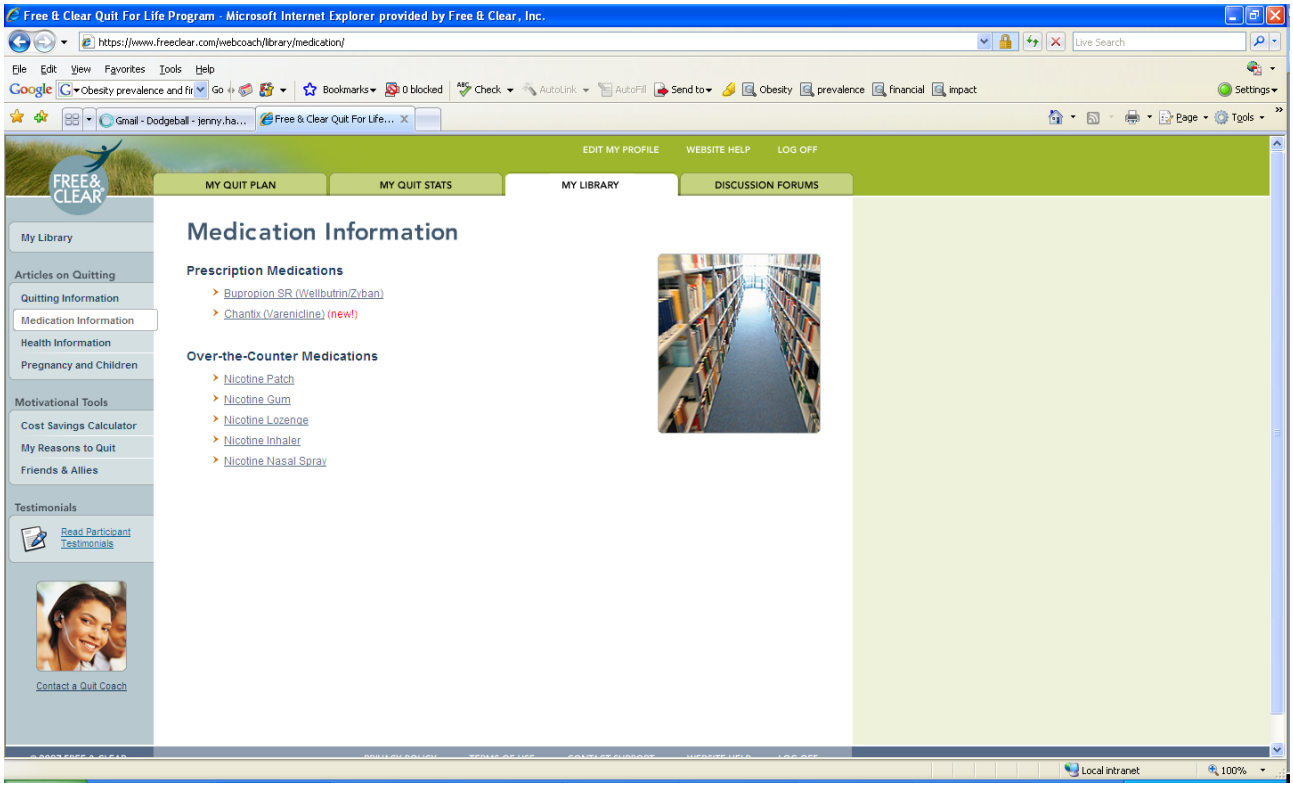


Figure 4. Quit calendar

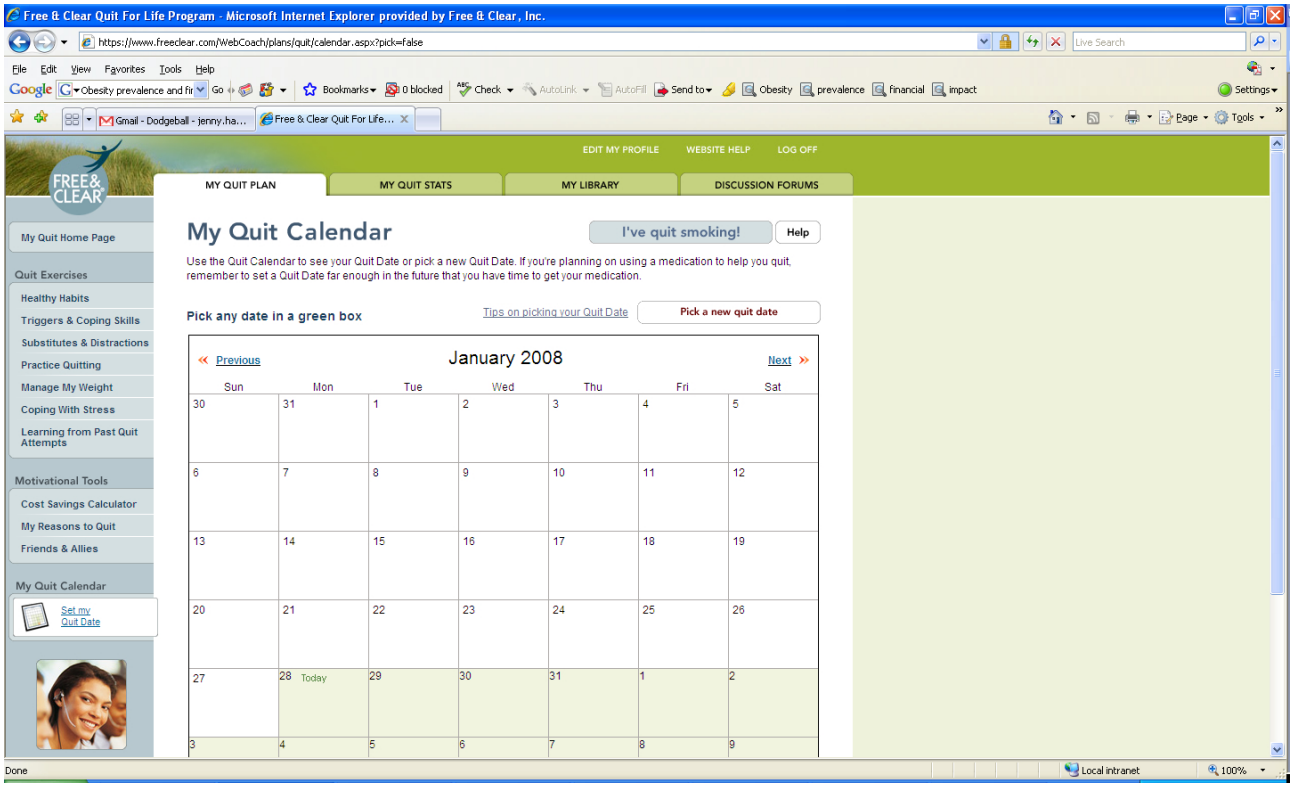


Figure 5. Progress tracker and cost calculator

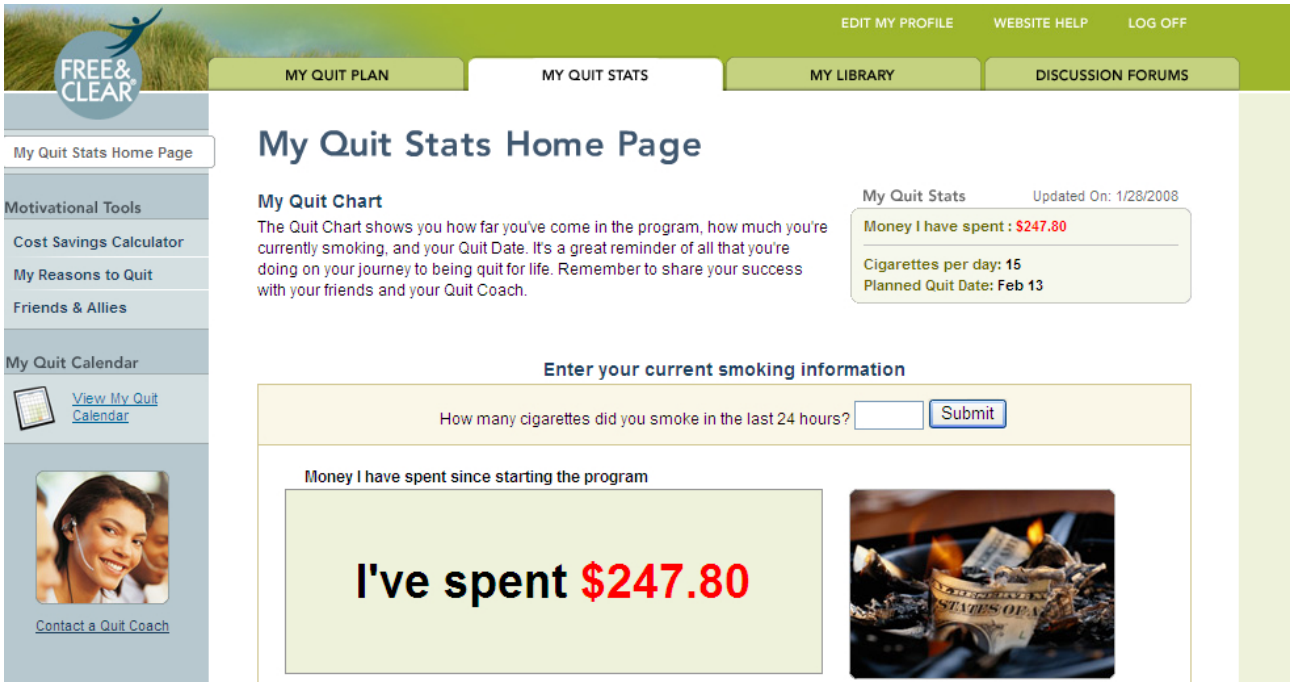


Figure 6. Email an ally

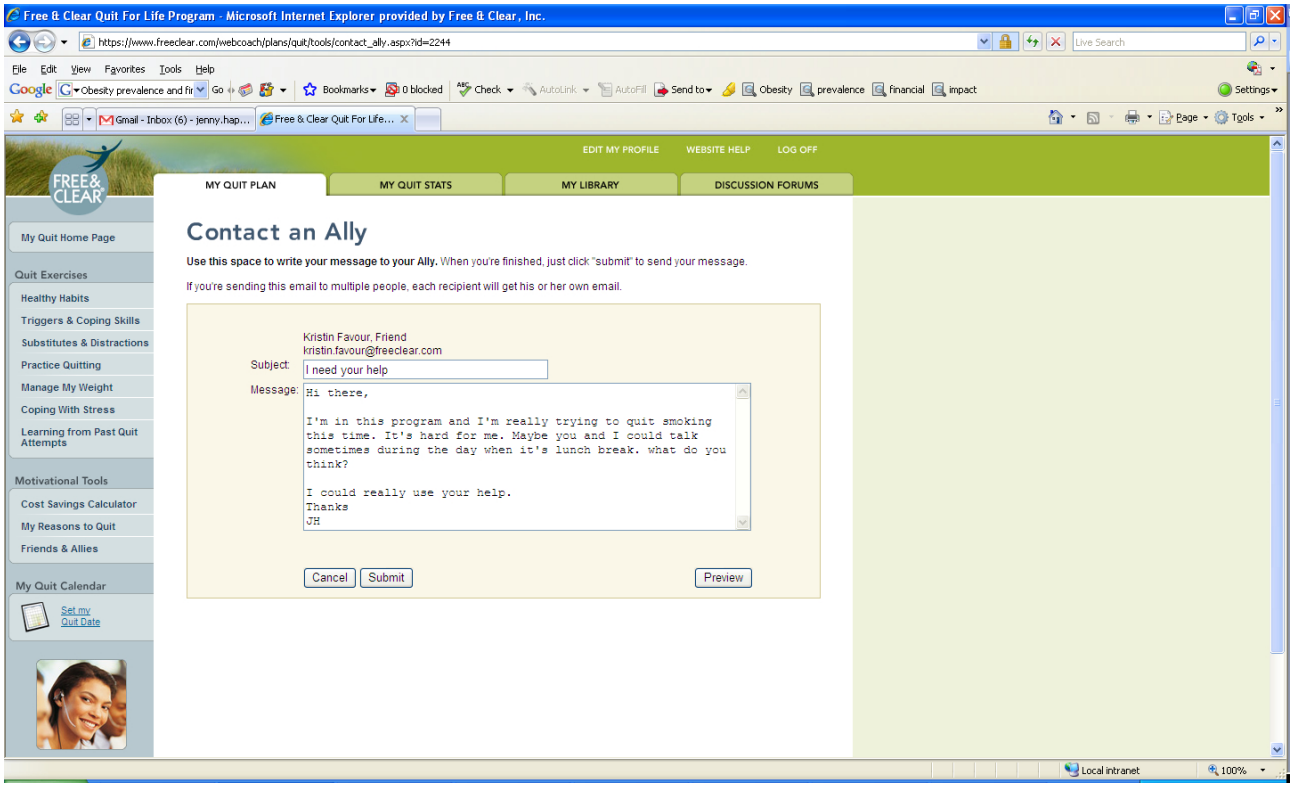


Figure 7. Discussion forum

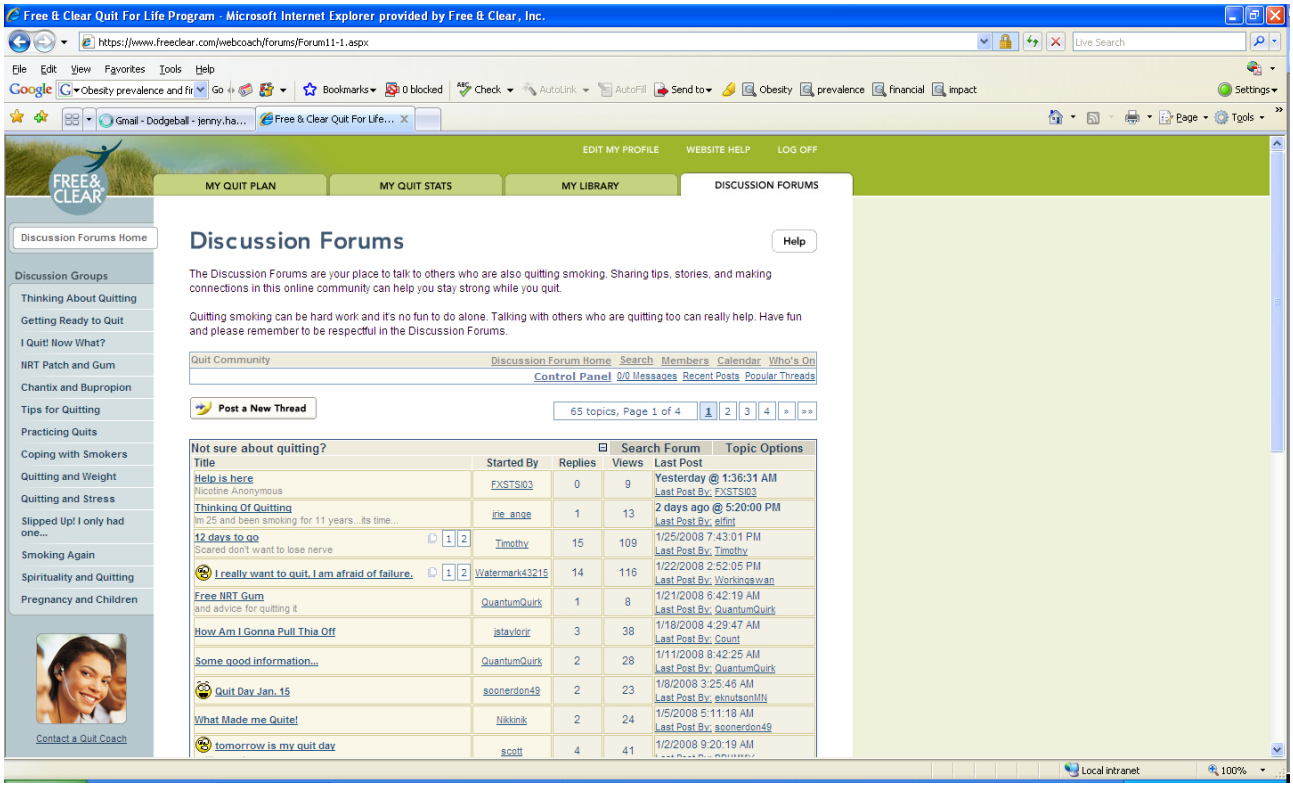
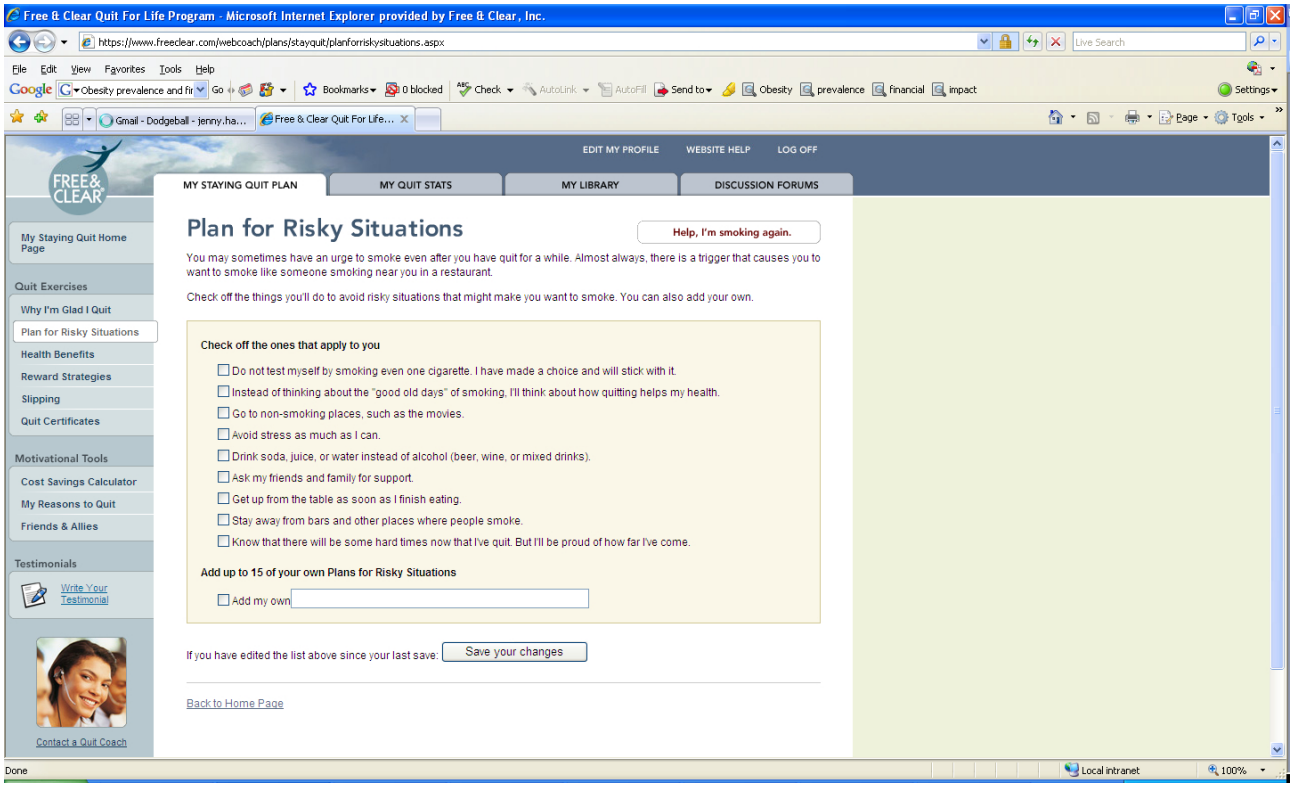


Figure 8. Relapse-prevention phase



Measures

Participant demographics (age, gender), contract type (health plan, employer), current tobacco use (tobacco type, amount used), nicotine dependence (measured as time to first use upon waking), and readiness to quit were derived from information collected at registration and the participants first call with a Quit Coach. Phone counseling (number of live calls completed) and Web use (log-ins, forum visits) were tracked and recorded. Participants who consented to follow-up were contacted 6 months after enrollment in the Quit For Life Program and were administered a telephone survey. Those individuals who could not be reached via telephone after 11 attempts or did not have

a working telephone number were sent a mailed survey. Approximately half of the participants responded to the survey (50.9%, N = 5675). The 10-minute follow-up survey addressed a variety of topics related to the participant's experience with the Quit For Life Program, including program satisfaction and tobacco use behaviors/ abstinence. Abstinence data were obtained through self-report; no biochemical verification took place. Tobacco abstinence was defined as no tobacco use whatsoever in the previous 30 days. Participants were asked to rate their satisfaction with the program using a 4-point scale (very satisfied, somewhat satisfied, somewhat dissatisfied, very dissatisfied). Satisfaction was defined as indicating that one was "somewhat" to "very satisfied" with the Quit For Life Program services. The 30-day abstinence and satisfaction measures have been used in other published studies [19].

Statistical Analysis

The results below summarize participant demographics and program utilization.

We conducted mean comparisons, chi-square analyses, and analyses of variance (ANOVA) to assess differences in counseling calls completed, Web Coach log-ins, and discussion forum log-ins by gender, age (18-25, 26-40, 41-60, 61+), contract type (health plan, employer), nicotine dependence (first cigarette of day within 5 minutes, > 5 minutes), cigarettes per day (< 15, 15-20, 21+), and readiness to quit (within 30 days, > 30 days). Within ANOVA, Scheffe's post hoc comparisons identified specific between-group differences. Within contingency table variables with more than two groups, post hoc Bonferroni chi-square comparisons examined all between-group differences.

We stratified Web Coach use into three discrete categories (0 log-ins, 1-4 log-ins, 5+ log-ins) and conducted ANOVA to examine rates of Web use and average calls completed, satisfaction, and quit rates by level of Web use. We also classified counseling use into four discrete categories (0 calls, 1-2 calls, 3-4 calls, 5+ calls) and examined quit rates by counseling calls completed and Web log-ins (0 vs 1+ log-ins). The call level categories were derived from historical data that demonstrate different quit rates associated with these call completion levels. Since historical data were not available for Web use, we calculated three levels: no use (0 log-ins), low use (1-4 log-ins), and high use (5+ log-ins). Similar cutoff points have been used in other online studies [10,14].

Quit outcomes were examined using ITT analysis and responder analysis. In the ITT analysis, all participants eligible for follow-up were included in the analysis (N = 11,143), and nonresponders to the follow-up survey were assumed to be continued tobacco users. In the responder analysis, results were based on those who responded to the follow-up survey and provided outcome information (N = 5675, 50.9% of the sample), and no assumptions were made about the tobacco status of participants lost to follow-up.

Examination of the data identified several instances of very high Web utilization and discussion forum use among a small group of participants (eg, 266 Web Coach log-ins, 566 forum log-ins). It is notable that the distribution of program utilization data (ie, number of counseling calls, Web log-ins, forum log-ins) was highly skewed. We employed a strategy of two-sided, 1% trimming, removing .05% of all values (N = 117) from both sides of these two variable's distributions to improve the estimate of central tendency. Trimming is a well supported method for robust examination of central tendency [23].

Results

Participants

Participants tended to be middle aged (mean = 43.0 years, SD = 10.8) and were evenly distributed among genders (54% female, 46% male); 83% of study participants enrolled in the program through their employer, while the remaining 17% enrolled through their health insurance plan. On average, participants smoked 12.5 cigarettes daily (SD = 12.4). Almost all (91.7%) participants reported planning to stop smoking within 30 days of their first contact with the program.

Overall, participants were less dependent on smoking than the general population of smokers. Responses to the single-item addiction index derived from the Fagerström Test for Nicotine Dependence [24] indicated that approximately one-third (35.6%) of respondents demonstrated a strong nicotine addiction (ie, smoking within 5 minutes of waking). Only 16% smoked more than a pack per day.

Program Utilization and Adherence

Participants used phone counseling more than online services. Participants completed an average of two counseling calls (mean = 2.1, SD = 1.6, median = 2.0, interquartile range [IQR] = 2.0), utilized Web Coach an average of one time (mean = 1.1, SD = 1.9, median = 0.0, IQR = 1.0), and used discussion forums less often (mean = 0.51, SD = 2.1, median = 0.0, IQR = 0.0) than they logged in to Web Coach. However, utilization rates were much higher for those participants who engaged in phone or Web services at least once. Among those participants who took at least one telephone counseling call (N = 9376), the mean number of counseling calls was 2.5 (SD = 1.4, median = 2.0, IQR = 2.0). Among those participants who logged in to the Web services at least once (N = 5413), the mean number of Web Coach log-ins was 2.2 (SD = 2.2, median = 1.1, IQR = 1.0), and the mean number of discussion forum log-ins was 4.4 (SD = 4.6, median = 3.0, IQR = 3.0).

We stratified use of Web Coach into three discrete categories: 0 log-ins (50.8%), 1-4 log-ins (43.9%), and 5 or more log-ins (5.4%). ANOVA was then used to compare counseling calls completed among the three log-in groups. For the purpose of analysis, we also stratified number of calls completed into comparison groups: 0 calls (15.9%), 1-2 calls (47.8%), 3-4 calls (28.2%), and 5 or more calls (8.2%).

Demographic differences emerged among callers in terms of Web Coach and online discussion forum use, as well as number of calls completed in the cessation program. Women were significantly more likely than men to utilize online discussion forums and complete a greater number of calls. Furthermore, older callers were significantly more likely to complete more calls than younger callers. Younger callers (eg, 18-25 years) logged in to Web Coach significantly less often than

middle-aged callers (ie, 41-60 years). Moderate smokers logged in to the Web Coach significantly more often than light or heavy smokers and logged in to discussion forums more often than light smokers. Callers eligible for tobacco cessation treatment through their employer were more likely to log in to Web Coach than those eligible for treatment through their health insurance plan (see Table 2).

Table 2. Web Coach and calls completed, by characteristic (N = 11,143). Numbers cited in statistics vary due to missing data for some analyses.

	No.	%	Calls, Mean (SD)	Web Coach Log-Ins, Mean (SD)	Forum Log-Ins, Mean (SD)
Gender					
Male	5170	46.4	2.1 (1.6)	1.1 (1.8)	.45 (1.9)
Female	5937	53.6	2.1 (1.6)	1.1 (2.0)	.57 (2.2)
Statistic			$t_{11,141} = 3.0$, $P = .003$	$t_{10,954} = -2.0$, $P = .05$	$t_{10,989} = -3.0$, $P = .003$
Age Group					
18-25	708	6.4	1.6 (1.4)	.83 (1.5)	.34 (1.3)
26-40	3670	32.9	1.8 (1.4)	1.0 (1.8)	.54 (2.1)
41-60	6346	57.0	2.3 (1.6)	1.1 (1.9)	.52 (2.2)
61+	419	3.8	2.8 (1.6)	1.1 (2.0)	.38 (1.9)
Statistic			$F_{3, 11,139} = 146.0$, $P < .001$	$F_{3, 10,952} = 7.0$, $P < .001$	$F_{3, 10,987} = 2.4$, $P = .07$
Nicotine Dependence					
First cigarette of day within 5 min of waking	2950	35.6	2.6 (1.4)	1.2 (2.0)	.59 (2.3)
First cigarette of day > 5 min of waking	5348	64.4	2.5 (1.4)	1.2 (2.0)	.56 (2.3)
Statistic			$t_{8296} = 1.8$, $P = .07$	$t_{8145} = -1.1$, $P = .29$	$t_{8171} = .55$, $P = .58$
Cigarettes/Day					
< 15	4996	53.4	1.6 (1.5)	1.0 (1.7)	.45 (1.9)
15-20	2846	30.4	2.6 (1.4)	1.2 (2.1)	.61 (2.4)
21+	1513	16.2	2.5 (1.4)	1.0 (1.9)	.50 (2.0)
Statistic			$F_{2, 9352} = 505.4$, $P < .001$	$F_{2, 9293} = 10.4$, $P < .001$	$F_{2, 9224} = 5.6$, $P = .004$
Contract Type					
Health Plan	1850	16.9	2.3 (1.6)	.96 (1.8)	.45 (2.0)
Employer	9105	83.1	2.1 (1.6)	1.1 (1.9)	.52 (2.1)
Statistic			$t_{10,953} = 1.0$, $P < .001$	$t_{10,768} = -3.1$, $P = .002$	$t_{10,804} = -1.3$, $P = .20$
Readiness to Quit					
Within 30 days	10,089	91.7	2.1 (1.6)	1.1 (1.9)	.51 (2.1)
> 30 days	914	8.3	1.9 (1.6)	1.1 (1.9)	.48 (2.1)
Statistic			$t_{11,001} = 4.9$, $P < .001$	$t_{10,816} = -.17$, $P = .86$	$t_{10,849} = .46$, $P = .65$

Relation Between Web Coach Use and Call Completion

Respondents who logged in to Web Coach more frequently were significantly more likely to participate in greater numbers of counseling calls. All groups differed significantly. In fact, the small number of participants (5%) who logged on to Web Coach five or more times completed on average one more counseling call than other Web Coach users. Post hoc tests confirmed that all groups differed significantly (see Table 3).

Table 3. Web utilization and average calls completed, by Web Coach log-in group (N = 11,143)

Log-In Group	No. (%)	Average Live Calls, Mean (SD)	Statistic
0	5656 (50.8)	2.0 (1.6)	$F_{2, 11,140} = 154.6$, $P < .001$
1-4	4888 (43.9)	2.1 (1.5)	
5+	599 (5.4)	3.1 (1.7)	

Program Outcomes

To assess outcomes, we examined rates of satisfaction and abstinence from tobacco for at least 30 days or more at 6 months after callers registered in the program. Among survey respondents, 92.1% were satisfied and 41.1% abstained from tobacco use for 30 days or more. When examining quit rates using the ITT analysis, the 30-day quit rate was lower (20.5%) due to attrition at follow-up.

Survey respondents who logged in to Web Coach five or more times were significantly more likely to be satisfied with their experience compared to those who never logged in. No other groups differed in terms of satisfaction. Survey respondents who logged in to the Web Coach more often were significantly more likely to have been abstinent from tobacco for 30 days or more. Even when using ITT analysis, individuals logging in to Web Coach more often were significantly more likely to cease tobacco use. In both responder and ITT analyses, all groups differed significantly (see Table 4). In both the responder and ITT analyses, a pattern emerged in which individuals who completed greater numbers of telephone calls and utilized Web Coach at least once reported significantly higher tobacco cessation rates overall (see Table 5).

Furthermore, a multivariate logistic regression revealed that both calls completed (OR = 1.56) and Web log-ins (OR = 1.14) were significant predictors of quit outcomes (30-day ITT) when controlling for age, gender, and cigarettes per day ($\chi^2_2 = 953.7$, N = 11,143, $P < .001$). Specifically, for each additional call, the odds of quitting increased by 56%, whereas for each additional log-in, the odds of quitting increased by 14%.

Table 4. Satisfaction and 30-day quit rates, by Web Coach log-in group

Log-In Group	Responders Satisfied, No. (%)	Responder 30-Day Quit, No. (%)	ITT 30-Day Quit, No. (%)
0	2268 (91.7)	873 (31.8)	873 (15.4)
1-4	2102 (92)	1156 (47.5)	1156 (23.6)
5+	353 (95.4)	253 (66.9)	235 (42.2)
Statistic	$\chi^2_2 = 6.1$ N = 5128 $P = .047$	$\chi^2_2 = 242.6$ N = 5551 $P < .001$	$\chi^2_2 = 292.7$ N = 11,143 $P < .001$

Table 5. Quit rates (responder and ITT), by call level and dichotomous log-in level

	0 calls, No. (%)	1-2 calls, No. (%)	3-4 calls, No. (%)	5+ calls, No. (%)
Responder Quit Rates[a]				
0 log-ins	44/270 (16)	348/1179 (30)	345/ 960 (36)	136/332 (41)
1+ log-ins	51/192 (27)	458/ 1057 (43)	638/1156 (55)	262/405 (65)
ITT Quit Rates[b]				
0 log-ins	44/1047 (4)	348/2766 (13)	345/1427 (24)	136/416 (33)
1+ log-ins	51/720 (7)	458/2561 (18)	638/1711 (37)	262/495 (53)

[a] $\chi^2_7 = 351.4$, N = 5551, $P < .001$. Chi-square compares quit vs not quit among each cell call group × Web log-in cell.

[b] $\chi^2_7 = 1045.8$, N = 11,143, $P < .001$.

Discussion

Principal Results and Comparisons With Prior Work

To our knowledge, this is the first paper to describe the utilization and outcomes of an integrated tobacco cessation phone/Web program. Quit rates were 41% among survey responders and 21% when using the more conservative ITT analysis method. Quit rates were similar to other studies involving proactive phone counseling (see meta-analysis [4]) and higher than studies involving the Web alone [8-11]. Quit rates also were higher for those participants who had more log-ins and who completed more counseling calls. Similar results have been demonstrated in other studies. For example, Saul et al [9], Japuntich et al [14], and Graham et al [10] found that online use, specifically number of log-ins, was positively correlated with quit outcomes. Similarly, several studies on phone-based interventions have demonstrated a dose response [5,19,20,25].

This study also extends our understanding of the use of an integrated phone/Web program. Participants completed an average of 2-2.5 counseling calls and logged in to the online program an average of 1-2 times. We found that participants tended to use phone services more than Web services. In addition, we observed that nearly half of participants never logged in to the Web Coach. The lower log-in rates for the Web program are most likely due to the automated assignment of Web access to every participant regardless of his or her interest in using the Web program. Thus, participants who chose to log in after receiving automatic access to the Web program may represent a self-selection bias toward the Internet, while nonuse may indicate a bias toward phone counseling.

In a study of a worksite program with incentives, Graham et al [10] found that of the 28.5% of employees who chose to use a Web program over other cessation materials, less than 1% never returned to the website after registering. This suggests that people who deliberately choose a Web program as their cessation method are likely to use the Web program. We believe the higher levels of never logging in for this real-world integrated program are likely due to the passive nature of the Web enrollment process in our program, the availability of other services (mailed materials and phone counseling) to help the participants with quitting, as well as how the program was promoted by health plans and employers.

Even participants who never logged in took an average of two calls. However, participants who logged in more frequently also were more engaged in counseling by phone. Specifically, the small sample of participants who logged in five or more times took, on average, one call more than those participants who logged in fewer times. Thus, there appears to be a population of smokers trying to quit who utilize more services. Furthermore, we observed a trend for higher quit rates among participants who logged in to Web Coach at least once and took more calls. Given that this is not a randomized trial, we are unable to draw causal inferences.

There were several demographic differences in utilization. Women were more likely than men to use the discussion forums and phone counseling, suggesting that women may use these services to obtain social support while quitting. Older smokers completed more calls and used the Web program more often than younger smokers. In other evaluations that we have carried out, we found that younger smokers take fewer calls. We were disappointed to find that they are less likely to use the Web Coach program as well. These findings are consistent with research that suggests that younger smokers are more ambivalent about quitting and less successful in their cessation efforts. We were somewhat surprised by the lower levels of engagement with this age group since they had proactively enrolled in the program on their own. The lower levels of engagement may suggest that younger smokers don't realize the benefits of a program when they quit and/or that their expectations for the program were not met and thus they were less engaged. This requires further study. Japunitch et al [14] found no difference in use by gender, ethnicity, or education but found a difference by age. Strecher and colleagues [26] found that a tailored Web program was more effective for those who had a tobacco-related disease, who had nonsmoking children at home, and who frequently drank, but no other known correlates of outcomes (eg, gender, age, motivation to quit) were found to significantly predict program effectiveness.

Limitations

There are some limitations that should be considered when interpreting the findings from this study. First, this is an evaluation of a real-world service and results are based on services people receive/use and not based on randomization to services. Thus, we are limited in our ability to make causal inferences regarding findings. Second, tobacco abstinence is based on self-report without biochemical verification. Since this a commercial service, biochemical verification of tobacco status is not a standard part of the services. It has not been deemed necessary in large studies of this kind and self-report has been considered adequate [27]. Third, the descriptive findings in this study are somewhat limited as there was a limited battery of measures included. Demographics were limited to age and gender. Lastly, it is notable that while many findings met statistical significance, measures of effect size tended to be small (eg, Cohen's d = .00-.12); thus the extent to which these findings reflect clinically significant differences remains unclear.

Conclusions

This study offers valuable information regarding the real-world use and effectiveness of a novel, integrated phone/Web program for tobacco cessation. Results indicate that more telephone counseling and greater use of the Web are associated with better quit outcomes. When provided access to both proactive phone counseling and Web-based services, smokers were more likely to utilize the phone over the Web. Yet those who chose to complement telephone counseling with Web services appeared to have experienced superior outcomes. Given the potential for increased efficiency and individual tailoring provided via Internet applications, and the strong evidence base for phone effectiveness, there is ample room for improvement in the development, promotion, and study of integrated approaches leveraging the phone and Web in order to further engage

smokers with these modalities of treatment. Findings from this study add further support for health plans and employers to offer cessation services for their members and employees. Promoting both phone and Web-based components of an integrated program achieves the best results.

Acknowledgments

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Conflicts of Interest

The authors are employed by Free & Clear, Inc., which developed and delivered the intervention evaluated in this study. The authors have stock options for Free & Clear, Inc. Tim McAfee owns stock in Free & Clear, Inc.

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Original Paper

Comparing Two Web-Based Smoking Cessation Programs: Randomized Controlled Trial

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Abstract

Background: Smoking cessation remains a significant public health problem. Innovative interventions that use the Internet have begun to emerge that offer great promise in reaching large numbers of participants and encouraging widespread behavior change. To date, the relatively few controlled trials of Web-based smoking cessation programs have been limited by short follow-up intervals.

Objective: We describe the 6-month follow-up results of a randomized controlled trial in which participants recruited online were randomly assigned to either a Web-based smoking cessation program (Quit Smoking Network; QSN) or a Web-based exercise enhancement program (Active Lives) adapted somewhat to encourage smoking cessation.

Methods: The study was a two-arm randomized controlled trial that compared two Web-based smoking cessation programs: (1) the QSN intervention condition presented cognitive-behavioral strategies, and (2) the Active Lives control condition provided participants with guidance in developing a physical activity program to assist them with quitting. The QSN condition provided smoking cessation information and behavior change strategies while the Active Lives condition provided participants with physical activity recommendations and goal setting. The QSN condition was designed to be more engaging (eg, it included multimedia components) and to present much greater content than is typically found in smoking cessation programs.

Results: Contrary to our hypotheses, no between-condition differences in smoking abstinence were found at 3- and 6-month follow-up assessments. While participants in the QSN intervention condition spent more time than controls visiting the online program, the median number of 1.0 visit in each condition and the substantial attrition (60.8% at the 6-month follow-up) indicate that participants were not as engaged as we had expected.

Conclusions: Contrary to our hypothesis, our test of two Web-based smoking cessation conditions, an intervention and an attention placebo control, failed to show differences at 3- and 6-month assessments. We explored possible reasons for this finding, including limited engagement of participants and simplifying program content and architecture. Future research needs to address methods to improve participant engagement in online smoking cessation programs. Possible approaches in this regard can include new informed consent procedures that better explain the roles and responsibilities of being a research participant, new program designs that add more vitality (changing content from visit to visit), and new types of reminders pushed out to participants to encourage return visits. Simplifying program content through a combination of enhanced tailoring and information architecture also merits further research attention.

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KEYWORDS

Tobacco; smoking cessation; Web-assisted tobacco intervention; Internet; intervention; adherence; engagement; physical activity

Introduction

The importance of smoking on public health is undeniable: "Cigarette smoking remains the leading cause of preventable mortality in the United States, resulting in nearly 16 million deaths since the first Surgeon General's report on smoking and health in 1964" [1]. In addition to the profound deleterious impact on smokers' health, "secondhand smoke causes premature death and disease in children and in adults who do not smoke" [2,3]. In response to the public health risks associated with smoking, numerous research projects have examined tobacco cessation approaches that are based in clinical settings as well as public health methods that permit wider dissemination [4-6].

One nascent area of development for public health smoking cessation programs involves the use of Internet-based interventions. To date, only a handful of published studies have described the efficacy/effectiveness of Web-based tobacco cessation programs. Several reports have described promising results of trials with participants from commercial or tobacco control agency Web-based programs for smokers [7-10]. Other published studies have described initial feasibility studies of Web-based tobacco cessation programs [11,12]. A few randomized controlled trials (RCTs) have been conducted [9,13-19], and their results have been generally encouraging [20]. However, interpretation of the randomized trials is complicated by short follow-up intervals, for example, 6 weeks in Strecher et al [16], 2.5 months in Etter [8], and 3 months in Lenert et al [15], Pike et al [9], and Swartz et al [18]. Additional trials with longer term follow-up assessments examining the use of Web-based interventions for smoking control are clearly warranted.

The current paper describes results of the Smokers' Health Improvement Program (SHIP) RCT that examined the 3- and 6-month outcomes for two Web-based programs: (1) an intervention condition (Quit Smoking Network; QSN) that provided users with extensive information and behavioral strategies drawn from clinic-based and self-help smoking cessation programs, or (2) a Web-based control condition that focused on increasing physical activity (Active Lives). Currently, because grant funding has ended, neither the QSN nor Active Lives website is currently available for review. However, screenshots of the programs are included in the Multimedia Appendix.

In addition to primary outcome measures of tobacco abstinence, we sought to examine the impact of condition on secondary outcomes, including participant exposure to program content, physical activity, and pharmacotherapy use. We also sought to test the putative predictors of outcome. Finally, we assessed the extent to which participants found their assigned program easy to use.

Methods

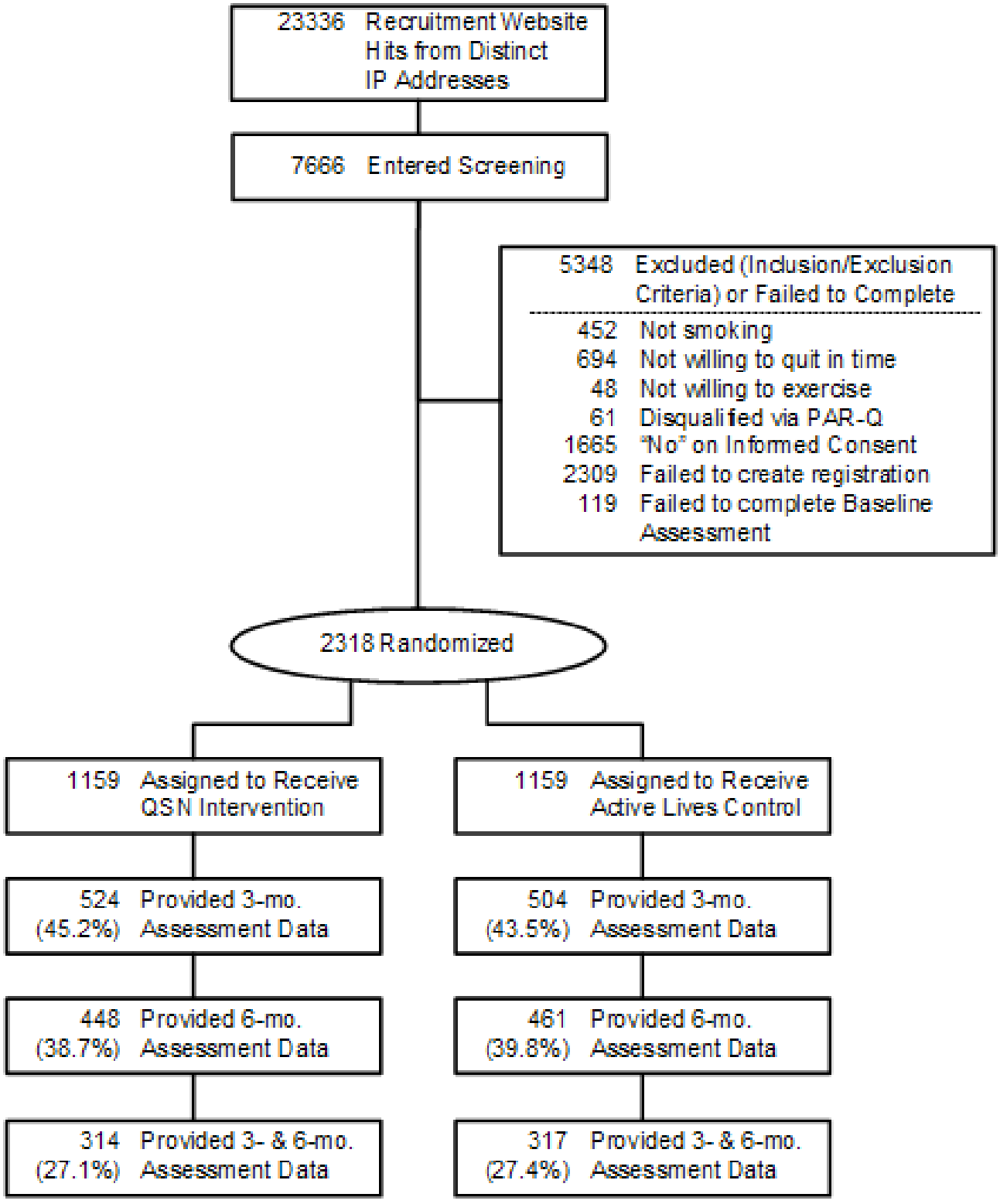
Study Design

The SHIP study was a two-arm RCT that compared two fully automated, Web-based smoking cessation programs: (1) the QSN intervention condition that presented cognitive-behavioral strategies, and (2) the Active Lives control condition in which participants received guidance in developing a personal fitness program to help them quit smoking. The QSN condition provided participants with smoking cessation information and behavior change recommendations while the Active Lives condition provided participants with physical activity recommendations, monitoring, and goal setting. The QSN condition was designed to be more engaging (it included video testimonials, for example), and it presented much greater content that is more typically found in smoking cessation programs. The Active Lives program provided content more explicitly aimed at increasing physical activity as a smoking cessation approach, and, although there is some evidence that physical activity adjuncts to smoking cessation programs may be helpful (eg, [21]), the Active Lives condition was intended to be a credible attention placebo control condition. Follow-up assessments occurred at 3 and 6 months following program enrollment. The trial was not registered, because enrollment started in spring 2005, before trial registration became mandatory.

Enrollment and Participants

We first sought to recruit participants through large worksites in order to reach our recruitment goals and to minimize attrition. This strategy proved unsuccessful. In consultation with an Internet marketing firm, we designed and executed a purely Internet-based recruitment campaign. The campaign involved ad placement on Google and Yahoo search engines (keywords "quit smoking" and "stop smoking") and links to their relevant affiliated sites. Clicking our ads enabled users to (1) visit our recruitment site (study description, inclusion/exclusion criteria), (2) submit answers to screening items, (3) provide their informed consent, and (4) complete the baseline assessment. This Internet marketing campaign was remarkably successful: we recruited 2318 participants in only 10 weeks at a cost of approximately US $13 per recruit. A total of 69.8% (1169/2318) came from Google, 19.9% (461/2318) from Yahoo, and the remaining 10.3% (238/2318) were recruited from word of mouth or from unknown other sources. The flow of participants across various study milestones is depicted using a CONSORT diagram in Figure 1. Note that 44.3% (1028/2318) of participants completed the 3-month follow-up assessment, 39.2% (909/2318) completed the 6-month assessment, and 631 (27.2%) of the randomized sample completed both the 3- and the 6-month assessments.

Figure 1. CONSORT diagram depicting flow of study participants



Study inclusion criteria were as follows: (1) at least 18 years of age, (2) current smoker interested in quitting within the next 30 days, (3) willingness to engage in moderate physical activity, (4) access to the Internet, (5) agreement with the informed consent statement as approved by the Institutional Review Board of Oregon Research Institute, and (6) completion of both program registration and the baseline assessment. Exclusion criteria included any positive answers on the 8-item Physical Activity Readiness Questionnaire (PAR-Q), designed to identify individuals for whom physical activity might be inappropriate or who should receive medical advice concerning the type of activity most suitable for them. Example exclusion items included "Has your doctor ever said you have heart trouble?" and "Do you often feel faint or have spells of severe dizziness?" [22].

Screening and baseline assessments were used to measure the characteristics of participants, including age, gender, race/ethnicity, current smoking, rurality [23], and education.

Study participants were predominantly white, urban, 30- to 50-year-old married women who had at least some college education and smoked 1-2 packs of cigarettes per day at baseline (see participant characteristics in Table 1). No statistically significant differences were found between conditions on any participant characteristics.

Table 1. Distribution of baseline participant characteristics

Characteristic	QSN No. (%)	Active Lives No. (%)	Total No. (%)
Age (years)			
< 30	266 (23.0)	253 (21.8)	519 (22.4)
30-39	256 (22.1)	286 (24.7)	542 (23.4)
40-49	360 (31.1)	327 (28.2)	687 (29.6)
≥ 50	277 (23.9)	293 (25.3)	570 (24.6)
Female	805 (69.5)	829 (71.5)	1634 (70.5)
Married	697 (60.1)	730 (63.0)	1427 (61.6)
Race/Ethnicity			
White	990 (86.8)	982 (86.4)	1972 (86.6)
Black	78 (6.8)	76 (6.7)	154 (6.8)
Other	72 (6.3)	79 (6.9)	151 (6.6)
Education			
No high school degree	79 (6.8)	80 (6.9)	159 (6.9)
High school graduate	302 (26.1)	276 (23.8)	578 (24.9)
Some college	453 (39.1)	490 (42.3)	943 (40.7)
College graduate	325 (28.0)	313 (27.0)	638 (27.5)
Rural vs urban	226 (19.9)	220 (19.5)	446 (19.7)
Number of cigarettes smoked/day			
≤ 10	194 (16.8)	199 (17.2)	100 (17.0)
11-20	497 (42.9)	458 (39.5)	955 (41.3)
21-40	423 (36.5)	442 (38.2)	865 (37.4)
≥ 41	44 (3.8)	57 (4.9)	101 (4.4)

Description of the Web-Based Programs

QSN Intervention Condition

The QSN condition incorporated a hybrid information architecture [24] in which first-time users were directed through a series of tailored Web pages (tunnel design) in order to introduce them to the key concepts and strategies of a behavioral program for quitting smoking. Once they emerged from the tunnel, users were able to choose their own path to access a broad array (using a matrix design) of additional content on quitting and maintaining nonsmoking.

Components of the smoking cessation intervention used in the study are based on Social Cognitive Theory [25,26] as it has been applied to tobacco abstinence [27,28]. These components are designed to help encourage tobacco abstinence via the use of strategies that address each participant's behavior, cognition, and environment [29,30]. This approach also builds on behavioral self-management [31,32], in which the intervention is viewed as providing structure, skills, and a supporting scaffold that encourage the participant to become an active problem solver in the iterative process of trying out and then refining the use of a series of strategies as a part of a personalized plan for quitting tobacco.

Key content modules focused on getting ready, developing a personal quitting plan, setting a personal quit date, using pharmacotherapy products including nicotine replacement therapy, avoiding and altering trigger situations, using substitutes, managing thoughts, using strategies to manage mood, and obtaining support from a peer-to-peer Web forum as well as a professionally moderated "Ask an Expert" forum. The program also offered an extensive library of additional content. Because users were required to log in to the website using their unique username and password, we were able to tailor portions of the program content to each participant's smoking/nonsmoking status (checked at the start of each session) and to display online prompts recommending the review of program content that a participant had not yet explored.

Active Lives Control Condition

Participants assigned to the Active Lives control condition accessed a Web-based program designed to encourage them to

engage in a personalized fitness program that would help them quit smoking. The Active Lives program was based primarily on Bandura's Social Cognitive Theory [25,26], research on interventions to promote physical activity [33,34], and our earlier research on an online diabetes self-management intervention [35]. The program guided each participant through a multi-step plan that included a motivational component (exploration of the benefits of physical activity and a clarification of personal goals and barriers), a behavioral action plan with extensive tracking features (eg, weekly activity schedules personalized to each participant's schedule and types of activities), additional online resources (articles and tips sheets), and access to a Web forum for peer support.

Method of Assessment (Online and Phone)

We attempted to collect all participant assessments via the Internet. Participants were sent an email reminder 3 days prior to an assessment and on the due date of that assessment. Participants who failed to complete their online assessment within 1 week were sent an additional email reminder. If participants had not completed their online assessment within a 2-week period, then a project research assistant initiated a process to complete assessments by phone.

Primary Outcome Measures: Smoking Cessation

Following the recommendation of the Society of Research on Nicotine and Tobacco [36], we assessed point prevalence smoking/nonsmoking status by asking "Have you smoked any cigarettes in the last week, even a puff?" Each participant's smoking abstinence was measured at 3 and 6 months post-enrollment. In addition, we examined repeated point prevalence nonsmoking at both the 3- and 6-month assessments. Because our intervention was accomplished entirely online without any personal contact between participant and researchers, we concluded that it was impractical to obtain biochemical validation of self-reported abstinence—a decision consistent with both the recommendations of Glasgow et al [37] for low-intensity intervention trials as well as with many of the published trials of Web-based smoking cessation programs (eg, [7,13,18]).

Putative Predictors

In addition to baseline demographic and smoking data (see Table 1), the set of putative predictors we planned to examine included self-efficacy, dependence, support for quitting, smoking among friends and family members, depression, and prior quit attempts. Tests of putative predictors help to establish the veracity of the dataset because they broaden the knowledge base and enable comparisons with other similar findings in the literature. Reporting predictors could help inform future intervention design in showing characteristics of those participants for whom the programs seemed most efficacious. Examples of studies that have examined predictors of outcome using participants who had participated in a tobacco cessation RCT include those performed by Oregon Research Institute researchers [19,38,39] and other research teams (eg, [8,15,40-43]).

Self-Efficacy

Confidence in accomplishing various facets of quitting smoking was assessed at baseline using a 5-point Likert scale (1 = not at all confident to 5 = very confident). Items included the following: "If you decided to quit smoking, how confident are you that you could quit?", "If you decided to quit smoking, how confident are you that you will not be smoking a year from now?", "How confident are you that you can resist smoking when you are feeling bored or restless?", "How confident are you that you can resist smoking when you are angry, frustrated, or tense?", "How confident are you that you can resist smoking when you drink alcohol?", and "How confident are you that you can resist smoking when you are around others who are also using it?

Dependence

Nicotine dependence was measured at baseline using an item excerpted from a scale developed by Piper et al [44]: "How strong are your urges when you first wake up in the morning?" This was assessed with a 7-point Likert scale (1 = not strong at all to 7 = extremely strong). In addition, participants were asked at baseline to answer the following question using one of eight answer options (1-5, 6-10, 11-15, 16-20, 21-25, 26-30, 31-40, 40 or more): "On average, how many cigarettes do you smoke each day?"

Support for Quitting

Participants were asked at baseline to rate the expected support for quitting: "If you decided to quit smoking, how supportive would the person you're closest to be of your efforts to stop smoking?" (1 = not at all supportive to 7 = very supportive).

Smokers Among Friends and Family

Participants were asked to answer two items recommended by Piper et al [44] using a 7-point Likert scale (1 = not true of me at all to 7 = extremely true of me): "A lot of my friends or family smoke" and "Most of my friends and acquaintances smoke."

Depression

The baseline assessment asked participants to answer two dichotomous (yes/no) items that measured depression: "In the past year, have you had 2 weeks or more during which you felt sad, blue, or depressed; or when you lost all interest or pleasure in things that you usually cared about?" and "Have you had 2 years or more in your life when you felt depressed or sad most days, even if you felt okay sometimes?"

Quit Attempts

Participants were asked to answer the question "In the past year, how many times have you made a serious attempt to quit?" using five answer options: 0, 1, 2, 3, or ≥ 4 attempts.

Secondary Outcome Measures

Participant Exposure

The extent to which participants accessed their assigned Web-based program was measured unobtrusively using a combination of database tracking and Web server log analysis [45] to determine both number of visits (sessions) and duration of visits. We also created a composite measure of exposure

(mean of standard scores for the number of visits and total time spent across all visits). We examined the pattern of declining participant visits to the Web-based programs following enrollment [45] by calculating each participant's final visit date to view program content (visits associated with completing online assessments were not included). If a participant viewed program content only one time and it occurred on his/her enrollment date, then he/she would be assigned 0 days (last visit occurred zero days since the day of enrollment).

Physical Activity

Two items from the Behavioral Risk Factor Surveillance System (BRFSS) [46] were used to measure whether participants engaged in vigorous or moderate levels of continuous activity: "In a usual week, do you do vigorous activities for at least 10 minutes at a time, such as running, aerobics, heavy yard work, or anything else that causes large increases in breathing or heart rate?" and "In a usual week, do you do moderate activities for at least 10 minutes at a time, such as brisk walking, bicycling, vacuuming, gardening, or anything else that causes some increase in breathing to heart rate?" Endorsement of these items was followed by the following question: "How many days per week do you do vigorous [moderate] activities?"

Pharmacotherapy Use

Participants in both conditions were asked the following question on the 3- and 6-month assessments: "Which of the following products or methods have you tried in the last 3 months?" Answer options included nicotine gum, nicotine patches, nicotine lozenges, nicotine spray, nicotine inhaler, other nicotine replacement product, and Zyban (bupropion). Two composite scores were derived for each participant: the sum of pharmacotherapy products used (from 0 to 6) and a yes/no score for any pharmacotherapy use.

Program Usability

At each of the 3- and 6-month assessments, participants were asked to answer "How easy was it to use the QSN/Active Lives program?" using a 5-point Likert scale (1 = not at all; 3 = somewhat; 5 = very).

Statistical Analyses

Logistic Regression and Survival Analysis

Putative predictors were tested using two complementary steps. First, we used binary logistic regression models that incorporated treatment condition as well as the interaction of the condition with each variable in order to identify any differential effects of the intervention on the prediction of smoking abstinence [47]. Second, significant predictors were then tested in a multivariate binary logistic regression using backwards elimination. Following the approach we used in another Web-based tobacco cessation program [45], we used Kaplan-Meier survival analyses [48,49] to examine the pattern of last visits to the Web-based program using the number of days post-enrollment as our unit of time. All analyses were conducted using SPSS statistical software, version 15 (SPSS Inc, Chicago, IL, USA).

Complete Case vs Intent-to-Treat Analyses

Given that only 39.2% (909/2318) of participants responded to the 6-month follow-up assessment, we decided not to use complex imputation methods [50]. Instead, we used two complementary approaches: (1) complete case analysis limited to data obtained from participants who responded to a follow-up assessment, and (2) an intent-to-treat analysis that used the original sample as the denominator and a simple imputation method in which all participants who did not complete an assessment were considered to be still smoking (missing = smoking).

Results

Assessment Completion / Participant Attrition

Of the 1028 participants who completed the 3-month assessment, 315 (30.6%) did so online and 713 (69.4%) were contacted by phone. Of the 909 participants who completed the 6-month assessment, 161 (17.7%) completed it online and 748 (82.3%) completed a phone assessment. The two conditions did not differ in terms of the proportion of online assessments at 3 months, but QSN had more online 6-month assessments than the Active Lives condition: 21.4% (96/448) vs 14.1% (65/461); $\chi^2_1 = 8.34$, N = 909, $P = .004$.

We used multivariate logistic regression on complete cases to examine possible baseline predictors using two dependent variables: (1) completion of the 6-month assessment and (2) completion of both the 3- and 6-month assessments. Positive predictors of completing the 6-month assessment included age (adjusted odds ratio [OR] = 1.33, 95% confidence interval [CI] = 1.23-1.44, $P < .001$), education level (OR = 1.18, CI = 1.07-1.29, $P = .001$), and confidence in being able to quit for one year (OR = 1.08, CI = 1.00-1.15, $P = .04$). Positive predictors of completing both the 3- and 6-month assessments included age (OR = 1.40, CI = 1.30-1.51, $P < .001$), marital status (OR = 1.13, CI = 1.05-1.48, $P = .01$), education level (OR = 1.13, CI = 1.03-1.24, $P = .01$), and confidence in being able to quit for one year (OR = 1.10, CI = 1.03-1.18, $P = .008$). None of the condition by predictor tests reached statistical significance.

Primary Outcome: Tobacco Cessation

Self-reported smoking abstinence was examined by condition using complete case and intent-to-treat analyses at 3 months, 6 months, and also for both the 3- and 6-month follow-up assessments (see Table 2). Results for the QSN and Active Lives conditions were remarkably similar.

Binary logistic regression tests (complete case) failed to uncover any significant differences in smoking abstinence between the QSN and Active Lives conditions when we considered assessments at 6 months or when we considered nonsmoking at both 3 and 6 months (see Table 3). Intent-to-treat (missing = smoking) analyses showed similar nonsignificant between-group differences.

Table 2. Smoking abstinence by condition at follow-up assessments

	3 Months No. (%)	6 Months No. (%)	3 and 6 Months No. (%)
Complete Case			
QSN	103/524 (19.7)	112/448 (25.0)	45/314 (14.3)
Active Lives	99/504 (19.6)	120/461 (26.0)	44/317 (13.9)
Intent-to-Treat			
QSN	103/1159 (8.9)	112/1159 (9.7)	45/1159 (3.9)
Active Lives	99/1159 (8.5)	120/1159 (10.4)	44/1159 (3.8)

Table 3. Logistic regression results of smoking abstinence by condition at follow-up assessments

	β	OR	95% CI		*P*
			Lower	Upper	
3 Months					
Complete case	−.001	1.00	.73	1.36	.996
Intent-to-treat	−.043	.96	.72	1.28	.768
6 Months					
Complete case	.054	1.06	.78	1.42	.722
Intent-to-treat	.077	1.08	.82	1.42	.580
Both 3 and 6 Months					
Complete case	−.037	.96	.62	1.51	.871
Intent-to-treat	−.023	.98	.64	1.49	.914

Predictors of Outcome

None of the interactions between putative predictors and treatment condition were significant. Results of multivariate binary logistic tests performed on smoking abstinence for all participants (collapsed across condition) at 3 months, 6 months, and both 3 and 6 months are presented in Table 4. Education emerged as a significant positive predictor of smoking abstinence in all three cases. Baseline smoking rate was negatively related to smoking abstinence on each of the single follow-up assessments. Expected support for quitting had a positive relation with smoking abstinence at the 3-month assessment and the combined 3- and 6-month assessment.

Table 4. Predictors of smoking abstinence by follow-up assessment

	β	OR	95% CI		*P*
			Lower	Upper	
3 Months					
Baseline cigs/day	−.125	.88	.80	.97	.010
Education	.408	1.50	1.24	1.83	.000
Expected support	.211	1.24	1.10	1.39	.001
Marital status	.415	1.52	1.07	2.14	.019
6 Months					
Baseline cigs/day	−.200	.82	.75	.90	.000
Education	.267	1.31	1.09	1.57	.004
Both 3 and 6 Months					
Education	.340	1.41	1.06	1.86	.018
Expected support	.205	1.23	1.02	1.48	.032
Serious quit attempts	−.121	.81	.67	.98	.030

Secondary Outcomes

Participant Exposure

The frequency and duration of each participant's visits to the Web-based program (not including visits to complete online assessment) were measured unobtrusively in Web server logs and using database tracking methods (see Table 5 and Figure 2). Compared to the Active Lives condition, participants in the QSN condition averaged more visits (2.14 visits, SD = 3.66 vs 1.74 visits, SD = 2.43; unequal variance $t_{2012.03} = -3.11$, $P = .002$). Analysis of data on duration of program usage by condition (Figure 2) revealed that the QSN condition was notably less kurtotic and skewed than the Active Lives condition (kurtosis = 21.79 vs 181.70; skewness = 3.53 vs 10.38). Analysis of these data revealed that participants in the QSN condition spent significantly more time visiting the program (18.04 minutes, SD = 22.18 vs 14.02 minutes, SD = 17.09; unequal variance $t_{2174.56} = -4.02$, $P < .001$).

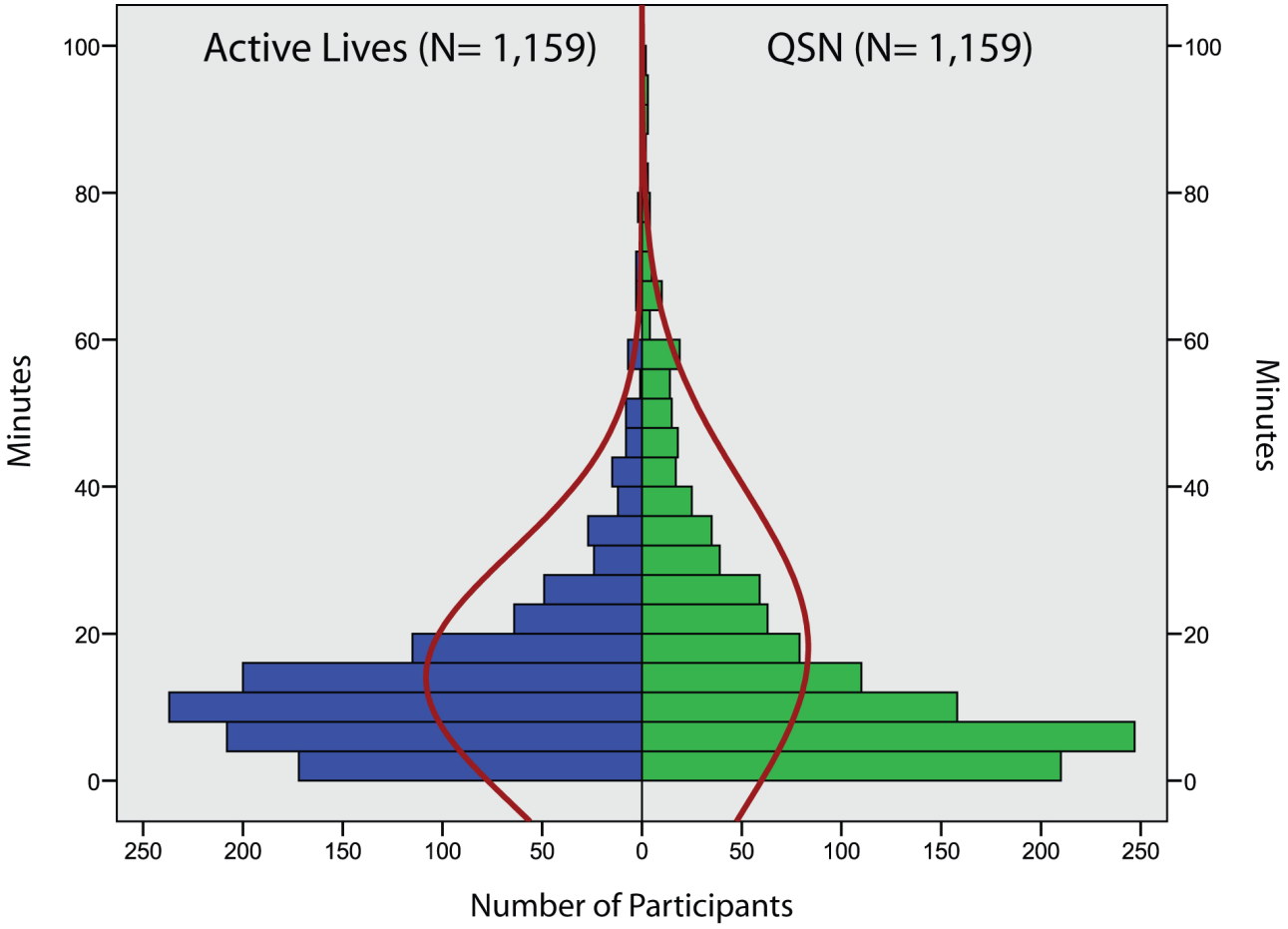
Table 5. Exposure by condition (IQR: Intraquartile Range)

	Number of Visits				Duration of Visits (minutes)			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR
QSN	2.14[a]	3.66	1.00	1 (1-2)	18.04[b]	22.18	10.00	19 (5-24)
Active Lives	1.74	2.43	1.00	1 (1-2)	14.02	17.09	11.00	11 (6-17)

[a]Between-condition comparison: $P = .001$.

[b]Between-condition comparison: $P < .001$.

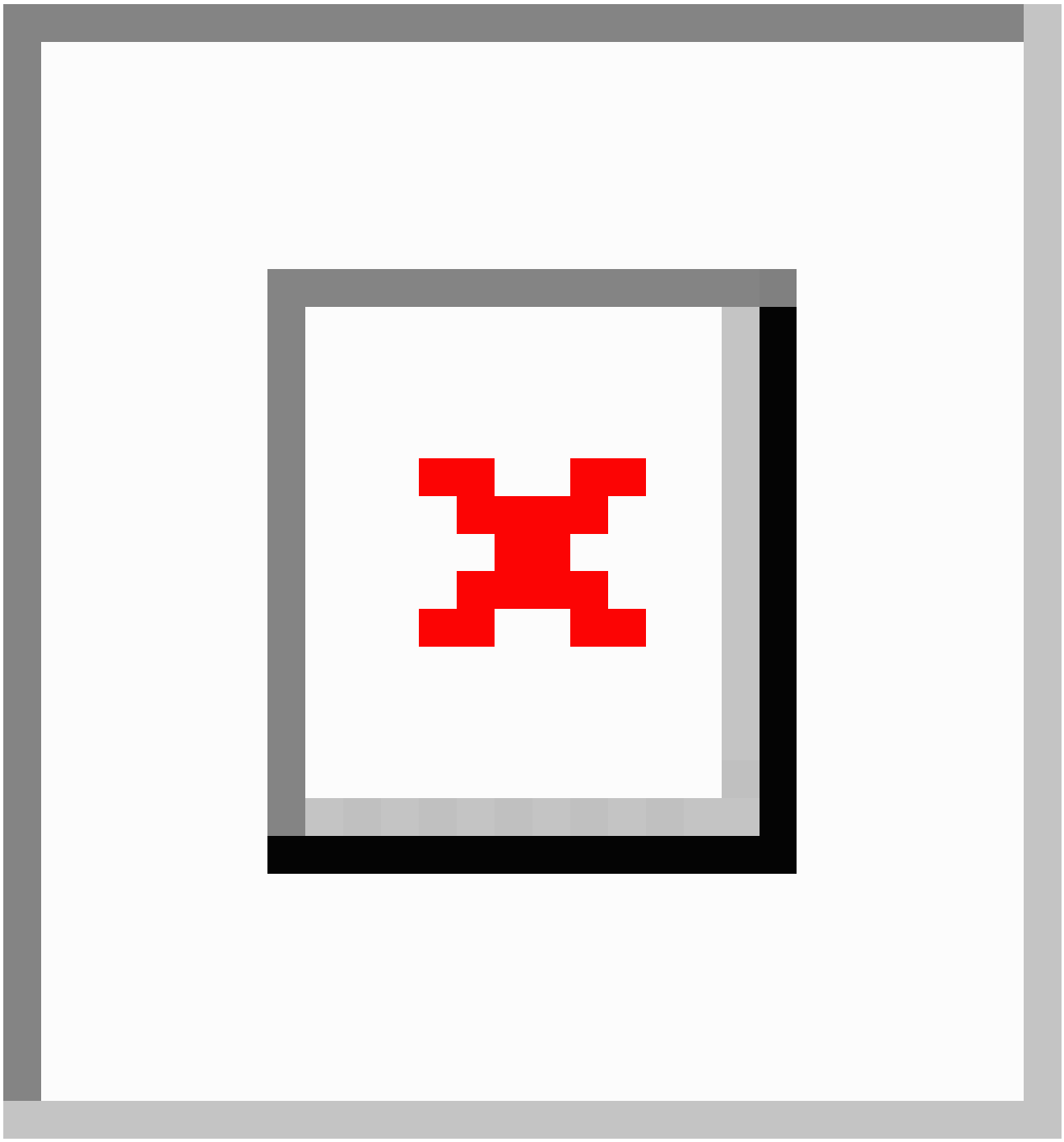
Figure 2. Total time (minutes) of Web program access by condition (red line indicates normal distribution)



We examined the pattern of participant exposure over time by condition. For purposes of this analysis, we defined exposure as the number of days elapsed between each participant's date of randomization/enrollment and the date of his/her last website visit to view program content. We applied the Kaplan-Meier survival analysis to these data, which allowed us to examine the timing of the last visit by condition (see Figure 3). By definition, all participants had a last visit since all participants stopped visiting at some point following enrollment. Note that Figure 3 shows a steep downward slope in last program visits soon after program enrollment, indicating that most participants stopped visiting the program soon after they started. There were notable drops in subsequent participation at times that corresponded with the follow-up assessments. While QSN had

somewhat longer estimated survival time (mean = 36.71 days, SE = 2.18) than the Active Lives condition (mean = 30.86, SE = 2.02), the Kaplan-Meier survival tests revealed that the overall trajectory of these post-enrollment program visit curves did not significantly differ by condition: Breslow (2.30, P = .13) and Log Rank Mantel-Cox (1.97, P = .16).

Figure 3. Survival analysis of program engagement over time by condition



Binary logistic regression analyses failed to reveal any significant dose-response effects using the composite exposure score (incorporating both number of visits and total usage duration) and smoking abstinence at both 3 and 6 months within and combined for conditions (complete case analyses).

Physical Activity

At the 6-month assessment, remarkably similar proportions of participants in the QSN and Active Lives conditions reported that they engaged in vigorous physical activity—40.2% (173/430) vs 38.0% (163/429), respectively—and moderate physical activity—76.7% (332/433) vs 79.4% (344/433), respectively. No significant group differences were found in the reported number of days the participant had engaged in at least 10 minutes of moderate or vigorous physical activity (group t values ranged from .13-1.33). Number of days of vigorous activity tended to increase slightly across the baseline, 3-month, and 6-month assessments for both the QSN (mean = 3.42, SD = 1.52; mean = 3.74, SD = 1.51; mean = 3.69, SD = 1.46; respectively) and Active Lives conditions (mean = 3.47, SD = 1.62; mean = 3.51, SD = 1.65; mean = 3.85, SD = 1.49; respectively). The days of moderate activity were slightly higher

for each group and also increased slightly across the baseline, 3-month, and 6-month assessments for both the QSN (mean = 3.93, SD = 1.75; mean = 4.40, SD = 1.91; mean = 4.44, SD = 1.83; respectively) and Active Lives conditions (mean = 4.01, SD = 1.76; mean = 4.42, SD = 1.80; mean = 4.33, SD = 1.88; respectively).

Pharmacotherapy Use

Between-group differences in terms of the number of pharmacotherapy products participants reported using were not significant at the 3-month assessment (mean = .68, SD = .86 vs mean = .60, SD = .83; unequal variance $t_{1026.97} = -1.54$, $P = .12$), but participants in the QSN condition reported using significantly more pharmacotherapy products than those in the Active Lives condition at the 6-month assessment (mean = .06, SD = .82 vs mean = .55, SD =.71; unequal variance $t_{880.06} = -1.76$, $P = .04$, 1-tailed).

We also examined pharmacotherapy use using a composite variable that measured any use (yes/no). At the 3-month assessment, significantly more QSN participants reported using any pharmacotherapy than did the Active Lives participants: 54.2% (262/524) vs 45.8% (221/504); $\chi^2_1 = 3.90$, N = 1028, $P = .048$. However, no group-wise differences emerged on this dimension at the 6-month assessment, with pharmacotherapy use reported by 47.3% (212/448) of QSN participants compared with 43.8% (202/461) of Active Lives participants.

Program Usability

We analyzed ratings of program ease of use obtained at the 3-month assessment from 67.0% (351/524) of QSN participants and 72.6% (366/504) of Active Lives participants. Results favored QSN over the Active Lives control condition (mean = 3.85, SD = 1.28 vs mean = 3.65, SD = 1.36; with a rating of 3 = somewhat; unequal variance $t_{714.79} = -2.05$, $P = .04$).

Usability ratings obtained at the 6-month assessment from 79.0% (354/448) of QSN participants and 60.1% (277/461) of Active Lives participants showed a similar relative advantage for the QSN condition: mean = 4.10, SD = 1.21 vs mean = 3.70, SD = 1.35; unequal variance $t_{629} = -3.91$, $P < .001$.

It is important to note that participants were also asked to rate how helpful they found specific program areas (eg, library of materials and the support group area), but we chose not to report these data because very few individuals provided data on these items and a number of those participants who did provide such ratings did not, in fact, visit the program area based upon our unobtrusive tracking of their use of their assigned website.

Discussion

The outcome results did not support our hypothesis that the QSN online smoking cessation intervention would be more effective than a credible control condition. The unremarkable impact of the QSN condition relative to the Active Lives condition is particularly surprising given that the Active Lives control condition presented very few strategies for quitting smoking since it was largely focused on helping participants improve their personal level of physical activity. The absolute level of nonsmoking at 6 months—less than 4% abstinence using intent-to-treat analysis—is less than results for other Web-based smoking cessation programs reported by Muñoz et al (5.6% to 26.0% abstinence at 6 months) [13]. However, with respect to the nonsignificant finding between conditions, the engagement of physical activity among the Active Lives participants was noteworthy. These data reflect their relatively high level of adherence to the recommended behavior change goal. Almost 80% of participants reported that they were engaged in moderate physical activity at the 6-month follow-up assessment. This implies that our control group was actively following the recommendations suggesting the importance of engaging in physical activity in aiding quit attempts and might explain, in part, the relative lack of difference in findings between the groups on quit success.

There are noteworthy strengths and limitations to consider when interpreting these findings. Strengths include the large sample of 2318 participants, the fact that the Web-based programs were fully automated to assure high fidelity of content delivery, and that the study used a RCT methodology.

One important limitation involved participant attrition (failure to complete follow-up assessments). At the 3-month follow-up, we experienced a 55.6% (1289/2318) attrition rate, which is larger than the 44% attrition rate reported by Swartz et al [18] but comparable to the levels reported for other Web-based smoking cessation programs: 57.2% by Stoddard et al [11], 62.5% by Strecher et al [16], 70.7% by Cobb et al [7], and 64.6% by Etter [8]. At the 6-month follow-up, we experienced a 60.8% (1409/2318) attrition rate, which is roughly comparable to the attrition at 6 months reported by Muñoz et al [13] for four studies of English- and Spanish-language Web-based smoking cessation programs: 73.9% (2051/2774), 69.9% (491/702), 65.7% (184/280), and 35.4% (102/288).

Although mean program exposure measures (especially duration) favored the QSN program when compared with the Active Lives control condition, the extent of these observed differences was not as large as had been expected. Nor did we find a dose-response relationship between program exposure and smoking abstinence at follow-up. Using median data, participants in the current study used the program for a single visit that lasted about 10 minutes.

Differences in study design among published studies of Web-based smoking cessation interventions and the nascent stage of the science make it difficult to generalize our program exposure results to the available body of research in this area. For example, some researchers have not reported exposure data [13,15,18], while others [8] reported number of pages viewed and average visit duration but not a precise calculation of exposure. The pattern of program visits (mean = 2.14, median = 1.0) observed for both conditions in this study is lower than the findings reported by Swartz et al [18] and Lenert et al [14] but roughly consistent with results of other online cessation programs reported by Muñoz et al [13]. In their comparison of five different Web-based smoking cessation interventions, Pike et al [9] noted that the two websites with the highest “utilization rates” had 9.7 and 6.0 visits per participant, while the visit rate on the remaining websites ranged from 1.8 to 2.2 visits.

It is important to note that Japuntich et al [51] reported much higher levels of exposure to an adjunctive Web-based intervention by participants who had multiple in-person contacts with research project staff (including a physical exam, several counseling visits, and five in-person follow-up assessments). It is reasonable to assume that there are likely to be significant differences between adjunctive use of Web-based interventions compared to fully automatic Web-based interventions like ours that do not involve any in-person contact and that deliver the intervention only by a rules-driven algorithm.

Nonetheless, there remains the opportunity to improve participant engagement in online smoking cessation programs. For example, future research should consider testing whether engagement might be facilitated by changing program content from visit to visit (enhancing vitality), by using more effective tailoring to improve the relevance of program content, and/or by using innovative reminders (eg, some combination of email, regular mail, text messages, e-cards) that encourage multiple program visits.

Analyses of pharmacotherapy usage were supportive of the fact that the QSN condition compared to the control condition encouraged significantly greater use of this treatment approach (more than 60% vs approximately 47%), although it is important to acknowledge that almost half of participants in the control condition used pharmacotherapy without being explicitly told to do so. Similarly, Swartz et al [18] reported that a majority of wait-list control participants indicated that they used pharmacotherapy products.

One interesting possibility is that our use of a physical activity control condition may have inadvertently jeopardized, to some extent, the generalizability of our results. Specifically, because of concerns about health among participants in the Active Lives condition, we excluded 61 individuals (prior to randomization) who had positive answers on the PAR-Q assessment, and an additional 48 individuals declined to participate because they did not want to increase their level of exercise activity. These 109 individuals would not have been excluded from a typical smoking cessation RCT. However, it remains for further research to determine whether these exclusion criteria may have had the effect of excluding individuals who otherwise would have been successful quitters using the treatment condition.

We considered possible control/comparison conditions for the present study. A no-treatment or waiting list control group is often recommended in order to reduce the likelihood of a type II (false negative) error when an intervention is expected to produce small effects. But we concluded that offering participants no treatment or delayed treatment would have been unhelpful because waiting list controls provide only limited information [52]. Moreover, from a pragmatic perspective, we were concerned that individuals assigned to a waiting list condition would have little reason to remain involved and would therefore be more likely to be lost to follow-up. When using an intent-to-treat model that defines missing = smoking, such differential attrition would have biased results in favor of the intervention condition or type I error [53]. Thus, we used a control/comparison condition that offered a face-valid, credible, Web-based intervention for smoking cessation that did not contain what have been shown to be the active ingredients of evidence-based smoking cessation intervention. It is reasonable to question whether a better choice of control condition would have been a basic or static information website similar to what has been used in other RCTs of tobacco cessation interventions (eg, [16,19]).

Our remarkably successful use of online recruitment may have resulted in recruiting smokers who were less likely (1) to remain fully involved over time in a research program and (2) to quit smoking. It was quite easy for prospective participants to enroll—we estimate that it would require less than 15 minutes from clicking on a link in a Google ad listing to completing the screening, online consent, registration, and baseline assessment. The absence of measures describing ease of enrollment (either self-report or using a measure of convenience like elapsed time) makes it impossible for us to discuss further the extent to which the present study may have had easier enrollment than other Web-based behavioral interventions. Adding more barriers/hurdles to this process would very possibly have increased engagement and reduced program attrition because only motivated individuals would have been able to participate [54,55]. But, while culling out less motivated individuals, this approach might spuriously inflate absolute effect sizes while reducing external generalizability [56]. It remains for future research to determine the extent to which open online enrollment with few barriers for entry results in greater attrition.

Another likely limitation of the QSN intervention is that it may have been too expansive; that is, it may have offered too much (sometimes redundant) content that forced users to navigate through a complex information architecture, which reduced utility and encouraged attrition. We obtained ratings of program usability at follow-up, but, of course, interpretation of such data is constrained by the fact that they are drawn from a minority of original participants who completed follow-up assessments. Content duplication and/or complex intervention design can erode therapeutic impact—more is not necessarily better [57]. Indeed, the likely mechanisms of change may not be best described by a linear dose-response relationship [58,59].

In many ways, the results of the current research underscore the complexity of developing and then evaluating Web-based interventions for smoking cessation. We used an intervention and an attention placebo control that recommended physical activity as a smoking cessation tool. Our initial plan was to recruit through worksites as had been done with success in other Web-based smoking cessation research [18]. Because we found that worksite recruitment produced little in the way of results, we turned to online recruitment tied to popular Web search engines, particularly Google. Using this approach, we were able to rapidly randomize over 2300 participants to our RCT of two Web-based smoking cessation programs that had been carefully crafted to provide users with the content they needed in an online context that they would find interesting and engaging.

In summary, the results of this Web-based smoking cessation intervention RCT failed to confirm our hypotheses. Negative findings play an essential role in the development of science [60] and are particularly illuminating with regard to shaping a reasoned appreciation for the complexity of creating, delivering,

and evaluating online health behavior change interventions. As we perform empirical tests of evolving interventions in this nascent field, we need to learn from both negative and positive outcomes as we strive to understand the factors that are associated with participant recruitment, program exposure, content tailoring, and participant attrition.

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Conflicts of Interest

None declared.

Multimedia Appendix

PowerPoint presentation of program screenshots

[PPT file (Microsoft Powerpoint File), 3.1 MB - jmir_v10i5e40_app1.ppt]

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Abbreviations

PAR-Q: Physical Activity Readiness Questionnaire
QSN: Quit Smoking Network
RCT: randomized controlled trial
SHIP: Smokers' Health Improvement Program

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Original Paper

Comparing Internet Assistance for Smoking Cessation: 13-Month Follow-Up of a Six-Arm Randomized Controlled Trial

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Abstract

Background: Although many smokers seek Internet-based cessation assistance, few studies have experimentally evaluated long-term cessation rates among cigarette smokers who receive Internet assistance in quitting.

Objective: The purpose of this study is to describe long-term smoking cessation rates associated with 6 different Internet-based cessation services and the variation among them, to test the hypothesis that interactive and tailored Internet services yield higher long-term quit rates than more static Web-posted assistance, and to explore the possible effects of level of site utilization and a self-reported indicator of depression on long-term cessation rates.

Method: In 2004-05, a link was placed on the American Cancer Society (ACS) website for smokers who wanted help in quitting via the Internet. The link led smokers to the QuitLink study website, where they could answer eligibility questions, provide informed consent, and complete the baseline survey. Enrolled participants were randomly assigned to receive emailed access to one of five tailored interactive sites provided by cooperating research partners or to a targeted, minimally interactive ACS site with text, photographs, and graphics providing stage-based quitting advice and peer modeling.

Results: 6451 of the visitors met eligibility requirements and completed consent procedures and the baseline survey. All of these smokers were randomly assigned to one of the six experimental groups. Follow-up surveys done online and via telephone interviews at approximately 13 months after randomization yielded 2468 respondents (38%) and found no significant overall quit rate differences among those assigned to the different websites ($P = .15$). At baseline, 1961 participants (30%) reported an indicator of depression. Post hoc analyses found that this group had significantly lower 13-month quit rates than those who did not report the indicator (all enrolled, 8% vs 12%, $P < .001$; followed only, 25% vs 31%, $P = .003$). When the 4490 participants (70%) who did not report an indicator of depression at baseline were separated for analysis, the more interactive, tailored sites, as a whole, were associated with higher quitting rates than the less interactive ACS site: 13% vs 10% ($P = .04$) among 4490 enrolled and 32% vs 26% ($P = .06$) among 1798 followed.

Conclusions: These findings show that Internet assistance is attractive and potentially cost-effective and suggest that tailored, interactive websites may help cigarette smokers who do not report an indicator of depression at baseline to quit and maintain cessation.

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KEYWORDS

Smoking cessation; Internet; cigarette smoking; randomized controlled trial

Introduction

To help serve the millions of smokers who can reduce their cancer risk by quitting, the American Cancer Society (ACS) offers telephone counseling and other services. One randomized trial found telephone counseling provided by the ACS to cost US $1300 per long-term quitter [1], well below the health-related costs of tobacco use of US $3391 per smoker per year estimated by the Centers for Disease Control and Prevention [2]. The ACS call center for smokers has grown to serve approximately 70,000 persons in 2006 at a modest cost per client. However, Internet service provides greater potential for cost-efficiency. With scalability, Internet services can provide assistance to many smokers at a very reasonable cost.

Although there are hundreds of websites that provide information about smoking cessation, fewer than one in 20 provide assistance that meets the basic standards regarding the use of evidence-based content of cessation advice, and very few provide useful interactivity [3]. Studies of websites that do provide interactive tailoring with evidence-based instruction and peer modeling have shown promising results [4], although it is difficult to obtain sustained use of online assistance as smokers attempt to go through the quitting process [5]. Randomized studies have found significant effects on sustained quitting for approximately 3 to 7 months from interactively tailored sites with regular out-bound emailed queries and messages designed to help smokers take discrete steps toward long-term cessation [6,7].

Internet-based assistance can offer both interactively tailored advice and online communities that allow visitors to learn from one another and receive social support. Reporting on a website with chat rooms, Cobb et al [8] found that 3-month maintained quitting rates among visitors were highly related to how many times the chat rooms were visited. In the short-term findings from the research reported here, in which diverse interactive sites were compared, the sites that obtained the highest number of visits produced the highest rates of cessation at 4 months following registration [9]. No large-scale randomized trials to rigorously assess the longer term effects of Internet assistance have previously been reported.

Depression is an important factor in smoking cessation [10]. There are generally high levels of depression among smokers [11], and depression inhibits quitting success by decreasing self-efficacy [12]. In research on smokers seeking assistance from telephone counseling, high levels of self-reported depression have been observed. Those with a valid, single-item [13] depression indicator were found to achieve lower rates of sustained cessation that those without it [14]. In that study, telephone counseling had a modest effect on those with the indicator, while its strongest effect was among those without it. In a more recent study that measured the frequency of self-reported depression on an interval scale [15], approximately half of the clients reported depression symptoms in response to the single-item indicator. In that study, enhancements in the protocol using cognitive therapy for depression did not significantly increase the quit rate among those with an indication of depression.

The present study was designed to describe long-term effects on quit rates among smokers using the Internet for quitting assistance and compare the 13-month follow-up quit rates for visitors to tailored interactive sites with the quit rate for visitors to a targeted, relatively static site provided by the ACS. Five interactive sites, each with somewhat different features, were selected to explore possible variations in their effectiveness. The planned hypotheses to be tested were that (1) quit rates will differ between sites and (2) tailored, interactive sites will have a greater effect than the targeted, relatively static site. Exploratory analyses were conducted to determine if quitting success is linked to the number of visits to the interactive sites. An additional post hoc analysis tested the hypothesis that quit rates for more interactive sites were greater among those who did not report an indicator of depression than among those who did.

Methods

A link was placed on the American Cancer Society (ACS) website for smokers who wanted help in quitting via the Internet. The link led smokers to the QuitLink study website, where they could answer eligibility questions, provide informed consent, and complete the baseline survey. The enrolled participants were randomly assigned to receive emailed access to one of five tailored interactive sites provided by cooperating research partners or to a targeted, minimally interactive ACS site with text, photographs, and graphics providing stage-based quitting advice and peer modeling.

The five research partners (Table 1) agreed to provide study participants with access to their Internet smoking cessation services free of charge. A targeted, relatively static site containing evidence-based self-help information and peer modeling (provided in print form for smokers using the ACS telephone counseling) was also posted on the Internet for use in this study. Participants entered the study via self-referral through the main ACS website, which is widely promoted in ongoing public communication. They enrolled by clicking a link to receive information about the project and completing a human subject consent protocol and baseline survey with a further link leading to randomization. They were then emailed a link to one of the six Internet sites listed in Table 1. This provided immediate access at no cost. Of course, participants could, for a fee, subsequently enroll in these or other Internet cessation services.

Table 1. Research sites and characteristics

Site	Description
Oregon Center for Applied Sciences	Included presentations with role models that mimic a counseling experience
ProChange	Featured extensive stage-based tailoring
QuitNet	Featured an online "community" with chat rooms
SmokeClinic	Included mood assessment and chat rooms
CAMH by V-CC	Included online community features and instant messaging
ACS – Break Away from the Pack PDF files	Included text, photographs, and graphics with stage-based peer modeling

Participation in the study was limited to English-speaking daily smokers residing in the United States who provided informed consent and completed the baseline survey. Enrollment was conducted from October 2004 through May of 2005, with a goal of 1000 participants per site and half that number at follow-up to provide sufficient statistical power for detecting meaningful differences between quit rates in the different experimental groups. Baseline data included demographics, smoking history, and questions about Internet use. A single-item depression indicator [13] asked participants whether or not they felt "sad or blue" every day for the past 2 weeks. Another question asked participants to rate their self-efficacy for quitting on 0-100 scale, with 0 corresponding to no confidence and 100 corresponding to complete confidence in being able to quit and maintain cessation. Data were collected from each of the five site providers on registration and the number of visits to the site by registered participants.

Follow-up surveys were conducted approximately 4 months and then 13 months after randomization, first by email and then by telephone to reach those who did not respond to the email inquiry. The quit rate indicator that was selected for analysis was successful abstinence for 30 days prior to the follow-up contact (30-day point prevalence). This is a standard criterion for assessing cessation in studies of telephone counseling [16], which allows for the possibility of slips or brief relapses during the months preceding the follow-up interview.

As fewer than half of the participants provided follow-up data, 13-month quit rates were calculated both as the proportion among followed participants and as the proportion among all enrolled participants—assuming that those who did not provide follow-up data did not quit smoking (intent-to-treat analysis). In the tests of hypotheses about variation between sites and in exploratory and post hoc analyses, chi-square statistics were used to calculate the significance of observed differences in the 13-month quit rates. These involved 2 × 6 (quitting status by randomized group), 2 × 4 (quitting status by grouped number of visits), and 2 × 2 (quitting status by pooled or selected groups) chi-square tabulations in the different significance tests that were performed.

This research was approved (HSC-SPH-04-038) by the University of Texas Health Science Center at Houston Committee for Protection of Human Subjects. The trial was not registered, because enrollment started before trial registration became mandatory.

Results

From October 2004 to May 2005, there were over 7 million visitors to the main page of the ACS website and 241,223 visitors to the part of the site concerned with smoking cessation, where the project invitation appeared. There were 44,616 visitors to the project entry page, but only 6451 of these visitors met eligibility requirements and completed consent procedures and the baseline survey. All of these smokers were randomly assigned to one of the six experimental groups. Participants were mostly women (70%), with a mean age of 41 years, a mean smoking rate of 21 cigarettes per day, and an average of 6.3 previous quit attempts. These features are similar to those of smokers who register to use the ACS telephone service to assist smoking cessation [1]. However, Internet study participants were more educated (75% vs 59% receiving some college education), more likely to be Caucasian (87% vs 74%), and less likely to report an indicator of depression when compared to smokers participating in our previous studies of telephone counseling (30% vs 40% or more in different studies). Multiple daily Internet use was reported by 66% of participants, and 21% reported using the Internet once a day. As Table 2 illustrates, there were no important baseline differences between the six experimental groups.

Table 2. Participant baseline characteristics by group [a,b]

Characteristic	Control Site (n = 1047)	Site 1 (n = 1052)	Site 2 (n = 1103)	Site 3 (n = 1042)	Site 4 (n = 1101)	Site 5 (n = 1106)
Gender						
Women	728 (70)	754 (72)	791 (72)	753 (72)	796 (72)	764 (69)
Men	319 (30)	298 (28)	312 (28)	289 (28)	305 (28)	342 (31)
Ethnicity						
White	920 (88)	926 (88)	972 (88)	902 (87)	954 (87)	968 (88)
Education						
Elementary school	5 (0)	5 (0)	2 (0)	4 (0)	5 (0)	6 (1)
Some high school	28 (3)	21 (2)	34 (3)	34 (3)	34 (3)	38 (3)
High school graduate	186 (18)	205 (19)	214 (19)	218 (21)	244 (22)	223 (20)
Some college	545 (52)	504 (48)	531 (48)	484 (46)	501 (46)	534 (48)
College graduate	277 (26)	312 (30)	316 (29)	301 (29)	306 (28)	298 (27)
Refused to answer	6 (1)	5 (0)	6 (1)	1 (0)	11 (1)	7 (1)
Living Situation						
Alone	187 (18)	193 (18)	209 (19)	186 (18)	193 (18)	194 (18)
With a nonsmoker	447 (43)	437 (42)	438 (40)	458 (44)	495 (45)	490 (44)
With a smoker	413 (39)	422 (40)	455 (41)	368 (38)	413 (38)	422 (38)
Current Mood						
Sad or blue	313 (30)	314 (30)	354 (32)	296 (28)	351 (32)	333 (30)
Internet Use						
Less than once a week	11 (1)	11 (1)	12 (1)	13 (1)	12 (1)	14 (1)
Once a week	16 (2)	24 (2)	20 (2)	20 (2)	15 (1)	19 (2)
Twice a week	36 (3)	26 (2)	36 (3)	37 (4)	32 (3)	26 (2)
Every other day	80 (8)	83 (8)	81 (7)	62 (6)	77 (7)	77 (7)
Once a day	225 (21)	218 (21)	217 (20)	208 (20)	238 (22)	247 (22)
Several times a day	679 (65)	690 (66)	737 (67)	702 (67)	727 (66)	723 (65)
Self-efficacy, mean (SD)	70.4 (23.4)	71.6 (23.0)	71.9 (22.8)	71.3 (22.6)	70.8 (23.8)	71.3 (24.1)
Age (years), mean (SD)	40.8 (11.1)	40.6 (11.3)	40.5 (11.4)	40.6 (10.9)	40.7 (11.3)	40.5 (11.3)
Daily Cigarette Use						
Weekday, mean (SD)	20.2 (12.3)	19.4 (11.2)	19.2 (10.6)	19.1 (10.4)	19.9 (12.0)	19.3 (11.3)
Weekend, mean (SD)	22.6 (11.3)	21.9 (11.0)	22.0 (11.0)	21.9 (11.2)	22.0 (11.5)	21.5 (11.1)
Previous quit attempts, mean (SD)	5.3 (5.7)	5.3 (6.8)	5.3 (6.6)	5.4 (6.7)	5.5 (6.5)	5.2 (5.4)
Number of years smoking, mean (SD)	22.0 (11.4)	21.7 (11.3)	21.7 (11.4)	21.6 (11.2)	21.9 (11.3)	21.8 (11.4)

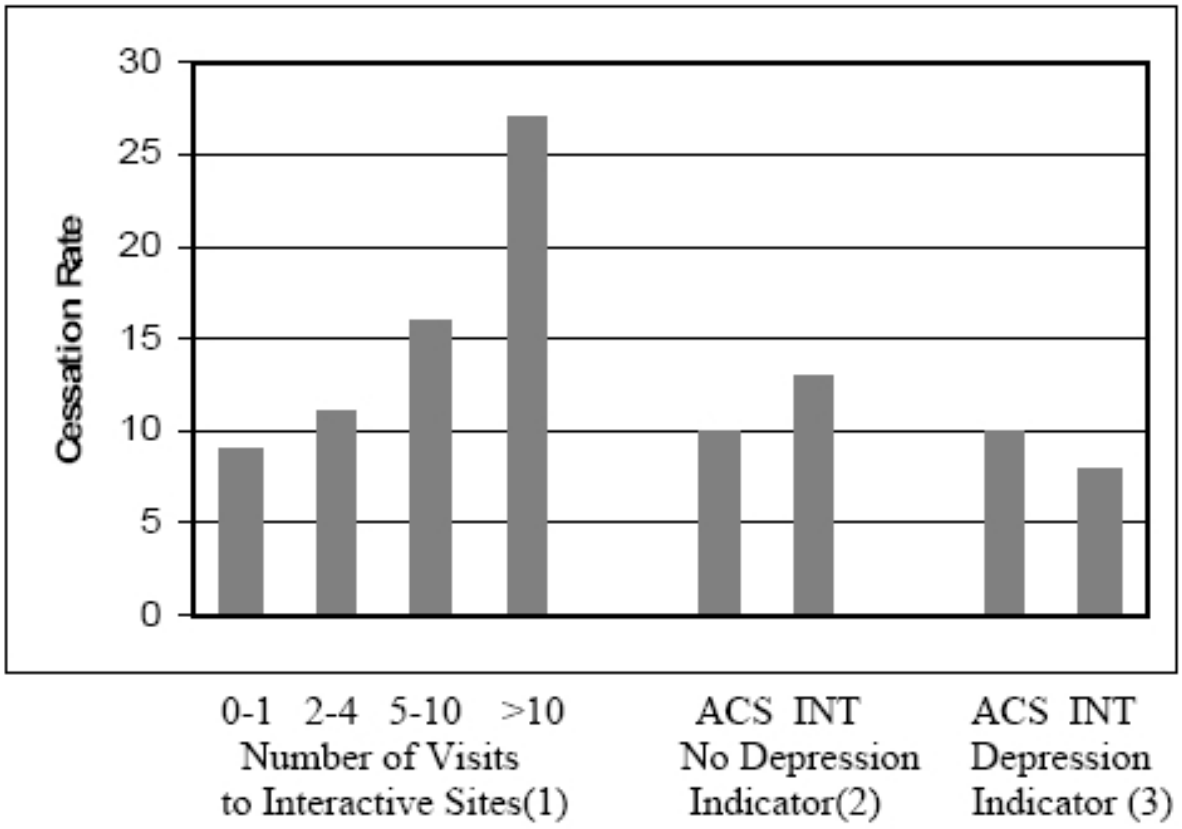
[a] Values are expressed as No. (%) unless otherwise indicated.

[b] The order of the sites does not correspond to Table 1.

Of the 6451 clients enrolled in the study, only 2468 (38%) provided information on their smoking status 13 months after randomization. The follow-up rates did not differ significantly between the six experimental groups. Quit rates, whether calculated as a proportion of those followed or of those enrolled, also did not differ significantly between the groups, failing to confirm our first hypothesis about variation in effectiveness. The second main hypothesis was also not confirmed, as there was no overall difference in 13-month quit rates between the entire group of smokers assigned to any of the five interactive sites and those assigned to the static ACS site. Approximately 10% of enrolled participants reported sustained cessation at that time point among those assigned to the static site, with rates ranging from approximately 8% to 12% among those assigned to the five different interactive sites. Calculated less conservatively as a proportion of those who were followed, the 13-month cessation rates ranged from approximately 20% to 30% among those in the five interactive groups.

Exploratory analyses, which arbitrarily grouped participants according to their level of exposure to the interactive sites, found a very strong observed relationship between quit rates after 13 months (as a proportion of all enrolled participants) and the number of times participants visited the site (see Figure 1). Most participants did not make more than two visits, and only 810 visited five times or more. However, the 13-month quit rate among those visiting five times or more was two times higher than among those with fewer than five visits (20.0 vs 9.8, $P <$ .001). Short-term results published previously from this research also showed a significant difference in 4-month quit rates among the tailored, interactive sites when sites were similarly grouped by level of utilization [9]. That finding was replicated in exploratory analyses of these 13-month follow-up data, with higher quit rates associated with the two most highly utilized sites than with the three less frequently utilized sites (intent-to-treat, 12.5 vs 10.6, $P = .03$; respondent only, 32.1 vs 27.9, $P = .04$).

Figure 1. 13-month quit rates by number of visits, indicator of depression, and type of site, either interactive (INT) or static ACS site (cessation rate is 30-day point prevalence assessed 13 months after enrollment; intent-to-treat analysis assumes dropouts did not quit



ACS: American Cancer Society static site; INT: Interactive sites
Cessation Rate: 30-day point-prevalence assessed 13 months after enrollment, intent to treat analysis.
(1) Chi square = 101, df = 3, $P < .001$, N = 3,049, 1,545, 503, 307
(2) Chi square = 4.1, df = 1, $P = .04$, N = 4,490
(3) Chi square = 1.6, df = 1, $P = .21$, N = 1,961

A total of 1961 study participants (30%) reported at baseline feeling “sad or blue” every day for the last 2 weeks, which provided an indication of self-reported depression. Post hoc analyses found that this group had significantly lower quit rates (intent-to-treat, 8.4 vs 12.3, $P < .001$; respondent only, 24.6 vs 30.8, $P = .003$). Groups were analyzed separately, based on the response to the depression indicator, to examine differential Internet assistance effects in those two groups. These post hoc chi-square analyses found that participants who did not report the depression indicator and were referred to the more interactive sites reported higher 13-month quit rates than those referred to the less interactive ACS site. As shown in Figure 1, the respective quit rates were 13% and 10% ($P = .04$) among 4490 enrolled participants not reporting the indicator of depression in an “intent-to-treat” estimation of experimental effects. Interestingly, further post hoc analyses found that participants with the depression indicator had significantly lower 13-month quit rates than those without it if they were assigned to

interactive sites (8% vs 13% among all enrolled 5404 participants, $P < .001$), but not if they were referred to the static ACS site (10% for those with or without the depression indicator among 1047 enrolled participants, $P = .94$).

Discussion

This study was exploratory and was not designed to rigorously test specific components of Internet assistance for quitting smoking but rather to describe and compare the long-term effectiveness of currently available programs. It provides self-reported data on cessation status without verification. While the follow-up response rate was only 38%, previous studies with monetary incentives for Internet research participants yielded responses from only about half of the study participants [4]. As Eysenbach [17,18] has noted, research on this topic is inevitably flawed by attrition. The intent-to-treat standard for assessing quit rates as a proportion of enrolled rather than followed participants may bias research on Internet-based cessation services toward the null hypothesis of no treatment effect. Enrollment in an Internet service should be deliberately designed to make it easy for the user, but the impersonal nature of Internet enrollment also makes it possible for people to enroll without making any real commitments to what they have signed up to do. This feature probably also explains the generally observed difficulty with continuation rates in Internet assistance (eg, [5]) and the low continuation rates observed here.

Although no significant differences were observed between the quit rates of different tailored, interactive sites in this 13-month follow-up, it is possible that differences were not detected because sample sizes in this study did not provide the statistical power for tests of differences of less than approximately 3% to 6% among the enrolled and followed groups, respectively. Among participants without an indicator of depression, the significantly different 13-month quit rates in the tailored, interactive sites and the targeted, relatively static site (13% vs 10% of enrolled and 32% vs 36% of followed participants) compare favorably with the long-term quit rates typically reported by telephone counseling interventions [1,19,20].

No similarly long-term study of Internet quitting assistance has been previously reported, and, despite the unavoidable limitations of unvalidated self-reports of cessation and a high rate of loss to follow-up, this exploratory study allows some cautious conclusions. It shows that Internet assistance is attractive and cost-effective. In a relatively short time, more than 6000 users enrolled through the link posted on the regularly publicized ACS website. Service was provided with no costs other than those associated with establishment of the website linkages and the targeted, relatively static site posting. Approximately 4 days of programming at a cost of less than US $2000 allowed approximately 5000 additional users for scalable services from the five tailored, interactive service providers. This contrasts with the much larger cost of serving 1000 new clients with telephone counseling (approximately US $100,000).

Based on previous studies of telephone counseling showing lower cessation effects among clients with an indicator of depression than among those without [14,15], it is not surprising to find a similar result in post hoc analyses of the data from this study. Studies that do demonstrate long-term intervention effects on cessation among depressed smokers involve much more intensive personal contact in individualized learning sessions (eg, [21]).

It was surprising to find that those who reported the depression indicator and were assigned to the tailored, interactive sites had, although not significantly, lower cessation rates than those assigned to the targeted, relatively static site. One major difference between the tailored, interactive sites and the targeted, relatively static site was the time that the participant must invest in the site. The tailored, interactive sites required the participant to spend time registering and providing the personal details that inform the tailoring, whereas the targeted, relatively static site was accessed without registration. The participant could link to the site and immediately read or download the materials for later reference. The greater effort required to participate in the interactive sites may have acted as a deterrent to quitting among depressed smokers.

Short-term results from the present study [9] found that cessation rates were strongly related to the mean number of visits to the different sites. Those sites with the most visits tended to produce better short-term results. This finding was repeated in the post hoc analyses reported here, which also show a strong relationship between number of visits and long-term quitting success. Future studies should employ randomized experimental designs to rigorously examine the effectiveness of various discrete features of Internet assistance, such as outbound emails, chat rooms, and other ways of engaging users and providing support for the quitting process.

The possible influence of depression on the effectiveness of interactive Internet assistance requires further research with more complex indicators of depression to examine how they relate to specific processes and responses in Internet-assisted smoking cessation. In this study, about one in three participants reported an indicator of depression, which is lower than the one in two rate that we currently find among research participants receiving telephone counseling [15]. However, this rate is still substantial, and we hope in further studies to identify ways to effectively provide everyone who seeks help via the ACS main website with services that can increase their odds of quitting.

The present study suggests that a high volume of use may be expected for Internet sites that offer useful assistance for smoking cessation. However, many persons seeking to quit smoking do not choose the Internet for assistance. The present study suggests that Internet-based cessation assistance may appeal to clients who are much more educated and presumably more comfortable with Internet communication than those who seek telephone-based assistance. Both modalities of service should be provided in comprehensive smoking cessation assistance programs.

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Conflicts of Interest

Vance Rabius, K Joanne Pike, and Dawn Wiatrek are employed by the American Cancer Society. Alfred L McAlister is a paid consultant for the American Cancer Society.

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Abbreviations

ACS: American Cancer Society

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Original Paper

A Digital Smoking Cessation Program Delivered Through Internet and Cell Phone Without Nicotine Replacement (Happy Ending): Randomized Controlled Trial

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Abstract

Background: Happy Ending (HE) is an intense 1-year smoking cessation program delivered via the Internet and cell phone. HE consists of more than 400 contacts by email, Web pages, interactive voice response, and short message service technology. HE includes a craving helpline and a relapse prevention system, providing just-in-time therapy. All the components of the program are fully automated.

Objective: The objectives were to describe the rationale for the design of HE, to assess the 12-month efficacy of HE in a sample of smokers willing to attempt to quit without the use of nicotine replacement therapy, and to explore the potential effect of HE on coping planning and self-efficacy (prior to quitting) and whether coping planning and self-efficacy mediate treatment effect.

Methods: A two-arm randomized controlled trial was used. Subjects were recruited via Internet advertisements and randomly assigned to condition. Inclusion criteria were willingness to quit on a prescribed day without using nicotine replacement and being aged 18 years or older. The intervention group received HE, and the control group received a 44-page self-help booklet. Abstinence was defined as "not even a puff of smoke, for the last seven days" and was assessed by means of Internet surveys or telephone interviews 1, 3, 6, and 12 months postcessation. The main outcome was repeated point abstinence (ie, abstinence at all four time points). Coping planning and self-efficacy were measured at baseline and at the end of the preparation phase (ie, after 2 weeks of treatment, but prior to cessation day).

Results: A total of 290 participants received either the HE intervention (n=144) or the control booklet (n=146). Using intent-to-treat analysis, participants in the intervention group reported clinically and statistically significantly higher repeated point abstinence rates than control participants (20% versus 7%, odds ratio [OR] = 3.43, 95% CI = 1.60-7.34, P = .002). Although no differences were observed at baseline, by the end of the preparation phase, significantly higher levels of coping planning (t_{261} = 3.07, P = .002) and precessation self-efficacy (t_{261} = 2.63, P = .01) were observed in the intervention group compared with the control group. However, neither coping planning nor self-efficacy mediated long-term treatment effect. For point abstinence 1 month after quitting, however, coping planning and self-efficacy showed a partial mediation of the treatment effect.

Conclusions: This 12-month trial documents a long-term treatment effect of a fully automated smoking cessation intervention without the use of nicotine replacement therapy. The study adds to the promise of using digital media in supporting behavior change.

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KEYWORDS

Smoking cessation; behavior change; Internet; cell phone; interactive voice response; short message service

Introduction

Two reviews [1,2] of a total of 29 randomized controlled trials (RCTs) of computer-based interventions for smoking cessation testify to the effectiveness of this form of intervention. However, as evidenced by these reviews, our knowledge on what differentiates successful interventions from unsuccessful interventions remains limited. Insufficient reporting of the interventions may have contributed to the difficulty to identify patterns of predictors for intervention efficacy [2]. Hence, in the following section we first describe the rationale behind the intervention under scrutiny, before formulating the aims and hypotheses of the study. Designing a complex smoking cessation intervention requires a multitude of choices to be made. By pointing to some key principles and assumptions that guided us in designing Happy Ending (HE), we hope to convey some information not only about whether this intervention worked, but also about why it may have worked.

The Theory and Research Behind Happy Ending

The psychological processes that quitters experience are different across various time points and follow a certain chronology [3-15]. Consequently, smoking cessation interventions should follow the same chronology, and the program content should be organized according to the psychological processes that people experience at certain time points. It is difficult to achieve this adjustment with a static and hierarchically organized Web page. One way to solve this in practice is to organize the program content into multiple pieces that are made available to the client sequentially and for a restricted period. In this way, the client progresses through a predetermined sequence of modules (ie, iterations) where the degrees of freedom are restricted. This can be referred to as tunneling [16], and it is the core organizing principle of HE.

HE starts with a 14-day preparation phase. Every morning, the client receives an email containing a hyperlink. By activating the link, the smoker has access to that particular day's website. See Table 1 for details of the number of contact points and their distribution over the program period. The order of the websites was based on a reasoned chronology, modeled according to psychological processes that people experience at certain time points in a process of therapy-supported self-regulation [3-15]. The first days were constructed to establish confidence in the treatment provider and a therapeutic alliance between the provider and receiver of the treatment [17]. Additionally, a major focus was to ensure that the client understood that self-awareness, self-monitoring, active participation, and engagement are crucial ingredients for personal goal attainment [18,19].

The participant is educated about his or her psychological profile and responses, both as a person and as a smoker. Consequently, smokers will be more aware of, and will learn about, such things as their smoking behavior and nicotine dependence, reasons for previous failures to quit, motivational basis for quitting, general and task-specific self-efficacy, problems that people often experience when quitting, and stress and weight regulation. One of the most important predictors of the outcome of self-change processes is self-efficacy, or the extent to which the person is confident that he or she will succeed [20]. Precessation and postcessation self-efficacy have been shown to play important roles in smoking cessation [21]. Consequently, HE is constructed to instill a high but realistic level of self-efficacy in the participants.

A crucial ingredient of the program is to educate the participants about the cognitive, affective, and behavioral reactions that smokers usually experience if a slip occurs (ie, if they smoke some cigarettes during the quit attempt). In HE, participants are told that the administrators expect that most of them will experience one or more slips [8]. Participants are told that it is not critical whether they experience a slip, but rather, how they react emotionally and behaviorally to slips. Hence, we try to prevent the devastating cognitive and emotional consequences ("snowballing") of breaking zero-tolerance rules [19]. By being prepared for these reactions, being able to recognize them when they occur, and having specific skills and support systems to master such setbacks, the probability that the self-regulation process will be successful increases significantly [19].

Furthermore, we have applied principles from cognitive behavioral therapy [22]. A core assumption here is that the client will learn to master his or her own life problems (ie, solve problems and difficult situations) without smoking. To do this successfully, the client must be able to recognize, understand, and change inappropriate patterns of thought that occur in relation to the acute problems that are experienced. HE attempts to instill this capability by giving the participants small practical problems to solve (behavioral tasks) or some issue to consider (cognitive and emotional tasks). Then, on the following day, the participants are asked to write down notes related to the previous day's issue in an interactive diary. The preparation phase also contains elements of behavioral skills training. These consist of (1) techniques related to the acquisition of new skills, such as self-stopping, the use of substitutions, self-monitoring, and foresight [19], and (2) coping planning [23] related to high-risk relapse situations.

In addition to the activities that take place on the websites, the participants stay in touch with HE via short message service (SMS) text messaging and interactive voice response (IVR). The purpose of this is twofold. First, it is important that the participants become used to communicating with HE via the cell phone because it plays a crucial role in the rest of the program. Second, the cell phone is used to support the other activities and processes that are initiated via the websites.

After the preparation phase comes a 30-day active quitting phase, which is initiated with the actual cessation attempt. Here, a number of activities are included to ensure that participants are actively involved in their own attempt to quit. Hence, there are numerous contact points every day between the participant and HE. Participants receive an email in the morning with a link to that day's specific website. However, there are several differences between these websites and the ones in the preparation phase. First, the Web activities focus on the motivational conflict that many smokers will experience during the first smoke-free days. Along with the temptations and impulses to smoke, this motivational conflict implies that the effect of the expected consequences of smoking versus not

smoking tends to change. In short, the positive short-term consequences of smoking (eg, feeling more relaxed, less irritable) tend to be inflated, while the long-term negative consequences of smoking (eg, health problems) seem to be deflated during the first days and weeks of a quit attempt [4,10,19]. To prevent this, the participants receive IVR messages about the short-term positive consequences of their quitting. This information resembles a type of biofeedback (eg, "Today your blood pressure has been reduced to that of a nonsmoker."), and the topic is further elaborated on the website of the day. The IVR messages are received every morning in the active quitting phase when the client logs on to the program by calling HE. The message also informs the client that he or she can read more about this topic on the website of the day. If the quitter does not log on, several reminders will be automatically activated by the program. Another purpose of this log-on procedure is to ensure that the quitter is actively involved, self-aware, and self-monitoring.

The websites in the active quitting phase contain elements and activities collected from social cognitive learning theory [20] and self-regulation theory [9,24]. Particular emphasis is placed on the importance of postcessation self-efficacy [20], identified as a key predictor of the outcome of a smoking cessation attempt [21]. In this regard, two types of self-efficacy expectations are important: the general expectation that one will successfully quit (success expectations), and the expectancy that one can manage difficult situations (temptations) without smoking. A major aim of the program is to strengthen the participants' postcessation self-efficacy by preparing them for tempting situations (ie, cognitions and emotions that they will experience), helping them learn from mastery experiences, and reminding them that they have a number of tools to help overcome the craving. Moreover, the client is encouraged to make concrete implementation intentions and coping plans regarding how to stay smoke-free in the immediate future [23,25]. Finally, every day the quitter continues to follow activities related to the diary: reading, considering, performing, and writing. In this phase, many of the tasks are based on principles from cognitive behavioral therapy and behavioral skills learning (eg, problem-focused mastery and self-stopping) [20,26].

An effective program should take into account the fact that a large proportion of quitters are likely to relapse. Relapses typically follow a pattern of intermittent episodes of smoking more often than they follow an abrupt resumption of smoking [7]. Hence, in most cases, a relapse has been preceded by one or more lapses, and one or more lapses clearly increase the risk of a full-blown relapse [7]. Among those who experience a first lapse, a subsequent lapse or relapse is very likely to occur, often within 1-4 days [3,12]. For intervention purposes, two lessons seem relevant. The first, addressed in almost all smoking cessation interventions, is the prevention of the occurrence of general risk factors. Second, programs that offer just-in-time therapy to remove or prevent escalation of processes that increase the risk of subsequent relapse are likely to be more effective. Moreover, such an intervention should aim at reducing the number of cigarettes smoked during the slip because this variable seems to predict the probability of later abstinence [27]. One way to shorten the period of smoking and reduce the amount smoked would be to have the client who slips prepare an implementation intention [28] regarding how and when to resume the quit attempt (eg, "I will continue my quit attempt from tomorrow morning."). Consequently, an automated IVR-based relapse prevention system is incorporated in HE. It entails the participant being called by HE every night (the logging-off procedure). The quitter is then asked whether he or she has smoked during the day. If the participant has smoked during the day (reported by pressing 2), this will activate a therapy regimen (ie, 1 of 5 different regimens depending on how many slips the quitter has previously reported). The purpose of the regimen is to induce the participant to attribute the slip to situational factors, thereby preventing negative emotions and a full-blown relapse. Furthermore, an important element is to make the quitter accept that if he or she relapses to smoking, it is part of a deliberate decision and not something that the person is more or less powerless to prevent.

The quitter may experience close-call situations in which the ex-smoker is brought to the brink of smoking [12,13], at which the occurrence of smoking or nonsmoking seems to be influenced by the quitter's acute coping responses. To help participants cope with close-call situations, HE contains an IVR-based craving helpline. Participants are instructed to call the helpline every time they are tempted to have a cigarette (making use of the principles of implementation intention and coping planning). Upon calling, they are asked to report how they feel and thus what kind of help they need. By the push of a button, clients choose between (1) emotion regulation, (2) motivation boost, and (3) stress regulation. Next, the client will hear a therapeutic message specifically designed to solve his or her problem (a new message at each call).

Finally, HE offers an 11-month follow-up phase. During this phase, the logging-off procedure continues daily for another 4 weeks, twice a week for another 2 weeks, and then once a week for the remaining follow-up period. Hence, the system will register slips and activate the relapse prevention system for the whole period. Furthermore, the participants have access to the craving helpline during the whole follow-up phase. Finally, the quitter receives a number of encouraging SMS and IVR messages during this phase.

In summary, compared with most other digital smoking cessation programs [1,2,29-32], HE has some unique features. First, it combines four media approaches: email, Web, IVR, and SMS. Second, HE is distinct in relying on tunneling [16] as a broad structuring principle. Finally, HE includes two components of just-in-time therapy (ie, the craving helpline and the relapse prevention system), which are not yet commonly observed in the field [33].

Previous Trials

We previously investigated the same digital multimedia smoking cessation intervention using a similar design in an earlier 12-month RCT [29]. Before that trial, only short-term effects (ie, 3 months after quitting) of digital cessation interventions were documented [30-32]. Thus, the trial represented a significant contribution to the potential of applying digital media in smoking cessation interventions. The study, however, had

two important shortcomings, which are addressed in the current trial.

First, in the previous trial [29], nicotine replacement therapy (NRT) was part of the recruitment inducement. In the final sample, 9 out of 10 subjects, in both experimental conditions, used NRT during their quit attempt. Consequently, it could be that the results only applied to those willing to use NRT, and, hence, there might have been a problem with generalizing the findings to all smokers. Therefore, in the current trial we aimed to recruit subjects who were willing to quit without the adjacent use of NRT.

Second, the previous trial failed to document the mediation effect of the program on relevant psychological variables. Technically, a complete mediation effect was found [29] on self-efficacy at 1 month after smoking cessation, but it was not possible to conclude this from the analysis because of the confounding variable of smoking status. One way to avoid this confounding variable is to investigate effects obtained before cessation, which lead us to the third aim of the current study: to explore the psychological effects caused by the intervention and eventual mediation of treatment effect related to these variables.

Hypotheses

We tested the hypothesis that a digital, fully automated smoking cessation intervention would produce an increased 12-month abstinence rate compared with a control condition of a self-help booklet. Furthermore, we expected the digital intervention to increase precessation levels of coping planning and self-efficacy. Finally, we expected the hypothesized increase in precessation coping planning and self-efficacy to partially mediate the treatment effect.

Methods

Design

This was a two-arm randomized controlled trial. Subjects were randomized to either receive HE (intervention), or a 44-page self-help booklet (control), described in further detail below. The trial was registered and approved by the Regional Ethics Committee, Norway, South-East (project number: 2.2005.353).

Subjects

Subjects were recruited by means of online banner advertisements in Norwegian regional newspapers from February 6 to 10, 2006. Banners were displayed 947,059 times, resulting in 2595 hits, which gave a hit rate of 0.3%. When clicking on a banner, potential subjects were routed to a website containing study information, an informed consent, and a baseline questionnaire. During the informed consent process, participants were informed that they would be arbitrarily split into groups that would receive different tools for smoking cessation. It was specified that the various tools did not include any form of medication and that participation in the study did not require attendance at face-to-face meetings or consultations. However, no information was provided whatsoever about the intervention conditions. Inclusion criteria were 1) willingness to quit on March 6, 2006, 2) at least 18 years old, 3) currently smoking five cigarettes or more on a daily basis, 4) willingness to quit without using NRT, 5) owning a mobile phone, 6) a Norwegian-registered phone number and postal address, and 7) having daily access to the Internet and email.

There were 427 unique registrations, 23 of which did not fulfill the inclusion criteria. Another 82 subjects were excluded because of missing values, and 19 subjects were excluded because they were suspected to know each other, based, for example, on sharing or having the same family name, postal address, email, IP address, or worksite. This was done to reduce the risk of communication across experimental conditions. Finally, seven subjects were excluded randomly because the required number of participants was 296 (according to a power analysis).

Intervention and Control Conditions

The control group received a 44-page self-help booklet issued by the Norwegian Directorate for Health and Social Affairs. The booklet contains general cessation information, a quit calendar, a 10-day quit log, the phone number of the national quitline, and links to relevant and open online tobacco cessation resources. The booklet recommends 10 days of preparation prior to quitting, in which readers are encouraged to map their smoking habits in the quit log. Additionally, for each of the 10 preparation days, the booklet suggests an exercise aimed at raising awareness about personal smoking habits. The 48-day quit calendar is composed of small, encouraging daily messages about improvements in health and well-being after quitting (eg, “Your risk of cardiovasculardisease is reduced.” and “Does food taste better to you now?”).

The treatment group received the digital multimedia intervention HE, described above. See Table 1 for details on the number of contact points and their distribution over the program period. All contacts were automated.

Table 1. Overview of potential contact points between HE and user during the entire intervention period [a]

Component of HE	Week 1-2	Week 3-6	Week 7-8 [b]	Week 9-10	Week 11-15	Week 16-54
Email	· · · · · · · · · · · · · ·					
Web page	· · · · · · · · · · · · · ·					
Text message	· · · · · · · · · · · · · ·	· · · · · · · · · · · · · ·			· · · · · · ·	
Log-on call		· · · · · · · · · · · · · ·				
Log-off call		· · · · · · · · · · · · · ·			· · · · · · ·	

[a] The seven columns within the week correspond to the number of days in a week. Each dot represents one intended contact.

[b] The number of messages per day was gradually reduced from 3 to 1 over the span of these 2 weeks.

Randomization, Allocation, and Data Collection Procedure

Based on computer-generated random digits, 296 subjects were randomly allocated to either the HE intervention or the booklet control condition. Stratified block randomization was applied to ensure equal numbers of both males and females in each group. Randomization was performed by the experimenter. The names and identities of the subjects, however, were concealed to the experimenter during randomization. After randomization, subjects received an email informing them which tool they would be provided with and when and how they would receive it. Subjects in the HE group were told that the intervention would begin on February 20, 2006, but that the designated quit date was March 6, 2006. Subjects in the control group were told about the booklet and were encouraged to read the booklet thoroughly before the designated quit date and to use it actively throughout their quit attempt. Information on the type of treatment provided to the other group was withheld for subjects in both experimental conditions.

Data were collected by means of online questionnaires at baseline, precessation, and at 1, 3, 6, and 12 months after cessation. An email containing a link to the questionnaire was sent to the subjects at each data collection point. Two email reminders were sent to nonresponders. For all postcessation follow-ups, telephone interviews were conducted with subjects who had not responded after the second reminder. The telephone interviews were structured and standardized with no person-to-person counseling or face-to-face contact between experimenters and subjects at any point. Four attempts were made to contact nonresponders by telephone in both conditions at every data collection point.

Variables

Abstinence was defined as having been completely smoke-free for the past 7 days. Subjects with missing values on abstinence data were coded as smokers. Abstinence data were based on self-reports with no biochemical verification and were assessed at 1, 3, 6, and 12 months after cessation. The main outcome in this trial was repeated point abstinence, that is, abstinence on all four postcessation measuring points.

Nicotine dependence was assessed by the Fagerström Test for Nicotine Dependence (FTND) [34] (Cronbach alpha .68). Self-efficacy was measured using two items rated on a 7-point scale and averaged (Cronbach alpha .82). Coping planning was measured using five items rated on a 4-point scale. Coping planning refers to behavioral and cognitive strategies used to connect anticipated barriers with suitable coping responses [23] (Cronbach alpha .86). Program adherence was continuously and automatically registered by a computer during the trial; that is, each and every user-initiated activity on the Web and the IVR service was registered.

The present study intended to evaluate the effect of HE without the adjunct use of NRT. All eligible candidates for the study were informed about this and agreed to attempt quitting without using NRT. However, it is important to note that subjects received information and recommendations regarding NRT in both conditions. For technical reasons, it was not possible to modify this feature from the program or the booklet. Therefore, to be able to control for possible NRT use, the subjects were asked at 3 months whether they had used NRT to quit smoking.

Data Analysis

An alpha level of .05 was chosen for all statistical tests and all tests were two-tailed. To check for differences between experimental conditions at baseline, *t* tests were used for scales and chi-square tests were performed for categorical data. Furthermore, all chi-square tests based on 2 x 2 contingency tables were applied the Yates continuity correction. Outcomes were examined using the intent-to-treat principle (ie, missing was counted as smoker).

For repeated point abstinence at 12 months and for point abstinence at 1, 3, 6, and 12 months after cessation, the odds ratio (OR) with the 95% confidence interval (CI) and a chi-square test for experimental condition were carried out, respectively. Hierarchical logistic regression was applied [35] to test whether coping planning and self-efficacy mediated the effect from the experimental condition on abstinence. These analyses were based on a complete case approach.

Results

Program Use, Attrition, and Subject Characteristics

The flow of participants is depicted in Figure 1. Six of the 296 subjects were excluded after randomization because it was discovered that they did not fulfill the inclusion criteria: two were signed up by another person and hence did not intend to quit, and four reported already having quit smoking at the point of randomization. These subjects are referred to erroneous

allocations in Figure 1. Consequently, the final number of participants was 290. Cumulative loss (loss to follow-up on at least one of the previous follow-ups) is shown in curly brackets.

Also note that participants who discontinued the intervention were approached for data collection.

At baseline, there were no variables on which treatment and control subjects differed significantly (Table 2).

Figure 1. Flowchart of participants

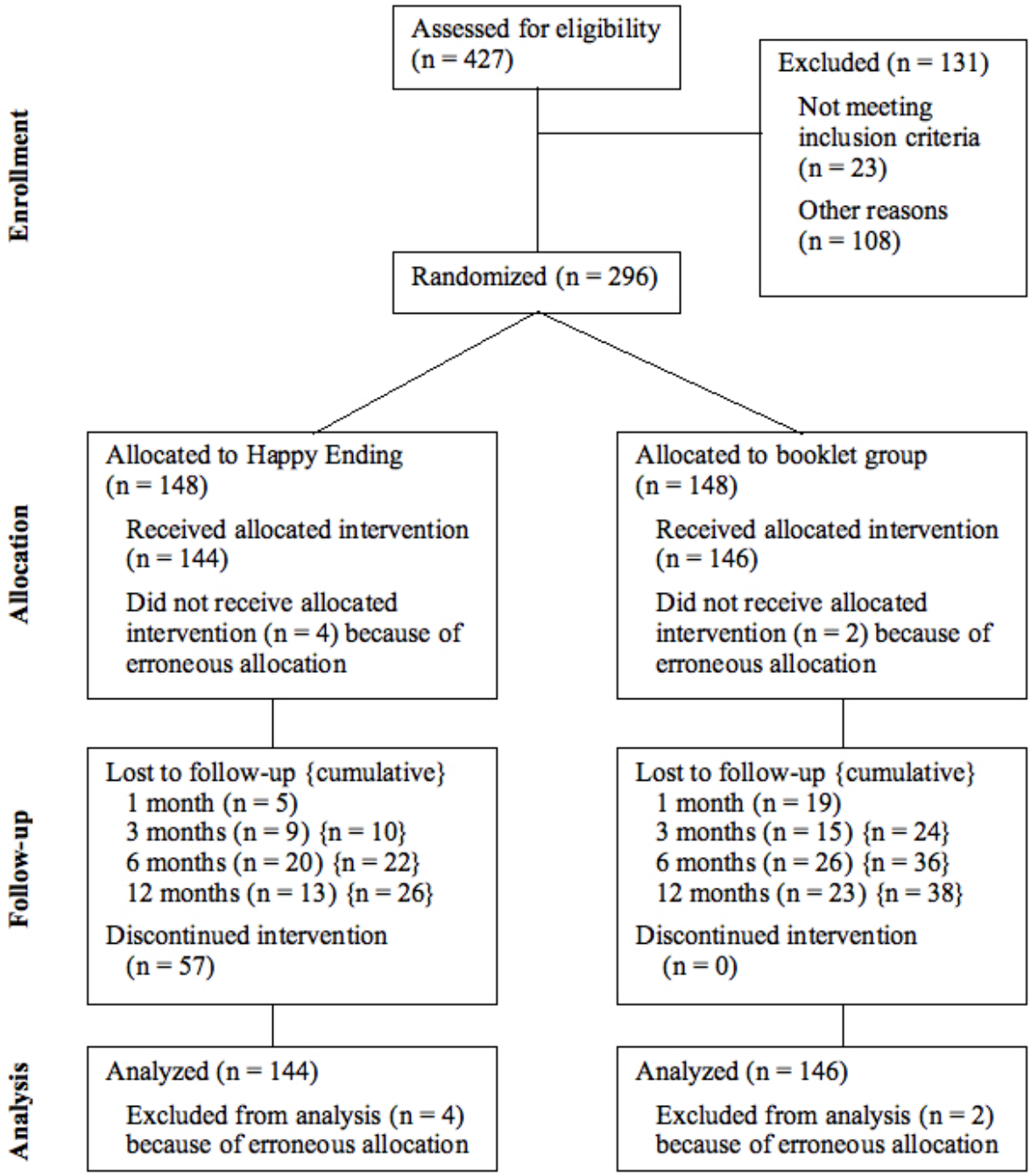

Table 2. Baseline sample characteristics[a]

Characteristic	HE (n = 144)	Control (n = 146)
Female, No. (%)	72 (50)	73 (50)
Has a college degree, No. (%)	70 (49)	76 (52)
Age (years)	39.5 ± 11.0	39.7 ± 10.8
Nicotine Dependence (FTND)	4.5 ± 2.3	4.6 ± 2.2
Cigarettes smoked per day	16.6 ± 7.2	17.6 ± 7.0
Precessation self-efficacy	5.1 ± 1.4	5.1 ± 1.3
Precessation coping planning	2.3 ± 0.6	2.4 ± 0.7

[a] Numbers are mean ± SD except where noted.

Computerized logging routines revealed that subjects in the treatment condition, to a large extent, accomplished the actions intended in the program design (ie, in 5-6 out of 10 cases). See Table 3 for details of program adherence, and Table 1 for details of contact points. Few clients, however, used the craving helpline: 80 (56%) never called the helpline, 45 (31%) called once or twice, and 19 (13%) called three times or more.

Table 3. Mean number of active client actions for three components of HE (n = 144)[a]

Active Client Action	Range	Mean	SD	%
Log-on call	0-42	26	16	62
Opening Web page	0-44	26	13	59
Responding to log-off call	0-102	53	37	52

[a] The log-off call was initiated by the program. Here, responding means answering either “yes” or “no” to the abstinence question. Theoretical range and observed ranges coincide with one exception: theoretical maximum for log-off calls is 104. The right-hand column shows the average percentage of actions completed.

In total, 57 subjects discontinued the intervention, of which 36 did so during the first 6 weeks. The reason for dropout was not recorded. These subjects were approached by Web and telephone interviews in exactly the same way as were program participants and subjects in the control group. At 1 month, 17 subjects (12%) reported that they found HE “not at all helpful,” 74 subjects (51%) found HE to be “helpful,” and 46 subjects (32%) reported HE to be “very helpful”; data were missing for 7 subjects (5%).

As shown in Table 4, the response rates observed in this study were generally high across both the experimental condition and across time. The response rate to the Web survey fell more sharply than total response rate over time. Nonresponders to Web surveys were approached by telephone. Correspondingly, the proportion of responses gathered by means of telephone interviews increased, suggesting the importance of combining Web surveys with telephone interviews, particularly for long-term follow-up. At 1 month after cessation, significantly more subjects in the treatment condition than the control condition responded to surveys ($\chi^2_1 = 7.5$, $P = .006$). Hence, selective attrition is a problem regarding point abstinence at 1 month. Between-group differences regarding total response rate at preparation, 3, 6, and 12 months, however, were not significant. The cumulative dropout rate at 12 months (ie, loss to follow-up at 1, 3, 6, and 12 months) did not significantly differ between treatment and control conditions. Hence, selective attrition was not a problem for interpretation of 12-month repeated point abstinence.

Table 4. Number of Web, phone, and total responses across conditions at specified time points; HE (n = 144) and control (n = 146)

Time	------ Web ------		----- Phone -----		----- Total -----	
	HE	Control	HE	Control	HE	Control
Preparation	132	131	–	–	132	131
1 month	128	119	11	8	139	127
3 months	119	110	16	21	135	131
6 months	101	97	23	23	124	120
12 months	101	89	30	34	131	123

Abstinence

The main finding from this trial was that participants in the intervention condition (n = 29, 20%) reported clinically and statistically significantly higher repeated point abstinence rates than control participants (n = 10, 7%) (OR = 3.43, 95% CI = 1.60-7.34, n = 290, P = .002). Hence, HE was efficacious in helping smokers to achieve long-term abstinence. HE was equally effective across sample subgroups, as defined by sex, age, and nicotine dependence; no interaction effect between experimental condition and any baseline characteristic was found.

Despite agreeing to quit without using NRT, 34 subjects (24%) in the treatment condition and 14 subjects (10%) in the control condition reported NRT use. The proportion of NRT users was significantly higher in the treatment condition compared with the control condition (χ^2_1 = 9.3, P = .002). When adding NRT use along with experimental condition in a logistic regression model, the OR decreased to 2.86 (95% CI = 1.31-6.24, n= 290, P = .008). In summary, our hypothesis that HE would produce an increased abstinence rate, compared with a control group receiving a self-help booklet, was supported, even when controlling for NRT use.

Table 5 shows the point abstinence and repeated point abstinence rate for each of the four follow-ups. Abstinence rates were significantly higher for the treatment condition than the control condition at 1, 3, and 6 months. At 12 months, however, the difference only reached a marginal significance level. Moreover, there is reason to believe that the effect size reported for 1-month abstinence is inflated because of selective attrition. Note from Table 5 that the proportion of abstainers gradually decreases from 1-6 months, but in fact increases from 6-12 months, particularly in the control condition. Hence, the lack of significant difference between groups at the 12-month point was, for the most part, due to subjects in the control condition performing a second quit attempt and not so much that subjects in the treatment condition relapsed to smoking.

Table 5. Point abstinence and repeated point abstinence rates across conditions at specified time points

Time After Cessation	HE (n = 144), No. (%)	Control (n = 146), No. (%)	OR	95% CI	P
Point Abstinence [a]					
1 month	60 (42)	25 (17)	3.46	2.01-5.95	.001
3 months	51 (35)	23 (16)	2.93	1.67-5.14	.001
6 months	42 (29)	20 (14)	2.59	1.43-4.69	.002
12 months	47 (33)	33 (23)	1.66	0.99-2.79	.07
Repeated Point Abstinence					
1 + 3 months	43 (30)	17 (12)	3.23	1.74-6.00	.001
1 + 3 + 6 months	34 (24)	10 (7)	4.24	1.99-8.89	.001
1 + 3 + 6 + 12 months	29 (20)	10 (7)	3.43	1.60-7.34	.002

[a] Point abstinence was based on 7-day point prevalence and intent-to-treat.

Precessation Coping Planning and Self-Efficacy

Pearson r between baseline and precessation coping planning was .32 (P < .001). The level of precessation coping planning was significantly higher in the treatment condition (mean = 3.0, SD = 0.5) than the control condition (mean = 2.8, SD = 0.5; t_{261} = 3.1, P = .002), as hypothesized.

Pearson r between baseline and precessation self-efficacy was .54 (P < .001). The level of precessation self-efficacy was significantly higher in the treatment condition (mean = 5.5, SD = 1.2) than the control condition (mean = 5.1, SD = 1.3; t_{261} = 3.0, P = .003), as hypothesized.

The between-group difference for both coping planning and self-efficacy was small, at only one-third of a standard deviation. Coping planning and self-efficacy were tested formally [35] as mediators of treatment effect. Experimental condition, baseline coping planning, and baseline self-efficacy were entered in block one; precessation coping planning was entered in block two; and precessation self-efficacy was entered in block three. Point abstinence at 1 month was the dependent variable. Precessation coping planning showed a small but significant mediation effect in block two, and precessation self-efficacy showed a small but significant mediation effect in block three. In block three, precessation coping planning no longer predicted abstinence significantly, meaning that the increase in precessation coping planning could not add more explanatory power over precessation self-efficacy. The correlation between coping planning and self-efficacy was lower at baseline (r = .26, P < .001) compared with precessation (r = .49, P < .001). When the above mediation analysis was repeated with repeated point abstinence at 12 months as the dependent variable, there were no mediation effects whatsoever.

In summary, HE slightly increased the level of both coping planning and self-efficacy during the 2-week preparation phase of the program. The increase in self-efficacy could explain at least some of the initial success in gaining abstinence (ie, at 1 month after cessation).

Ancillary Analysis

A complete case analysis showed the repeated point abstinence rate at 12 months to be 25% (29/118 subjects) in the treatment

group versus 9% (10/108 subjects) in the control group (χ^2_1 = 8.22, OR = 3.19, 95% CI = 1.47-6.92, n = 226, P = .004). Compared with the intent-to-treat analysis, this represents a small increase in abstinence rate for both groups, but a small decrease in effect size.

We also looked into what happened when subjects who did not use the intervention at some minimal level were excluded. Excluding subjects who performed fewer than five actions in each of the three categories of log-on calls, opening Web pages, and answering log-off calls resulted in an abstinence rate in the treatment condition of 26% (n= 111). Inclusion of only those who used the intervention at some minimum level and applying a complete case approach further increased the quit rate to 29% (n = 100).

Discussion

This trial demonstrated the efficacy of the digitally delivered and fully automated HE smoking cessation intervention over a self-help booklet condition—without the combined use of NRT—in producing increased repeated point abstinence at 12 months. The ability of HE to increase precessation self-efficacy could explain some success in gaining early abstinence.

The fact that some quitters used NRT, even though they had promised not to do so, resulted in a somewhat inflated effect size. However, this could not seriously compromise conclusions because the main effect from the experimental condition is still clinically and statistically significant even after controlling for NRT use. Hence, the success of HE can be explained by the psychological support provided by the program. Exactly what mechanisms are at play to cause the treatment effect is not fully clear at this stage. We do know that HE instilled a somewhat higher level of precessation self-efficacy compared with the control condition and that this could explain at least some of the initial success in gaining abstinence.

In a previous trial on the same intervention and with a similar design [29], NRT was part of the recruitment inducement, which potentially could have influenced the representativeness of the sample; that is, the results from that trial may apply only to smokers willing to use NRT. In contrast, the current trial recruited smokers willing to quit without the use of NRT. Although some of the subjects used NRT anyway, the treatment effect on the main outcome was still impressive after controlling for NRT use. Hence, this trial significantly adds to the generalizability of the findings in both trials; findings now apply to both NRT users and nonusers. However, generalizability may still be a concern in both trials because of recruitment by self-selection.

This trial could not biochemically verify self-reported claims of abstinence due to the geographic spread of the sample, cost, and other practical concerns. However, false reporting is considered to be minimal when there is little or no personal contact between treatment provider and subjects [36]. In the current trial, the amount of personal contact between experimenters and subjects was equal in both conditions and was restricted to data collection (ie, telephone follow-up of nonresponders); hence, it not likely that misreporting could compromise conclusions.

In summary, this trial extends the public health significance of digital multimedia interventions for smoking cessation. It shows that psychological support can be effectively mediated through modern distance communication technology and that automated support as a stand-alone intervention is, in fact, sufficient for a significant effect on long-term behavior change.

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Conflicts of Interest

The second author has a financial interest in the intervention under scrutiny, as a shareholder of Happy Ending AS.

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Abbreviations

FTND: Fagerström Test for Nicotine Dependence
HE: Happy Ending
IVR: interactive voice response
NRT: nicotine replacement therapy
RCT: randomized controlled trial
SMS: short message service

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Original Paper

Online Advertising as a Public Health and Recruitment Tool: Comparison of Different Media Campaigns to Increase Demand for Smoking Cessation Interventions

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Abstract

Background: To improve the overall impact (reach × efficacy) of cessation treatments and to reduce the population prevalence of smoking, innovative strategies are needed that increase consumer demand for and use of cessation treatments. Given that 12 million people search for smoking cessation information each year, online advertising may represent a cost-efficient approach to reach and recruit online smokers to treatment. Online ads can be implemented in many forms, and surveys consistently show that consumers are receptive. Few studies have examined the potential of online advertising to recruit smokers to cessation treatments.

Objective: The aims of the study were to (1) demonstrate the feasibility of online advertising as a strategy to increase consumer demand for cessation treatments, (2) illustrate the tools that can be used to track and evaluate the impact of online advertising on treatment utilization, and (3) highlight some of the methodological challenges and future directions for researchers.

Methods: An observational design was used to examine the impact of online advertising compared to traditional recruitment approaches (billboards, television and radio ads, outdoor advertising, direct mail, and physician detailing) on several dependent variables: (1) number of individuals who enrolled in Web- or telephone-based cessation treatment, (2) the demographic, smoking, and treatment utilization characteristics of smokers recruited to treatment, and (3) the cost to enroll smokers. Several creative approaches to online ads (banner ads, paid search) were tested on national and local websites and search engines. The comparison group was comprised of individuals who registered for Web-based cessation treatment in response to traditional advertising during the same time period.

Results: A total of 130,214 individuals responded to advertising during the study period: 23,923 (18.4%) responded to traditional recruitment approaches and 106,291 (81.6%) to online ads. Of those who clicked on an online ad, 9655 (9.1%) registered for cessation treatment: 6.8% (n = 7268) for Web only, 1.1% (n = 1119) for phone only, and 1.2% (n = 1268) for Web and phone. Compared to traditional recruitment approaches, online ads recruited a higher percentage of males, young adults, racial/ethnic minorities, those with a high school education or less, and dependent smokers. Cost-effectiveness analyses compare favorably to traditional recruitment strategies, with costs as low as US $5-$8 per enrolled smoker.

Conclusions: Developing and evaluating new ways to increase consumer demand for evidence-based cessation services is critical to cost-efficiently reduce population smoking prevalence. Results suggest that online advertising is a promising approach

to recruit smokers to Web- and telephone-based cessation interventions. The enrollment rate of 9.1% exceeds most studies of traditional recruitment approaches. The powerful targeting capabilities of online advertising present new opportunities to reach subgroups of smokers who may not respond to other forms of advertising. Online advertising also provides unique evaluation opportunities and challenges to determine rigorously its impact and value.

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KEYWORDS

Internet; advertising; consumer demand; smoking cessation

Introduction

Less than 5% of smokers are able to quit on their own [1,2]. Despite the availability of effective smoking cessation treatments [3], only one in five smokers use proven cessation aids when attempting to quit [4-8]. The population impact (reach × efficacy [9,10]) of cessation treatments could be dramatically increased by increasing the reach and utilization of evidence-based interventions such as telephone- and Web-based programs [3,11,12, 13-16]. Recent expert panels have called for innovative initiatives to increase consumer demand for cessation treatments [17,18]. The National Institutes of Health State-of-the-Science panel on tobacco called for research to "understand the role of different media in increasing consumer demand for and use of effective, individually oriented tobacco cessation treatments for diverse populations" [17].

Historically, consumer demand for cessation treatments has been largely a function of marketing and promotion via traditional media (ie, television, newspaper, radio). Systematic reviews have shown that traditional mass media approaches are effective in increasing treatment utilization [19] and in promoting tobacco cessation when combined with telephone counseling [19,20]. However, there are a number of limitations to traditional media, including costs that can be prohibitive [21]. Mass media approaches tend to yield the lowest participation rates in community-based cessation trials (compared to telephone and other interpersonal methods), reaching only 2.2% of targeted smokers [22]. There is little flexibility with most traditional media formats since it is difficult and costly to switch approaches (eg, changing messages, altering ad content) once funds are spent. From the smoker's perspective, access to cessation services is one-step-removed, requiring the smoker to write down contact information or to remember a call to action.

Evaluation of the performance of traditional media is challenging as well. It is difficult to randomize to conditions, to control for "spillover" of media into control markets, or to determine how many people actually viewed a billboard or listened to a radio advertisement (ie, the "true denominator" [23]). For television advertising, gross rating points (GRPs) provide an estimate of the percentage of the target audience reached by an advertisement. Otherwise, evaluation relies on the number of individuals who make an initial call to a cessation program and on responses to questions such as "How did you hear of our program?" which may be affected by errors in recall when multiple media campaigns are running simultaneously.

Online advertising may represent a cost-efficient strategy to increase consumer demand for smoking cessation treatments. Approximately 70% of US adults use the Internet [24], and use has increased steadily since 2000 across race, education, income, age, and rural/urban categories [25,26]. As of 2007, a majority of African Americans (62%) and Latinos (78%) reported using the Internet, as did 55% of individuals living in households with an annual income less than US $30,000 [27]. Approximately 12 million adults search for information on quitting smoking each year [28]. Online advertising can be implemented in many forms (eg, banner ads, text ads, or "paid search"), and surveys consistently show that consumers are receptive [29-31]. Online ads can provide smokers with immediate access to Web-based cessation treatments. Ads can be strategically placed on websites with known demographic profiles (eg, Univisión.com for a Latino audience) and geo-targeted by Internet Protocol (IP). Millions of individuals search the Internet each year for information on quitting smoking [28], and paid search ads allow a cessation program to have visibility at the top of the search results where searchers are likely to see the ad.

Perhaps most importantly, online advertising provides new tools for research evaluation to track and estimate impact as well as a real-world laboratory to test various ad strategies and to make adjustments in real time based on the results [32]. With online ads, it is possible to track a number of "denominators," including the number of times an ad is viewed, the number of ad clicks, the number of individuals who register for cessation treatment in response to an online ad, and the cost of recruiting smokers to treatment. This real-time evaluation of consumer demand permits continuous quality improvement throughout a marketing initiative so that if an ad is not performing well in terms of recruitment volume or cost-effectiveness, it can literally be replaced within hours.

Online advertising is extremely sophisticated, with billions of dollars spent by marketing agencies each year [33,34]. However, the science of how to develop and test online advertising as a mechanism to boost consumer demand for behavioral health interventions is in its infancy [19]. Several studies in HIV and sexually transmitted disease (STD) prevention research have used online advertisements to recruit participants [35-39], but details about their effectiveness and cost-efficiency is limited. Smoking-related studies have used online advertising to recruit smokers to Web-based cessation programs [40,41] but provide little information about the approaches used. Other cessation studies have incorporated the Internet into recruitment efforts but have not used banner or paid search ads [42-45]. We know of no published studies that have examined the cost-effectiveness of online advertising or compared online

advertising to traditional media approaches in recruiting smokers to cessation programs.

The aims of this study are (1) to demonstrate the feasibility of online advertising as a strategy to increase consumer demand for cessation treatments, (2) to illustrate the tools that can be used to track and evaluate its impact on consumers by means of a comparison between traditional media campaigns and online marketing campaigns, and (3) to highlight some of the methodological challenges and future directions for researchers who wish to advance the science of online advertising. This study represents a preliminary investigation into the use of online advertising to cost-efficiently reach, recruit, and engage smokers in cessation treatments, and it raises a number of important questions regarding methodological issues unique to this type of research.

Methods

Overview of Settings and Advertising Campaigns

The study was conducted between December 1, 2004 and October 31, 2006 as a partnership between Healthways QuitNet LLC, ClearWay Minnesota, and the New Jersey Department of Health. During the study period, online advertising campaigns were run to promote QuitNet's Web-based cessation program [13] and the state-run telephone quitlines in Minnesota and New Jersey. The advertising campaigns were managed by Healthways QuitNet, including negotiation of contracts with online advertising partners.

Procedure

This feasibility study used an observational design consisting of the delivery of advertising campaigns within two conditions: an online condition and a traditional mass media (comparison) condition. In both conditions, the timing of the advertising campaigns, delivered in two states, permitted their impact to be evaluated on several dependent variables: (1) number of individuals who enrolled in a cessation treatment, (2) the demographic, smoking, and treatment utilization characteristics of smokers recruited to treatment, and (3) the cost to enroll a smoker in treatment.

Online Advertising Condition

Within the online condition, several creative approaches and advertising partners were developed.

Creative Approaches

All online ads were banner or paid search (text) ads. There were four categories of creative approaches used in ads during the study period (see Multimedia Appendix for samples):

1. Ads that focused on the importance of getting support during the quitting process (eg, "Don't quit alone, Quit with us," "Remember the buddy system? It works for quitting too");
2. Ads that used humor to capture the attention of Internet users (eg, "Cold turkey is good for sandwiches, not for quitting");
3. Ads that used website-specific concepts (eg, "Quitting has its highs and lows, but favorable conditions are on the way" placed on Weather.com)
4. Paid search (text) ads (eg, "New Jersey QuitNet: Expert support, free resources, & med advice")

Advertising Partners

There were three categories of advertising partners: (1) national websites, (2) local websites, and (3) search engines. Banner ads were placed on national and local websites and were purchased on a per impression basis using a negotiated cost per mille (CPM) rate, the cost of showing the ad to one thousand viewers. National websites included Yahoo!, AOL, Weather.com, 24/7 Real Media, and WebMD. All five sites were selected as advertising partners based on their broad reach. In addition, WebMD was selected to target Web users seeking health information. Local websites in Minnesota were StarTribune.com and PostBulletin.com, and NJ.com was used in New Jersey.

Paid search ads were run on search engines and were purchased on a per click basis. Two types of campaigns were run on each search engine: (1) Geo-targeted campaigns displayed ads to Internet users in a specific geographic region based on their IP address. Generic keywords such as "quit smoking" or "stop smoking" can be used in this type of campaign. (2) Country-wide campaigns displayed ads to Internet users throughout the United States. In order to reach the target populations in Minnesota and New Jersey, ads included keywords such as "NJ Quit Smoking." The search engines used in this study included Google, MSN Adcenter, and Overture (now part of Yahoo! Search). These search engines are known to have a user base with slightly different demographic characteristics [46], which provides additional opportunities for targeting specific segments of smokers. Banner ads were displayed prominently on the side or top of advertising partner websites, and paid search ads were displayed on search engine results pages.

User Experience

All ads included a call to action that instructed the viewer to "click here" to get more information. Clicking on the ad took the user to a landing page where he or she read a brief description of three cessation treatment options: (1) 24/7 online support, (2) telephone counseling, or (3) telephone and online support. If users selected the first option, they were taken immediately to the state-sponsored QuitNet website where they were prompted to register and begin using the website. If the individuals selected the second or third option, they were asked to fill out an online quitline referral form, which provided a quitline counselor with basic contact information; individuals selecting option three were then directed to the state-sponsored QuitNet website to register.

Traditional Media Comparison Condition

At the same time as the online advertising campaigns, a number of traditional media campaigns were also run in Minnesota and New Jersey to promote the QuitNet website. These campaigns included billboards, television and radio ads, outdoor advertising (eg, bus sides, bus shelters), direct mail, and physician detailing. To ensure a consistent look and feel between the traditional

media campaigns and online ads, the same creative approaches were used. In the majority of cases, identical content was used for traditional media and online ads; however, in some cases, the similarity in creative approach focused primarily on the use of the same logo and color scheme. Only the traditional media ads listed the QuitNet URL in the call to action since this information was not necessary in online ads.

Free search engine listings also generate a high volume of traffic to the QuitNet website [47]. As a result of this heterogeneous mix of marketing and promotion efforts, a large number of smokers register to use QuitNet's service each month [47]. As a comparison group, we extracted registration data on all individuals who joined QuitNet during the study period in response to all other forms of advertising (ie, not an online ad).

Measures

Online Ad Tracking Data

When an Internet user clicked on an online ad, a unique event identifier was stored on the Healthways QuitNet server along with information about the specific ad that had been displayed, the website on which it was displayed, and the type of cessation program that the individual chose from the landing page (Web only, phone only, Web plus phone, no action).

Phone and Web Registration Data

The unique identifier was also linked to registration data if the individual registered with QuitNet and/or telephone counseling. The QuitNet registration process asked individuals to select a username and password and to indicate their age, gender, race, education level, smoking rate, time to first cigarette, readiness to quit smoking, and reason for registration. Registration data for telephone counseling included email address, first and last name, telephone number, preferred contact time, and consent to share this information with a quitline counselor.

QuitNet Utilization Data

The following utilization metrics were extracted from the QuitNet database for all registered QuitNet users: number of log-ins, minutes per log-in, number of page views, and interactions with other users and expert counselors. Site usage was tracked by the system through short-term (length of session) and long-term (persistent between sessions) cookies, allowing for identification of users throughout their life cycle whether logged in or not. Utilization data for telephone counseling were gathered by the individual vendors in Minnesota and New Jersey and were not available at the time of this analysis.

Statistical Analyses

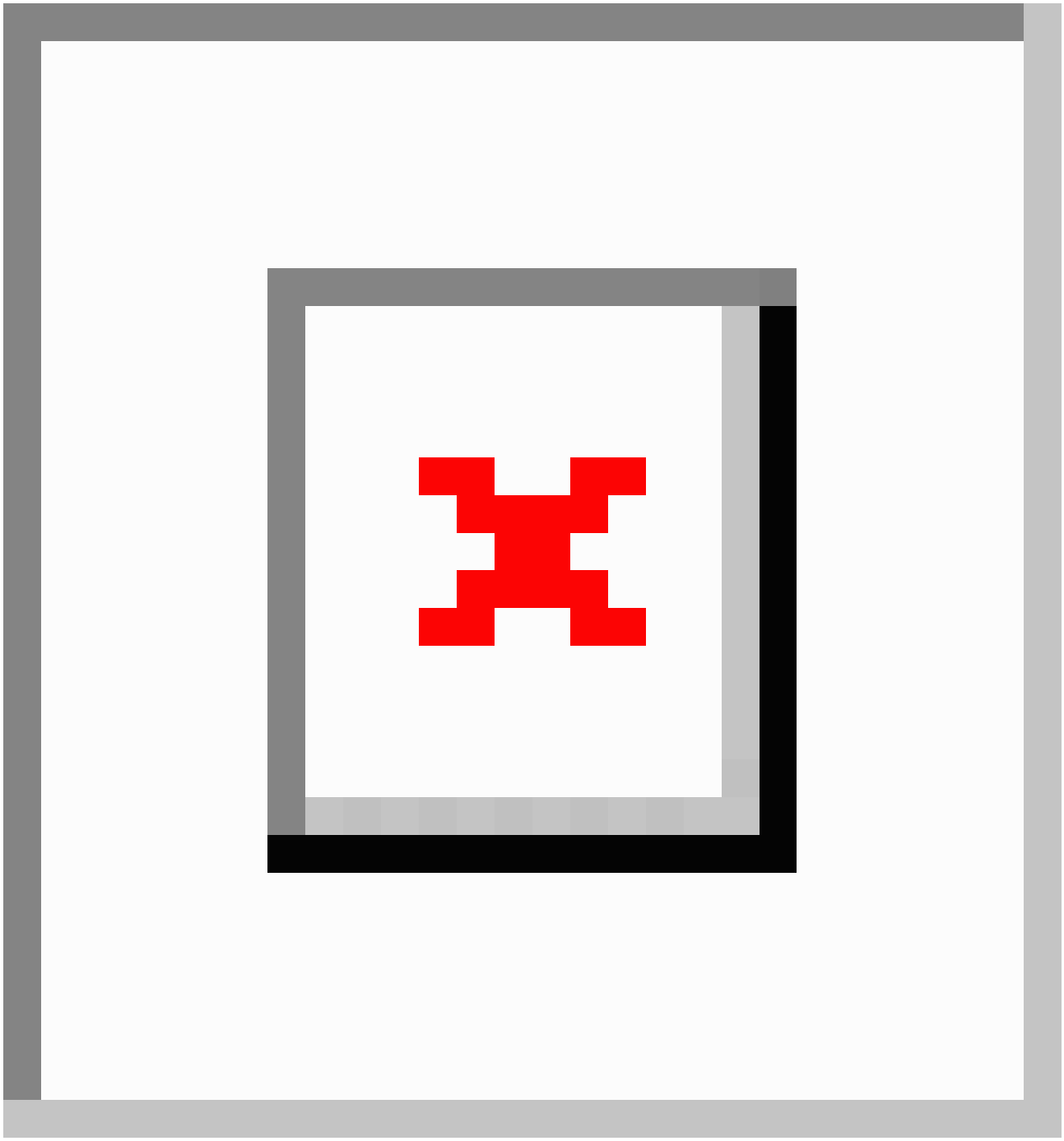
We summarize data regarding response rates, treatment enrollment, and costs using relative frequencies for categorical variables and descriptive statistics for continuous variables. Univariate analyses were conducted to examine differences on demographic and smoking variables between traditional media and online ad responders. Statistical significance levels were calculated using *t* tests to examine mean differences in continuous variables and chi-square or nonparametric tests to examine differences in proportions of categorical variables. For categorical variables with more than two levels, squared Pearson residuals were investigated to examine the source of any statistically significant differences.

Results

Overall Response Rates

As shown in Figure 1, a total of 130,214 unique identifiers were created on the Healthways QuitNet server during the study period: 23,923 (18.4%) were for traditional media responders who registered with QuitNet, and 106,291 (81.6%) were for online ad clicks. Of the online ad clicks, 9655 individuals (9.1%) registered for some form of cessation treatment: 6.8% (n = 7268) selected Web only, 1.1% (n = 1119) selected phone only, and 1.2% (n = 1268) selected both Web and phone.

Figure 1. Response rates for online and offline ads



Characteristics of Users Recruited via Online Ads Versus Traditional Media

We examined differences in demographic and smoking variables between treatment users recruited via online ads and those recruited via traditional media. As shown in Table 1, there were differences for all variables examined. Compared to traditional media, online ads recruited a higher percentage of 18- to 24-year-olds ($P < .001$), men ($P < .001$), non-White individuals ($P < .001$), those with a high school degree or less ($P = .02$), those who had not yet quit smoking (ie, those in precontemplation, contemplation, or preparation phase of motivational readiness, $P < .001$), and those who smoked within 30 minutes of waking ($P < .001$). In addition, online ad responders smoked more ($P = .002$), although the very small mean difference (19.0 cigarettes/day vs 18.7 cigarettes/day) is not likely to be clinically meaningful.

Table 1. Online vs traditional recruitment: demographic and smoking characteristics [a]

	Online Recruitment (n = 8536) [b]	Traditional Recruitment (n = 23,923)	*P*
Age (years)			< .001
18-24	14.1	12.6	
25-44	57.3	59.2	
45-64	27.5	26.8	
65+	1.1	1.4	
Male	41.7	38.3	< .001
Race/Ethnicity			< .001
White	83.9	88.2	
Black / African American	5.5	3.9	
Hispanic	4.3	3.1	
Asian / Pacific Islander	3.5	2.5	
Native American / Aboriginal	0.6	0.7	
Other	2.2	1.6	
Education			.02
High school / GED [c] or less	24.6	23.2	
Some college / junior college	40.9	40.2	
College grad or higher	34.5	36.6	
Motivational readiness			< .001
Never smoker	0.8	1.7	
Precontemplation	1.5	1.0	
Contemplation	40.4	36.5	
Preparation	45.7	42.6	
Action	10.7	16.5	
Maintenance	0.9	1.7	
Cigarettes per day, mean (SD)	19.0 (9.7)	18.7 (9.4)	.002
Time to first cigarette			< .001
Less than 30 minutes	72.1	69.2	
30 minutes or more	27.9	30.8	

[a] Values are percentages unless otherwise noted.

[b] Does not include the 1119 individuals who registered for "phone only" since demographic data are not available on this group.

[c] General equivalency diploma.

Within the online ad condition, we examined differences between those who responded to paid search ads (n = 6163) and those who responded to banner ads (n = 2271). The rationale for these analyses was to explore whether individuals actively searching for cessation assistance via search engines (paid search responders) are different from those who respond to a more "passive" advertising strategy (banner ads). There were significant differences across the demographic categories we examined, with banner ads recruiting a larger percentage of 18- to 24-year-olds (14.9% vs 13.8%, $P < .001$), men (43.7% vs 41.0%, $P = .03$), non-White individuals (20.7% vs 14.6%, $P < .001$), those with a high school education or less (26.3% vs 23.9%, $P = .03$), and those who had not yet quit smoking (92.7% vs 82.7%, $P < .001$). Banner ad responders smoked slightly less than paid search responders (mean = 18.6, SD = 9.9 vs mean = 19.2, SD = 9.6; $P = .01$), although this statistically difference is not likely to be clinically meaningful. There were no differences between paid search responders and banner ad responders on time to first cigarette.

We also compared online and traditional media responders on website utilization metrics to determine if online ad responders engaged with the QuitNet website to the same degree. The metrics examined included the total number of log-ins during the study period, average number of minutes per session, total time spent online, total number of pages viewed, and three

metrics of community participation: the percentage who posted in one of the community forums, the percentage who sent email through QuitNet's internal messaging system (QMail) to at least one other person, and the percentage who received QMail from at least one other person. Consistent with other studies [13,40], patterns of website utilization varied widely; therefore, given the very large skewness of these utilization variables, we report the median and interquartile range in Table 2. There were statistically significant differences on all metrics examined, with higher website utilization among traditional media responders. Although statistically significant due to the enormous power in this study, differences in website utilization are small in magnitude and not likely to be clinically meaningful.

Table 2. Median (interquartile range) of QuitNet utilization among online and traditional media responders [a]

	Online Recruitment (n = 8536)	Traditional Recruitment (n = 23,923)	*P*
Number of log-ins	1 (1-3)	1 (1-4)	< .001
Average session length (minutes)	12 (8-19)	12 (8-20)	.01
Total minutes spent online	20 (10-47)	24 (12-63)	< .001
Total pages viewed	35 (20-76)	40 (22-98)	< .001
Percentage posting at least once in public forums	8.3	11	< .001
Percentage who sent Qmail to at least 1 person	28.1	35.5	< .001
Percentage who received Qmail from at least 1 person	6.4	10	< .001

[a]Between-group differences were analyzed using Wilcoxon W test for continuous data (median) and chi-square (proportions).

Reach to Subgroups of Smokers by Selected Creative Approaches

Next we explored whether certain online ads were more effective in recruiting specific subgroups of smokers than traditional media. As shown in Table 3, we examined the percentage of individuals in specific demographic and smoking subgroups recruited by traditional media approaches and compared it to the percentage recruited by specific types of online ads (ie, quitting with support, humorous, text ads). We focused on subgroups of smokers that are traditionally underrepresented in most cessation programs, including males, younger adults, racial/ethnic minorities, and those with lower levels of education. These analyses examined the impact of creative approach across multiple websites on which ads were placed in order to control for the potential influence of variations in website demographics [46]. For this reason, we excluded the creative approach that used website-specific concepts since ads were only placed on two websites (WebMD and Weather.com).

Compared to traditional media, humorous ads were effective in recruiting a higher percentage of males ($P < .001$), young adults ($P < .001$), non-White individuals ($P < .001$), and those with a high school degree or less ($P = .004$). Humorous ads were also the only creative approach that was effective in recruiting smokers with lower levels of education. Ads that focused on the importance of support during quitting recruited a higher percentage of young adults ($P < .001$) and non-White individuals ($P < .001$) compared to traditional media. Paid search ads recruited a higher percentage of males ($P < .001$), young adults ($P = .004$), and non-White individuals ($P < .001$).

Table 3. Demographic characteristics of individuals recruited to cessation treatment by recruitment approach

Recruitment Approach	Male (%)	Age 18-24 Years (%)	Non-White (%)	High School Degree or less (%)
Traditional media (comparison group)	38.2	12.5	11.8	23.2
Humor (online)	44.1 [a]	15.9 [a]	20.6 [a]	26.8 [b]
Quit with support (online)	39.8	13.4 [a]	21.2 [a]	26.4
Paid search (online text ad)	41.0 [a]	13.8 [b]	14.6 [a]	23.9

[a]$P < .001$ (compared to traditional media).

[b]$P < .01$ (compared to traditional media).

Cost-Effectiveness

To illustrate how the real-time data collection of online ads can be used to rapidly inform impact and improve cost-effectiveness, we present the results of selected online advertising campaigns run in New Jersey during two specific time periods: December 2004 to May 2005 and August 2006 to October 2006. During the entire study period, several ads were tested across multiple websites, each with cost-effectiveness results. The findings presented in Table 4 and Table 5 from these selected campaigns are designed to highlight the types of metrics that can be analyzed and several of the most important lessons learned.

It is important to note that online media campaigns typically evaluate effectiveness by the click-through rate and the average

cost per click. The click-through rate is a ratio of the number of clicks divided by the number of impressions, and the average cost per click is the fee charged by an advertiser divided by the number of clicks on an ad. While both metrics are useful measures of the performance of an individual ad and allow for comparison of ads across websites, they do not reflect the actual costs of getting an individual smoker *enrolled* in a smoking cessation treatment program. Thus, in the tables below, we present the total cost of each campaign, the number of individuals who clicked on ads during the campaign, and the number that enrolled in a cessation treatment program. The conversion rate is a ratio of the number of individuals who registered with a cessation program (Web only, phone only, Web plus phone) divided by the total number of individuals who clicked on the ads. The cost per registrant is calculated by dividing the total amount spent in a campaign by the number of cessation program registrants.

Table 4 shows the results of a series of campaigns that were run between December 2004 and June 2005. The WebMD campaign was stopped after 1 month due to the low conversion rate and extremely high cost per registrant, and funds were allocated to a subsequent campaign with Google (Phase II). Similarly, funds were reallocated from the NJ.com campaign to Google (Phase II) in June 2005 given the low yield of ads on NJ.com.

With a total budget of US $45,000, the online ads run on these six advertising sites during a 6-month period resulted in a total of 1285 individuals who registered with a cessation program. The average conversion rate was 9%, with a range of 2% to 16%. The only advertising partner to yield a conversion rate higher than 10% was Google, with the other partner sites producing much lower conversion rates. The average cost per registrant was US $35, with a range of US $7-$476.

Table 4. Cost-effectiveness in early New Jersey campaigns (December 2004 to June 2005)

Advertiser	Spend (US $)	Number of Ad Clicks	Number Registered for Cessation Treatment	Conversion Rate	Cost per Registrant (US $)
Google Phase I	$5000	4651	762	16%	$7
Yahoo	$10,000	3769	265	7%	$38
AOL	$5000	1390	44	3%	$114
Weather.com	$10,000	1238	92	7%	$109
WebMD (Feb 1-28)	$10,000	476	21	4%	$476
NJ.com (Jan 1-May 31)	$4530	2061	39	2%	$116
Google Phase II (June 1-31)	$470	546	62	11%	$8
Total Media Spend	**$45,000**	**14,131**	**1285**	**9%**	**$35**

Using lessons learned from these campaigns and others, a different series of ads were run in New Jersey between August 2006 and October 2006, as shown in Table 5. During this 3-month period, 751 individuals registered with a cessation program at an average cost of US $38 per registrant. Although the overall conversion rate was slightly lower than in the earlier series of campaigns, three advertising partners produced conversion rates higher than 10%. In addition, the cost per registrant was far lower across advertising partners, with three of the sites averaging less than US $20 per registrant. In addition, ad placement appears to have improved based on the overall number of ad clicks (n = 11,110) during this 3-month time period as compared to 14,131 ad clicks during the previous 6-month campaign.

Table 5. Cost-effectiveness in later New Jersey campaigns (August 2006 to October 2006)

Advertiser	Spend (US $)	Number of Ad Clicks	Number Registered for Cessation Treatment	Conversion Rate	Cost per Registrant (US $)
Overture	$109	115	24	21%	$5
MSN	$112	88	18	20%	$6
Google	$7651	4143	476	11%	$16
Yahoo	$10,011	2008	135	7%	$74
AOL	$4999	2478	71	3%	$70
24/7 Media	$6000	2163	27	1%	$222
Total Media Spend	**$28,882**	**11,110**	**751**	**7%**	**$38**

Discussion

To reduce the population prevalence of smoking, innovative marketing initiatives are needed to increase awareness and utilization of proven cessation treatments. Data from this preliminary study are among the first to demonstrate the feasibility of using online advertising to recruit smokers to Web- and telephone-based cessation programs. Online advertising in

just two states resulted in cessation treatment utilization by over 9600 smokers, almost half the number of registered users during the same time period as all other forms of advertising throughout the United States. If online advertising were implemented on a national basis, it could potentially result in more than 200,000 smokers using Web- or telephone-based cessation treatment.

Since the results of these analyses were based on an observational study within the context of a set of real-world interventions, the assumptions made in interpreting the results and the inability to control for or rule out potential confounders implies that the conclusions are tentative and subject to alternative explanations. They are used to illustrate the feasibility and potential of online advertising, as well as some of the challenges and caveats that researchers will need to consider in terms of design, sampling, methods, and measurement in this new area of research. This paper explores new territory, and, since it was not designed at the outset as a research study, the discussion that follows should be considered as illustrative of the potential for this new informatics and communications technology to strengthen the science of dissemination as well as the dissemination of the science [48].

These results illustrate the ability of online ads to reach specific subgroups of smokers that may not traditionally seek cessation assistance [49,50]. Compared to traditional media, online ads recruited a higher percentage of males, young adults, racial/ethnic minorities, and those with a high school degree or less, with banner ads driving much of the effect. Smoking continues to be more prevalent among these groups [51], making it critical to identify effective methods to increase consumer demand for cessation treatments. The potential of online advertising to reach and recruit smokers from these subgroups is promising. Website utilization data suggest that online ad responders are not merely "casual browsers" who happened to click on an online ad, but rather smokers who engaged with the website to a similar extent as smokers recruited via other channels. It is also interesting to note that online ads attracted a small percentage of "never smokers" despite the fact that messages targeted current smokers. Recently, research has focused on interventions designed for support persons as a way of increasing the reach of cessation treatments to smokers themselves [52]. Online advertising could be used to recruit support persons for these types of interventions.

We also examined the effectiveness of various creative approaches in recruiting specific types of smokers. Humorous ads were the most effective in reaching subgroups of smokers who are less likely to participate in cessation treatment and were the only creative approach that recruited a higher percentage of those with a high school degree or less compared with traditional media. It is interesting to note that ads focused on the importance of getting support did not increase the percentage of men using cessation treatment over traditional media, whereas paid search ads did recruit a higher percentage of men. These data provide just an initial glimpse into the many types of analyses that are possible and also raise important questions that should be addressed in future research where rigorous, controlled research designs could be employed to tease apart specific parametric effects. Specifically, what types of communication messages or creative approaches are most effective for specific subgroups of smokers? Are gain-framed or loss-framed messages more effective in online advertising in recruiting smokers to treatment? To what extent is cultural targeting important, and is targeting at the surface level (ie, matching of materials and messages to characteristics of the target population) or deep level (ie, messages and interventions incorporate information about cultural, social, environmental, psychological, and historical factors that differentially influence health behaviors) more effective?

This study is also the first to present detailed information about the cost-effectiveness of various online advertising strategies. Consistent with a social implementation approach to cost-effectiveness, we excluded costs associated with development and preparation [53]. On average, it cost US $36 to recruit a smoker to Web- or phone-based treatment using online ads. Paid search advertising on search engines tended to be the most cost-effective approach, with a cost of US $5-$8 per registrant. Paid search also yielded the highest absolute number of registrants and the highest conversion rates. These results compare favorably to the few reports of costs associated with traditional recruitment methods, which range from US $19-$500 per enrolled smoker depending on the recruitment channel [54-57]. The ability to closely monitor the performance of ads resulted in pulling funds from two underperforming campaigns (WebMD and NJ.com) and reallocating these funds to a campaign that more than doubled the conversion rate and dramatically reduced the cost per registrant.

This study employed an observational approach to determine preliminary feasibility and cost-effectiveness of online advertising. Future research studies will need to identify the most rigorous and appropriate research designs and statistical methods to be used with this kind of "real-world" data. In particular, the balance between internal and external validity must be carefully considered [58]. Many of the threats to internal validity inherent in this kind of research can be addressed by giving careful consideration to research design and methodological issues, while at the same time strengthening the external validity of the study by, for example, specifying the characteristics and behavior of users at each level of "denominator" in a manner that is simply not possible with traditional media campaigns. Studies of traditional mass media often use interrupted time series designs with a comparison group. Geo-targeting in Internet research may permit the same type of comparison group to be created. Time series regression analysis may be the most appropriate statistical approach for interrupted time series designs [19] as it accounts for underlying time trends and auto-correlation between individual observations. Quasi-experimental Latin Square designs [59] and adaptive clinical designs as discussed by Collins et al [60] may also be ideally suited for this type of research. Future research should also explore the degree to which various online advertising strategies are linked to treatment utilization and/or cessation outcomes.

Results should be considered within the context of several other limitations. First, a percentage of those who completed the quitline referral form may have been unreachable or uninterested in telephone counseling, so the estimates of those recruited to "phone only" may have be inflated. Second, this study relied

on cookies to track website utilization among registered QuitNet members. Individuals who regularly delete cookies from their computer cannot be tracked with the same accuracy as those who do not. Related to this issue, cookies (along with email address) were also used to minimize duplicate enrollment on QuitNet. It is possible that the same individual could be represented more than once as a QuitNet user if they had deleted cookies, registered from a different computer, and/or registered using a different email address. It is also possible that some individuals were represented more than once in the total number of online ad clicks (n = 106,291) as it was not possible to identify unique individuals in this process. Third, a small percentage (< 3%) of those who registered on the QuitNet website indicated that they were seeking assistance for someone else rather than for themselves. For this preliminary study, we elected to include them in the total number of individuals who registered for some type of treatment given the growing literature on the importance of support persons. Future studies may consider analyzing this subgroup separately. Finally, it is possible that online ad responders had seen promotional materials in other (offline) places prior to clicking on a banner ad or paid search ad. This prior exposure may have primed them to click on an online ad. It will be important for future research studies to more clearly understand this "multiple exposure" effect.

In summary, multiple marketing and promotion channels are critical to raise awareness of the importance of cessation, to motivate smokers to consider cessation, and to link smokers to proven cessation treatments [18]. Online advertising is forecast to experience enormous growth over the next 3 to 5 years, encroaching on budgets typically allocated for traditional media [33,34]. This feasibility study illustrates the potential of online advertising to promote the utilization of evidence-based cessation treatment. The tools available to track and evaluate program, process, and outcome metrics require careful consideration of both internal and external validity issues in designing research studies in this new domain. The technology and tools available can both strengthen the science of dissemination and also help improve interventions that will more effectively disseminate the products of evidence-based science. Despite the limitations of this observational study, the results provide useful and informative preliminary support to warrant more investment in the design and conduct of future studies to advance the science of marketing and consumer demand in the Internet age.

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Conflicts of Interest

None declared.

Multimedia Appendix 1

Examples of online ads (focused on support, humor, website-specific concepts, and paid search (text) ads). Note: Some ads are animated, but the animation will not show in the PDF file. For the original gif files download Multimedia Appendix 2.

[PDF file (Adobe PDF), 288 KB - jmir_v10i5e50_app1.pdf]

Multimedia Appendix 2

Examples of online ads, original jpg/gif files (compressed). To view animated gif's, open files with your web browser (eg. Internet Explorer) or similar software.

[ZIP file (compressed), 100 KB - jmir_v10i5e50_app2.zip]

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Original Paper

Patterns of Use of an Automated Interactive Personalized Coaching Program for Smoking Cessation

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Abstract

Background: The QuitCoach, an "expert system" program of tailored advice for smoking cessation developed in Australia, has been publicly available since July 2003, albeit with limited promotion. The program is designed to be used on multiple occasions, guiding the user through the process of smoking cessation in the manner of a "life coach". Email reminders are sent at scheduled intervals to prompt optimal and repeated use.

Objectives: The aims of this study were to characterize QuitCoach users and to determine what characteristics of smokers affect their participation over time. Of particular interest was whether users tend to return following a relapse and, thus, use the program as a tool for relapse prevention or recovery. We also explored patterns of change associated with returns to the site, whether prompted by reminder emails or not prompted at all.

Methods: Between July 2003 and June 2007, 28,247 individuals completed an initial assessment on the QuitCoach, of whom 83.7% (n = 23,656) registered. Data were collected during a 10-minute online questionnaire that all users completed in order to obtain tailored cessation advice. This included questions concerning basic demographic information, quitting history, current smoking status and cigarette consumption, stage of change, and use of pharmacotherapy.

Results: The median age of users was 34 years, and 62% were female. Most (96%) were current smokers. Overall, 91% were planning to quit in the next 30 days, and half (49.9%) had set a quit date. Those who had recently relapsed to smoking following a quit attempt made up 37%. Among registered users, 27% returned for a second visit, a median 9 days after their first. Overall, a third visit was completed by 11% and 2% returned within 2 days. Women, older smokers, those who had recently quit, and those using pharmacotherapy were more likely to return. From the second visit on, most people who completed an assessment had quit. Likelihood of responding to a prompt to return was largely unrelated to user characteristics or cessation outcome.

Conclusions: Internet-based programs have considerable potential to reach large numbers of smokers at low cost. The QuitCoach is attracting considerable use, with most using it to make a quit attempt and, for those who continue to use the QuitCoach, to help them stay quit. Nonetheless, most users only visited the site once, suggesting improved strategies are needed for encouraging repeated use.

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KEYWORDS

Smoking cessation; Internet; behavioral medicine

Introduction

Cigarette smoking is a major public health problem. Worldwide, tobacco use claims an estimated 4.9 million lives annually [1], with this figure expected to increase to 10 million per year by 2030 [2]. Peto et al [2] have noted that helping current smokers to quit is the single most important step to reduce mortality and morbidity associated with cigarette smoking in the short term.

Many smokers find it difficult to quit. While most smokers have tried, only 3 -5% are able to achieve prolonged abstinence for 6 - 12 months after a given unassisted quit attempt [3]. It is clear, however, that good quality structured support and advice increases smoking cessation rates over self-managed attempts, with long-term success rates reaching approximately 15 - 20% independent of any effect attributable to use of pharmacotherapy [4].

Computer-generated advice programs, which can provide personalized smoking cessation advice tailored to the characteristics of individual smokers, are a promising medium for delivering effective smoking cessation assistance to large numbers of smokers [5]. A recent meta-analysis found that tailored advice is more effective than generic (non-tailored) advice, despite considerable variation in the quality of tailored programs that have been tested in trials [6]. Tailored advice programs that have the capacity to monitor progress over time in a timely fashion and provide feedback in response to changes (ie, build an ongoing relationship with the smoker through their quit attempt) are likely to be most effective [7].

In this paper, we explore how QuitCoach [8], a tailored, automated advice program program, is used, and which characteristics of smokers affect usage patterns.

Methods

The QuitCoach

The QuitCoach [8] is the tailored, automated advice program which is the focus of this paper. It was developed at The Cancer Council Victoria, Australia, and is provided by Quit Victoria. The site is currently promoted quite widely on Australian quit smoking websites, including QuitNow [9], the website on all Australian cigarette packs since 2006, and Quit [10], Quit Victoria's smoking cessation site.

The QuitCoach is designed to be used on multiple occasions, guiding the user through the process of smoking cessation in the manner of a "life coach". It is designed to provide tailored advice replicating many of the core features of in-person, multi-session cognitive-behavioral counseling. Following an online assessment (typically 10 - 15 minutes in duration), users receive advice tailored to the answers they provided. The advice is based on an integrated mix of empirically grounded modifications to stage-based and other cognitive-behavioral theories of behavior change [11], focusing on behavioral strategies, cognitive restructuring, and motivation. Particular attention has been paid to relapse prevention, using a model that explicitly takes into account discontinuity in the proximal task associated with quitting over time [12].

The advice is organized around what we call perspectives on change, which are revisions of the stages of change of Prochaska and associates [13]. We call them perspectives because they represent different points of view from which the quitting process is experienced by the people taking themselves through the process [14]. The perspectives and the labels we give them here are specified in Table 1. The critical transitions defining perspective boundaries pre-quitting are: deciding to think actively about quitting or planning to quit; setting an implementation plan (eg, a quit date); and actually quitting. Post-quitting, there are less clear transitions between the first few days, when withdrawal symptoms are likely to be highest, and the subsequent period, separated by the time when the frequency of strong urges to smoke drops below daily without pharmacological assistance. The perspectives were derived both from conceptual analysis of the process of smoking cessation and from empirical evidence of discontinuity in predictive capacity across the boundaries [12]. This distinguishes the perspectives on change from the arbitrarily defined boundaries postulated by Prochaska [15].

Table 1. Perspectives on change and their definition

Perspective	Definition
Not planning	Not planning to quit in the next 30 days.
Planning	Planning to quit in the next 30 days, but not meeting criteria for committed perspective.
Set date	Setting a quit date in the next 2 weeks or cutting down to quit and expects to cut down to zero within 2 weeks.
Just quit	First week of quit attempt, or up to 2 weeks if cravings are described as continual (hourly or more often).
Consolidation	From end of "just quit" till strong urges to smoke occur less than daily, or concurrent use of quit smoking medication.
Established	Less than daily strong urges to smoke and no use of quit smoking medication.

The advice provided is individually tailored in response to answers to questions asked in a set of 5 modules. To receive tailored advice, a user needed only to complete the first "core" module. Following this, users had the option of viewing their tailored advice or continuing on to complete other modules. Following the completion of each module, more detailed advice was appended to the advice document. The core module covered demographics and smoking history (both largely only in the initial assessment), and at each assessment the following were covered: current smoking patterns, recent quitting activity, use of or plans to use cessation help, assessment of perspective on change, and affect. The second module, also asked only in the initial assessment, included questions on the user's social context: household composition, presence of smoking bans at home and at work, proportion of friends who smoke, social support to quit, and medical conditions relevant to quitting. The three additional modules assess perceived values of smoking, reasons for quitting and perceived barriers, self-efficacy, and processes of change for quitting. Tailored advice is provided on all these topics, identifying strengths and areas where extra work is likely needed to progress.

If users have registered on the site, they can use it to update assessments and, thus, the advice provided to them. In

subsequent visits, the questions asked are only those relevant to the person's new situation, and the advice provided takes into account changes the user has made since the previous visit, as well as their situation at the time. The focus of change is generally restricted to the implications of change between perspectives, when such shifts occur. When the person remains within a pre-quit perspective, changes in other variables are used to help diagnose problems that are preventing them from moving forward and to offer possible solutions. Post-quitting, progress in reduction of urges to smoke and beliefs about the need to smoke in various contexts is tracked and, thus, progress to becoming a stable non-smoker. Progress is congratulated and areas of inadequate progress or regress analyzed, and recommendations are provided for increased focus on strategies for overcoming the identified problems.

Registered users are encouraged to return when their situation changes. In addition, they are sent a reminder email to log-in on a follow-up date scheduled by the program, based on an algorithm designed around their perspective on change, with returns encouraged more rapidly for those closest to their quit date. Therefore, there can be considerable variation in the time from an assessment to when an email is sent to encourage a new one. A second, and final, reminder is sent several days after the first, if the user has not logged on in the meantime.

A prototype version of the QuitCoach, in which users were telephoned for each assessment and mailed the tailored advice (fundamentally identical to the website) was demonstrated in a randomized trial to be effective in a sample of smokers seeking help [14]. Using a conservative analysis (in which missing cases at follow-up were treated as smokers), 20% of those who received the program achieved 6-month sustained abstinence at 12-month follow-up, compared with 12% in a control group receiving one-off standard printed self-help materials (OR 1.82, 95% CI 1.31 - 2.55). The effect size was comparable with typical effects of face-to-face cessation counseling [16].

The effectiveness of the program in the RCT is likely to have been enhanced by high levels of optimal participation. With repeat visits prompted by a telephone call, over half of trial participants accepted five or more visits. Ongoing use of the program was related to greater likelihood of success [14]. However, as an Internet resource in which users are prompted to return by email rather than a telephone call, most users only use it once, and only around 10% use it more than twice [17].

Nonetheless, email reminders consisting of a simple message to return to the site for updated advice appear to stimulate return [17]. Returns to the site were generally clustered around the times the emails were sent out. However, as most users failed to return at all, their effectiveness is clearly limited. Graham et al [17] also found that a significant minority of users returned on the same day, or the day after, their first visit.

As compared with smokers in general, QuitCoach users are more likely to be female, aged 25 - 44, and more nicotine dependent. Compared with users of a Quitline, they are also more likely to be female, aged 20 - 49, somewhat less dependent, and less likely to have already started their quit attempt [18].

Participants

The study covers the period from January 2003, when the site first became available to the public, to June 2007, when the site was replaced by a new version. There were 29,524 separate records in the QuitCoach user database (excluding 285 test cases). Over the last 5 months of use (January - May 2007), new users were completing assessments at an average rate of almost 900 per month.

At the beginning of the core assessment, participants were asked to complete the following statement: "I am using the QuitCoach because...". Of the respondents, 83.8% (n = 24,740) indicated they were using the QuitCoach because they wanted advice to help them quit smoking or stay quit; 12.2% (n = 3594) were "just having a look"; and 3.5% (n = 1048) indicated they were a health professional or researcher interested in the way the program worked. A few (n = 142) respondents who gave other reasons for using the website, for example health professionals and a subset of ex-smokers (more than 6 months quit who were "just having a look"), were excluded from further analysis. The final eligible sample was 28,247 users.

Measures

All data were collected during the standard QuitCoach smoking assessment [14].

The information used in this paper comes primarily from the core module at the initial assessment (visit 1) which was completed by all users whose data was retained. The data used included a person's gender and age, perspective on change (Table 1), recent quitting history, reported use of pharmacotherapy (eg, nicotine replacement therapy, bupropion), use of other professional cessation assistance, and dependence as measured using the heaviness of smoking index—alternate version (HSI-AV) [19], calculated as the square root of daily cigarette consumption minus the natural logarithm of time to first cigarette of the day. At each subsequent visit, we used data on current perspective on change and recent quitting history. In addition, data was collected on registration status, number of modules completed at each visit, time between visits, and number of visits.

Three kinds of basic usage were defined: to make a quit attempt (all smokers using who had not relapsed in the last week); to recover from relapse (smokers relapsing in the last week); and to sustain a quit attempt (all using when quit). Returns to the site were coded as follows: before a scheduled prompt to return was sent; from the initial prompt to just before the second prompt; from the second prompt for 1 week; and any later return. The actual duration of these categories varied by perspective on change, with those closest to the point of quitting receiving their first scheduled reminder email earlier than those further from quitting. For those in the "Not planning" and "Established" perspectives, the first reminder was sent 30 days after the initial visit; for those in "Planning" and "Consolidation", the interval was 2 weeks; and for those "Just quit", it was 1 week. For those who had set a quit date, the email was sent 4 days after their quit date.

Statistical Analysis

Descriptive statistics were used to characterize the sample. Differences between groups were determined using the Pearson's chi-square test for categorical variables and the independent sample *t* test for continuous variables. For non-normally distributed variables we report the inter-quartile range (IQR). An alpha level of $P < .01$ was used for all statistical tests, given the large sample size.

Results

User Profile

Users were predominantly female (62%). The median age was 34 years, with 16.6% ≤ 25 years, 37% aged 26 - 35, 33.5% aged 36 - 49, 11.4% aged 50 - 64, and 1.6% aged over 65 years. Users were a median 17 (IQR = 15 - 18) years old when they first started to smoke daily and had been smoking cigarettes for a median 17 (IQR = 9 - 25) years. Current smokers smoked an average of 19 (SD = 9.7) cigarettes per day, with their first cigarette of the day a median 20 (IQR = 10 - 60) minutes after waking, and nearly all (98.5%) smoked daily.

Most users (95.8%) were current smokers at their first visit. Of these, 4.5% were not planning a quit attempt, 41.4% were planning without a set date, and 49.9% had set a quit date or a cut down schedule. The 4.2% of quitters consisted of 1.6% recent quitters (within the last week), 2.0% consolidating (quit more than a week ago but with daily urges to smoke and/or current use of quit smoking medication), and 0.7% established (reporting less than daily urges and no use of medication). Men who visited were slightly more likely than women to visit as smokers before setting a quit date. A similar pattern was seen for the youngest (< 25) and older (> 50) age groups.

Among those smoking at baseline, 12.2% had not previously tried to quit, 11.9% had not quit (for more than 24 hours) in the last 5 years, 26.6% had last tried 1 - 5 years ago, 30.1% 1 month to 1 year ago, 7.5% 1 week to 1 month ago, and 11.7% had tried in the last week (including 2.7% who had relapsed earlier on the day of the initial QuitCoach visit). Of those who had tried to quit in the last 5 years, 16.6% had a longest attempt of less than a week, 20.1% from 1 week to 1 month, 30.5% from 1 month to a year, and 8.6% for a year or more.

Among those quit at baseline, 36.9% had been quit for less than a week, including 7.9% who had quit "today", and 11.6% who had been quit for only 1 or 2 days. A further 36.2% had been quit from 1 week to 1 month.

Overall, 22.6% (n = 6371) of the sample reported currently using pharmacological support, with 83.3% using some form of nicotine replacement (NRT, patch, gum, lozenge, or inhaler) and 15.1% using bupropion. Other professional help was being sought by 3.4% (n = 916) of users. Of these, quit counseling (n = 418) and advice from a doctor/psychiatrist (n = 331) were the most frequently accessed forms of help. A further 4.5% of users (n = 1208) reported that they were getting help from friends, family, or a self-help manual.

Most users (60.9%) completed all five of the question modules on their first visit. Those wanting advice to quit smoking (63.8%) were more likely to complete a full assessment than those "just having a look" (40.9%). Those planning to quit (61.9% of those just planning and 61.5% with a set quit date) were more likely to complete the full assessment than others. For example, only 53.3% of those already quit at baseline did so.

Registration

Overall, 83.8% (n = 23,657) of users registered with the site. Participants who were "just having a look" were less likely to register (59.9%) than those who wanted advice to quit smoking (87.1%). Women were more likely to register ($P < .001$, see Table 2). Registration decreased linearly by age category ($P < .001$). Users in the set date and just quit perspectives (83.1%) were more likely to register than those in other perspectives ($P < .001$).

Of those who completed the entire assessment at baseline, 91.8% registered, compared with 71.2% of those who only partially completed the assessment.

Table 2. Registration and return use of the site

Baseline Characteristics	% Registering	n	Returned once (n = 3747)	Returned more than once (n = 2714)	Total multiple use (n = 6460)
Sex					
Male	81.6	8805	14.3	9.6	23.9
Female	85.1	14837	16.8	12.5	29.3
Age					
25 or under	88.9	4174	14.2	7.5	21.7
26-35	87.5	9142	15.4	10.7	26.1
36-49	80.8	7631	16.3	13.8	30.1
50-64	74.7	2396	18.7	14.0	32.7
65+	67.8	299	19.7	13.4	33.1
Perspective on change					
Not planning	70.3	884	12.0	6.0	18.0
Planning	81.0	9482	14.1	6.9	21.0
Set date	87.5	12329	17.2	14.6	31.8
Just quit	83.1	373	17.4	25.2	42.6
Consolidation	80.3	449	22.9	20.3	43.2
Established	73.3	140	15.0	17.1	32.1
Previous attempt					
None	81.6	5141	13.7	9.5	23.2
Short (< 1 wk)	84.0	3780	14.7	9.0	23.7
Long (≧ 1 wk)	84.8	13769	16.7	12.2	28.1
Recency of last quit					
< 1 week	84.5	2710	14.0	8.9	22.9
Nicotine dependence (HSI-AV score)					
Less than 0	87.7	3329	15.1	9.2	24.3
0 - < 2	85.2	6785	16.2	11.6	27.8
2 - < 4	83.0	8310	15.5	11.4	26.9
More than 4	80.9	4271	15.5	10.9	26.4
Current use of pharmacotherapy					
Yes	86.0	5481	18.8	17.2	36.0
No	83.1	18176	15.0	9.7	24.7
Use of other professional help					
Yes	87.2	799	19.5	19.8	39.3
No	84.3	21878	15.8	11.4	27.2
Total	83.8	23657	15.8	11.5	27.3

Note: All group comparisons were significant at the $P < .001$ level.

Repeated Use of the QuitCoach

Among registered users, 27.3% (n = 6461) returned for a second visit a median 9 (IQR = 6 - 15) days after their first visit. The time interval to first return varied from 0 (same day) to 365 days (NB cases were archived after one year of inactivity). Most of those who returned (73.0%) did so within 2 weeks, and 92.8% did so within a month. Notably, 20.3% of returns occurred before any prompt to return was sent (including 11.6% within 2 days). Most returns (56.9%) were in response to the initial prompt, and 14.2% returned up to one week after the second prompt, leaving 8.6% who returned of their own accord at some later time. The effect of prompting was unrelated to sex or age.

Smokers not planning to quit at the initial assessment were unlikely to respond to either prompt (16.3% of those who returned cf 71.1% overall), being more likely to return for a second visit either before their initial prompt or after prompting had ended. Those with a set date were least likely to return early, but note they had less time to do so.

The rate of return increased over time, with 31.1% of users post-June 2006 returning, compared with the 25.7% for pre-June 2006 users ($P < .001$). Three-quarters (74.1%) of those who returned for a second visit completed the full assessment at baseline, compared with only 64% of those who did not return.

Characteristics associated with repeat use are provided in Table 2. Women were more likely to return than men ($P < .001$), and returns increased linearly by age category ($P < .001$). In addition, those using pharmacotherapy (36.0%) were more likely to return, as were those seeking other professional help (39.3%). Return varied by baseline perspective ($P < .001$). It was highest among those who had just quit and in the consolidation perspective on change (42.6% and 43.2%, respectively) and lowest in those not planning an attempt. Among those with a quit date, likelihood of return was related to a recent relapse. Those who had recently relapsed to smoking (in the last week) were less likely to return (24.9%) than those without a recent failed attempt ($P < .001$).

Progress While Using

Of the 6461 cases that returned for a second visit, 58.9% (n = 3808) were quit at their second visit, including 56.9% of the 6063 users who were smoking at the initial visit. A further 19.3% had made a quit attempt and subsequently relapsed, meaning that over three-quarters (76.2%) of smokers who returned for a second visit had made a quit attempt. Among those originally in the set date perspective (n = 3915), 90.9% at least made a quit attempt (72.9% quit, 18.0% relapsed). Those in the set date perspective who had recently relapsed (in the last week) at the initial visit were less likely to be quit at the second visit than those who had not (64.9% vs 73.8%, $\chi^2_1 = 14.49$, $P < .001$).

Those who were smoking at baseline and quit at second visit were quit a median 7 days (IQR = 6 - 14). Only 5.9% reported returning on the same day or the day after beginning their quit attempt.

Most participants who were quit at baseline were still quit at their second visit (89.4%, n = 356), including 5% who had relapsed and then started a new quit attempt before returning.

Over a quarter (29.9%) of users who returned were using pharmacotherapy at their first visit, and of these 91.7% made a quit attempt by visit 2 compared with 70.1% of those not using medication. Of those who made a quit attempt, 81.4% of those using medication were quit at visit 2, compared with 70.5% of those not using medication. Uptake of medication from visit 1 to visit 2, which occurred for 20.9% of those not using, was associated with a quit attempt; 90.3% made a quit attempt compared with 64.7% who did not use medication at all. Of those making an attempt, 76.9% of those who took up medication were still quit at visit 2, compared to 68.2% of those not using medication.

Early returners (prior to the first email reminder) were less likely to have progressed in their quit attempts (43.4% had not made an attempt) compared with those responding to the prompts (17.3% for the initial prompt and 14.6% for the second one). However, those returning after prompting ended were also less likely to have made an attempt (32.4%). This latter group would appear to be users who had given up on their initial attempt and who had returned subsequently, presumably when they were more ready to try again.

We also explored whether those who returned very rapidly (within 2 days of the initial assessment) differed from the less rapid early returners. There were few notable differences, apart from the expected lower level of progression among the very early returns. A greater proportion of the early returns for those with a quit date were rapid, with those furthest from quitting least likely to return within 2 days ($P < .001$). Rapid returns also increased with increasing levels of dependence.

It is notable that 47.9% of those returning after prompting ended (4.1% of all second visits) are considering a new quit attempt. Only 15.4% were attempting to recover from a relapse. The remaining 36.7% were quit and were presumably using the program to overcome unexpected problems in maintaining their attempts. Among those returning either before or with prompting, only 3.7% (3.2% overall) could be considered to be initiating a new attempt, having relapsed back to smoking more than a week ago. Overall, 7.3% of returns were pursuing a subsequent quit attempt, 19.4% were continuing to pursue their initial attempt, 14.2% were recovering from a recent relapse, and 58.9% were using to stay quit (53.4% just quit and 5.5% quit before visit 1).

Visit-by-Visit Progression

Patterns of outcomes for those returning to the site over the first 5 waves of data are summarized in Table 3. For each wave, among those who returned, we report status at their previous visit as well as at that visit to indicate what happened between visits, and to illustrate differences between those who returned and those who did not. Overall, there is a tendency for greater percentage returns with each successive visit. At each wave, those who were quit at a given wave were more likely to return for a subsequent visit, with the percentage quit increasing at each visit, whereas the percentage using the QuitCoach to make a new attempt decreased. Relapsers, in particular, were less likely to return. While the percentage quit increased (at least up to visit 5), most of the quitting took place between the first and second wave. By wave 4, those who returned were marginally less likely to be quit at the next wave, largely due to an increase in new attempts. The percentage using to make a subsequent attempt (more than a week post-relapse) increased over time (4.8% at visit 2 to 8.9% at visit 5), while the percentage using it to recover from a relapse (within a week) declined from 14.2% at visit 2 to 4.3% at visit 5. Among smokers at wave 2, those who had relapsed within the last week were less likely to return for a third visit than those who had not made any quit attempt (26.4% vs 38.8%, $\chi^2_1 = 21.13$, $P < .001$).

By wave 5, over half of active users had successfully quit for more than a month, and less than 1% had failed to make any quit attempt.

QuitCoach Use for Recovery From Relapse

Recent relapse reported on one visit was associated with reduced subsequent use. The 11.4% of smokers coming to the site initially who had relapsed from a previous quit attempt within a week of their initial visit were less likely than other users to return for subsequent visits (22.9% cf 27.2%). Of those who did return (n = 620), 52.1% were quit at visit 2 and another 28.7% had tried again but relapsed. Overall, 38.9% of this group who made a second visit returned for a third, with those now quit at visit 2 more likely to do so (46.7% vs 27.0% for double relapsers and 35.3% for those who did not try to quit again between visits). Of those smoking at visit 2 who returned (n = 90), 41.1% were now quit and 34.4% had tried (again) and failed. Of those quit at visit 2 (n = 151), 84.8% were still quit at visit 3. A similar pattern was found for the 14.2% of the sample (34.1% of smokers at time 2) who were recent relapsers at their second visit. Those in this group were less likely to return for a third visit (23.3% cf 32.5%), and of those who did return (n = 214), 41.6% were quit at visit 3 and another 41.1% had tried again but relapsed.

Table 3. Cessation activity between visits

Status at visit	First to second		Second to third		Third to fourth		Fourth to fifth	
	Status at V1	Status at V2	Status at V2	Status at V3	Status at V3	Status at V4	Status at V4	Status at V5
N	6461	6461	2714	2714	1062	1062	583	583
% of previous wave		27.0		42.0		39.1		54.9
% of total sample		27.0		11.5		4.5		2.5
Average interval (days)	19.3		22.8		28.6		36.2	
To prevent relapse								
Quit since last visit	N/A	53.4	64.2	11.8	13.5	5.6	6.2	3.9
Quit before last visit								
< 1 month	4.8[a]	3.5	5.0	52.1	57.8	38.7	44.6	27.6
≧ 1 month	1.3[a]	2.0	2.1	13.1	12.0	38.3	37.2	54.4
Total Quit	6.1	58.9	71.3	77.0	83.3	82.6	88.0	85.9
To recover from relapse								
Relapse < 1 week ago	9.5	14.2	7.9	9.3	5.7	6.2	5.3	4.3
To make a quit attempt								
Relapse ≧ 1 week ago	15.9	4.8	2.9	4.3	2.8	5.6	3.1	6.3
Failed quit before last visit	N/A	N/A	N/A	2.4	1.7	3.2	1.4	2.6
New quit attempt	15.9	4.8	2.9	6.7	4.5	9.0	4.5	8.9
No previous quit attempts	68.4	22.0	17.8	7.0	6.5	2.4	2.2	0.9
Total use to make a new attempt on that wave	84.3	26.8	20.7	13.7	11.0	11.2	6.7	9.8

[a]First visit refers to time quit, as there is no previous visit.

Discussion

The QuitCoach appears to attract a diverse range of smokers. There is a predominance of females, and less surprisingly, a relatively young age profile. Men and older smokers are also less likely to use other forms of behavioral cessation assistance such as Quitlines [20,21]. Balmford et al [18] show that in relation to the general population of Australian smokers, QuitCoach users are also slightly more addicted and more likely to have made a recent (failed) quit attempt.

Most QuitCoach users start using the program as smokers; that is, they mainly come to the site to help them quit. If they persist with the program (and only a minority do), they predominantly do so to help themselves stay quit. This also includes higher rates of return use among those few who started using when quit. There are also small but important minorities who use the site to initiate a subsequent quit attempt, both immediately after a failed initial attempt and after some delay (use beyond the prompting period), and some who use it to recover from a relapse. The QuitCoach is designed to support all three of these types of use.

Users are much more likely to continue using to stay quit than recover from relapses or initiate new attempts. Similarly, Wang and Etter [22], in a real-world evaluation of an online, tailored advice program with email prompts, found users in the action stage to be most likely to return. This probably reflects the reality that most smokers give up for a while after setbacks in

a quit attempt, waiting for some time before they are prepared to try again. That there is any repeated use by those struggling to overcome obstacles is particularly gratifying, assuming the use is helpful.

The analyses reported here all assume that the information users provide is accurate. Most of the responses are consistent (some of this may be due to logic checks effectively forcing consistency); however, there are a small percentage of apparently inconsistent responses. For example, among users who were smoking at baseline but quit at visit 2, a number reported being quit for longer than their inter-visit interval. We suspect that there is some use of the site for "what if" purposes, exploring what advice would be provided if the questions had been answered differently. In this case, what they might expect if quit for longer. Because the advice provides normative information as to what is typically experienced at various points in the quitting process, it would be potentially useful to find out what to expect in the future. Otherwise the patterns of responses are consistent, insofar as we have analyzed them, suggesting most users report their current situation and respond consistently.

We expected repeat usage of the program to be greater among those with greatest need; however, the evidence for this was mixed. The lowest rate of return was in the lowest dependence group, and very rapid return was more frequent for those most dependent, suggesting that a proportion are using in ways consistent with probable need. However, those with a longer previous quit attempt were more likely to return, as were those using pharmacotherapy and those using other professional help. This suggests that some of the repeated use is from those who are help seekers by nature, not necessarily those who might need it most. Women and older smokers were more likely to return, as has been found for a similar online program [22].

This study cannot be used to assess the effectiveness of the program. However, it has been shown to be effective when delivered in a different manner [14]. That said, it is apparent that a minority of users have developed an ongoing relationship with the site, consistent with them at least perceiving considerable benefit. Moreover, those continuing to use once quit achieved high rates of abstinence, at least over the period they continued to visit.

Rates of initial use by those already quit were low. The proportion of first-time users who were already quit was considerably lower than has been found for the Victorian Quitline, a telephone-based support service targeted to the same population of smokers provided by Quit Victoria [18,23]. Both the finding that initial use is almost exclusively by smokers, and that those first using when quit were more likely to continue using, suggests that most users coming to the site believe that quit smoking advice is primarily something that is useful before quitting. Without the experience of getting advice and seeing that it can apply to the post-quitting period, they may not spontaneously see the need for it or fail to understand the capacity of an online expert system to tailor information to those already quit. That those returning for all subsequent visits were more likely to be quit at previous visits is consistent with this explanation. Finding effective ways to encourage recent quitters who are experiencing difficulties to seek help is a priority. There is a need to better inform smokers of the capacity of online programs such as this to deliver interactive tailored advice and that tailored advice can be generated regularly throughout the quitting process to facilitate both a quit attempt and staying quit.

Only 27% of registered users (31% more recently) returned for a second assessment, despite prompting to return by up to two reminder emails each. Failure to return to an Internet-based smoking cessation program is common. Wang and Etter [22], for example, reported that only 20% of users of the Swiss Stop-Tabac program returned for a second visit when prompted by email. Moreover, Saul et al [24] achieved only a 39.4% online follow-up rate when users of a Web-based cessation intervention were actively followed up 6 months after initial use. The QuitCoach did not actively follow up with users, nor explicitly request that they return. Rather, the emails simply suggested to users that it would be a good time for them to return for a re-assessment, as things may have changed and the advice they received last time may no longer be relevant. That most returns to the site occurred soon after receipt of a reminder email suggests that they were having some effect.

There are several possible reasons why most users failed to return. Some may have lost interest in quitting altogether; others may have believed that they were doing so well that they didn't need any more help; and still others may not have progressed and saw no need as they might have expected the advice they received would be largely identical to what they had previously received. We may have failed to remind others because of a changed email address (or because an incorrect address was deliberately provided due to privacy concerns) [25], because our reminder was blocked by a spam filter, or because the email was perceived to be spam [26].

The program also may not have been effective in communicating the value of returning. Findings from a series of user-based site evaluations we conducted in 2006 suggest that many users simply did not understand why they should return. Participants in the evaluation consistently read their advice with great interest and commented favorably on it; yet some expressed surprise when asked whether they would return. As they had already received useful quitting advice, it was not apparent to them why they would need to return for more. We have taken steps to redress this by providing better information on what the site offers and how to use it, including a greater emphasis on its potential value post-quitting. Moreover, the program needs to do more to build the kind of relationship with a smoker that will foster ongoing interaction, in part by signaling the value of this relationship. We are exploring the use of SMS messaging (or other mobile phone-delivered media such as MMS) to provide timely prompts and reminders to help smokers manage and remain engaged with their quit attempt over time and to return to the site at strategically important points. Messages delivered in this medium are being designed to provide brief snippets of information and advice tailored to the user's perspective on change and to other potentially important predictor variables that are measured during the QuitCoach assessment. SMS messaging has been shown in one trial to be an effective way to deliver smoking cessation support [27], although that program was not designed to be integrated with a program with the capacity for more detailed advice provision.

The other challenge is to maintain longer-term interest in quitting among those who fail. It is gratifying that some, albeit a small percentage, seem to return spontaneously when engaged in a subsequent quit attempt. This demonstrates that these smokers at least saw value in the advice and were prepared to use the program again. As smoking cessation often takes several attempts, programs such as this that one can return to are likely to be of benefit to some.

Personalized, tailored cessation advice programs like the QuitCoach have the potential to reach many smokers very economically. The QuitCoach has been used by many, but rarely to the extent thought optimal. More research is needed both on the marginal additional benefits of additional assessment/feedback cycles for those who currently choose not to use them, and on ways of optimizing use.

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Conflicts of Interest

The authors, led by RB developed the QuitCoach and continue to do work to improve it; however, they have no commercial interest in it.

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Abbreviations

HSI-AV: heaviness of smoking index—alternate version
IQR: inter-quartile range
MMS: multimedia messaging service
NRT: nicotine replacement therapy
RCT: randomized controlled trial
SMS: short message service

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Original Paper

Effect of Adding a Virtual Community (Bulletin Board) to Smokefree.gov: Randomized Controlled Trial

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Abstract

Background: Demand for online information and help exceeds most other forms of self-help. Web-assisted tobacco interventions (WATIs) offer a potentially low-cost way to reach millions of smokers who wish to quit smoking and to test various forms of online assistance for use/utilization and user satisfaction.

Objectives: Our primary aim was to determine the utilization of and satisfaction with 2 versions of a smoking cessation website (smokefree.gov), one of which included an asynchronous bulletin board (BB condition). A secondary goal was to measure changes in smoking behavior 3 months after enrollment in the study.

Methods: All participants were adult federal employees or contractors to the federal government who responded to an email and indicated a willingness to quit smoking in 30 days. We randomly assigned participants to either the BB condition or the publicly available version—usual care (UC)—and then assessed the number of minutes of website use and satisfaction with each condition as well as changes in smoking behavior.

Results: Among the 1375 participants, 684 were randomized to the BB intervention, and 691 to the control UC condition. A total of 39.7% returned a follow-up questionnaire after 3 months, with similar rates across the two groups (UC: n=279, 40.3%; BB: n=267, 39.0%). Among those respondents assigned to the BB condition, only 81 participants (11.8%) elected to view the bulletin board or post a message, limiting our ability to analyze the impact of bulletin board use on cessation. Satisfaction with the website was high and did not differ significantly between conditions (UC: 90.2%, BB: 84.9%, P= .08). Utilization, or minutes spent on the website, was significantly longer for the BB than the UC condition (18.0 vs 11.1, P = .01) and was nearly double for those who remained in the study (21.2) than for those lost to follow-up (9.6, P< .001). Similar differences were observed between those who made a serious quit attempt versus those who did not (22.4 vs 10.4, P= .02) and between those with a quit date on or a few days prior to the enrollment date versus those with a later quit date (29.4 vs 12.5, P = .001). There were no statistically significant differences in quit rates between the BB and UC group, both in intent-to-treat analysis (ITT) and in analyzing the adherence subgroup (respondents) only. Combined across the UC and BB groups, 7-day abstinence was 6.8% with ITT and 17.6% using only participants in the follow-up (adherence). For participants who attempted to quit within a few days of study entry (vs 30 days), quit rates were 29.6% (ITT) and 44.4% (adherence).

Conclusions: Quit rates for participants were similar to other WATIs, with the most favorable outcomes demonstrated by smokers ready to quit at the time of enrolling in the trial and smokers using pharmacotherapy. Utilization of the asynchronous bulletin board was lower than expected, and did not have an impact on outcomes (quit rates). Given the demand for credible online resources for smoking cessation, future studies should continue to evaluate use of and satisfaction with Web features and to clarify results in terms of time since last cigarette as well as use of pharmacotherapy.

Trial Registration: Clinicaltrials.gov NCT00245076; http://clinicaltrials.gov/ct2/show/NCT00245076 (Archived by WebCite at http://www.webcitation.org/5dBuBASA0)

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KEYWORDS

Smoking cessation; Internet; World Wide Web; randomized trial; self-help

Introduction

More than 4.8 million people are estimated to die each year from smoking-related disease worldwide [1]. In the United States, 44.2% of smokers try to quit each year [1], and about 10% of the adult population has searched online for information about quitting smoking [2]. Such demand dwarfs the 1% to 2% of smokers who call quitlines [3] and the 1.3% of smokers estimated to seek behavioral counseling each year [4,5]. The willingness of smokers to search for assistance online is widely attributedto the convenience and anonymity of the Internet. The reach of the Internet suggests that even if the direct effects of Web-assisted tobacco interventions (WATIs) are very small, a sizable population-level impact on smoking is achievable. However, studies of WATIs are challenged by low retention of participants and the massive sample sizes needed to capture small effects [6-9]. In addition, the difficulty of testing a "real-world" intervention [7] and the impracticality of constraining samples to those not using any other form of help contribute to the general reluctance in the field to employ a randomized controlled trial (RCT) to explore any direct effects of a Web-assisted intervention. However, the reach of the medium, its ease of use, and the many types of assistance that it can offer make it an excellent format in which to evaluate competing forms of help.

For example, the American Cancer Society (ACS) compared quit rates on their static website to 5 other interactive websites and found no differences among the 6451 people who participated [9]. However, when analyses were grouped by level of use, participants of interactive websites with higher utilization had slightly higher 7-day abstinence rates at 3 months (12.2% vs 10.2%) than participants of low-utilization websites. Similarly, in another RCT that included bupropion and frequent counseling before randomizing participants to an intensive website requiring log-ins or to no website [6], no direct effect of Web access was observed. However, as with the ACS trial, higher abstinence rates were reported by those who logged in most often. A third RCT that failed to show an effect of an intervention on quit rates compared a cessation website that emphasized mood management versus standard cessation materials [8]. While no difference between website conditions was observed, a unique benefit of mood management was shown for smokers with a past history of depression, consistent with previous research from this group [10]. One RCT that appeared to show an effect of one website over another was conducted by Strecher and colleagues [11]. This study reported higher 3-month quit rates among participants randomized to a website with tailored information versus untailored information. However, because participants in the tailored condition had more contact with study personnel than in the untailored condition, the effects could not be ascribed to the intervention. The only RCT that we know of to clearly demonstrate a difference between two similar websites was conducted by Etter [12], who randomized nearly 12,000 participants to receive either his original website (stoptabac.ch) or an abbreviated version of this website designed for Novartis that emphasized nicotine replacement information. Quit rates at 3 months (7-day abstinence) favored the original program both for current smokers (10.9% vs 8.9%) and former smokers (25.2% vs 15.7%).

Although results from these 5 studies are somewhat inconsistent, 2 commonalities were demonstrated. First, all showed that RCTs can be successfully conducted via the Internet and can produce abstinence rates comparable to many traditional cessation interventions. Second, these trials also highlight the importance of enrolling large numbers of participants (thousands) and ensuring that a large proportion of participants will actually use the Web feature being tested. In 2 of the above studies, insufficient utilization of the feature being tested may have prevented an effect from being observed [6,8]. Despite this, these RCTs provided useful information about different features of a website without the timing confound that occurs with serial testing.

RCTs that test the therapeutic effects of virtual communities on outcomes are scarce and have produced no evidence of direct effects on smoking outcomes [13]. In fact, we know of no studies showing that such tools favorably impact website usage or patterns of website use. However, previous descriptive studies outside of the tobacco control literature support the function of bulletin boards as providing social support through information exchange with others [14,15]. One study within the field of tobacco research found that participants of a widely used website for smoking cessation used the bulletin board more than any other feature on the website and that those who used it were 3 times more likely to be quit compared to those who did not [7].

In previous usability tests of smokefree.gov [16] and a customer satisfaction survey of this website (unpublished data, National Cancer Institute), the majority of registered participants (61%, n = 1261) agreed or strongly agreed that a bulletin board or similar feature would be valuable. Given this, we opted to test the usage and satisfaction with such a feature, including potential interaction effects with other features on the site, in the context of an RCT of smokefree.gov. We further sought to compare our intervention results (overall) to other similar studies. Finally, we examined demographic characteristics of our population to ensure that we had reached as broad a cross-section of smokers as was possible among smokers employed by the federal government.

Methods

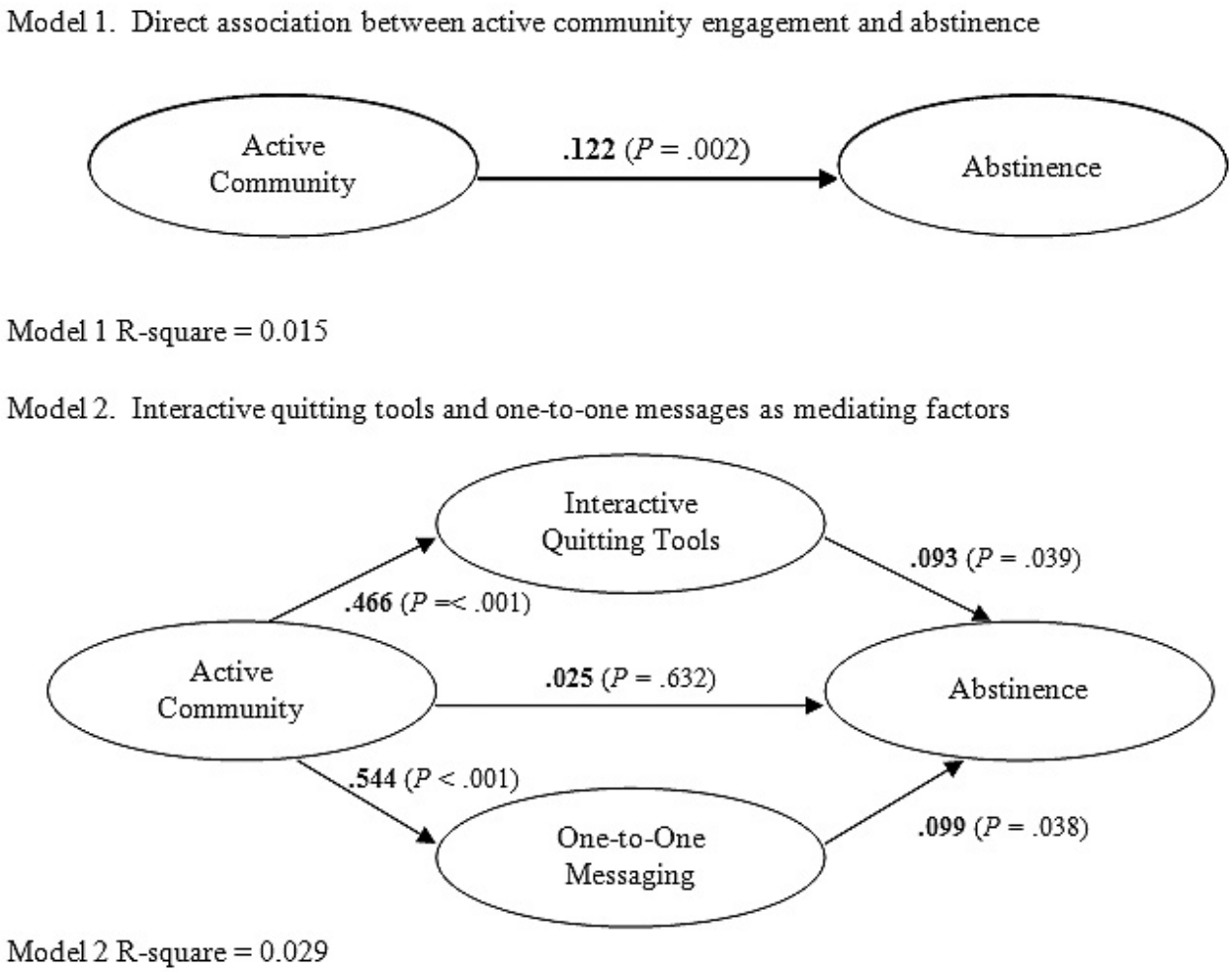
Participants

Approximately 120,000 invitations to review the smokefree.gov website were sent out in 2 phases. All invitations were sent blind to the receiver's smoking status; thus the majority was sent to nonsmokers. The first group of approximately 43,000

federal employees received an email invitation between April 12, 2005 and May 5, 2005 asking them to participate. The second series of emails was sent to a different group of approximately 80,000 federal employees and contractors between February 28, 2006 and November 11, 2006. Emails contained information about a service for smokers interested in quitting, along with an embedded link redirecting interested participants to a site used to screen for eligibility. The redirected page screened for eligibility and admitted those who indicated that they were a federal employee or contractor, were a minimum of 18 years old, and had a willingness to quit smoking. Federal employees and contractors were selected because federal agencies may not survey the public except under extraordinary circumstances (Paperwork Reduction Act of 1980, 44 USC 3501). Additionally, in order to test short-term cessation rates and explore linkages between cessation and pharmacotherapy, we limited this study to those over 18 years of age who were ready to quit in the next 30 days or who had begun an initiation attempt within 5 days before enrollment. Noneligible parties were directed to the publicly available version of smokefree.gov that did not collect any information from visitors.

Those eligible for participation were directed to a Consent/Study Description section that used an active consent format on three separate pages. Consenting participants were asked to provide a contact email, to choose an ID and password, and to complete a baseline questionnaire asking about demographics, history of nicotine/tobacco use, previous treatments for cessation, and a quit date. Once these steps were completed, participants were randomized to the publicly available version of smokefree.gov, designated as usual care (UC condition), or an identical-looking website that included an asynchronous bulletin board (BB condition). Randomization occurred via a computer algorithm (ie, random number generator) that selected from ID numbers generated with returned baseline questionnaires. Participants were told that they would be randomly assigned to 1 of 2 experimental conditions of the website and that the efficacy of both was unknown. The research team was also blinded to the assigned condition. Those in the BB condition were required to enter a username and password when posting messages. We have illustrated the flow-through of participants from beginning to end in Figure 1.

Figure 1. CONSORT flow diagram



Data Collection

Study enrollment, including informed consent and all data collection, occurred via secure (encrypted) Web transmission using SSL software. Data were transmitted in only one direction—from the participant to the study database, which could only be accessed by the study team. All identifying information was stripped from the summary datasets.

Follow-up questionnaires included items about smoking abstinence, satisfaction with the resources provided ("Did you find the resources on the website useful?" 0 = not at all, 4 = extremely useful), use of other cessation aids during the study period (see Table 2), and extent of perceived social support. Participants were asked, "Since you signed up for the Smokefree study, was there someone you had frequent contact with who has been supportive of your efforts to quit smoking?" Participants who answered "yes" were then asked, "How supportive was that person?" Responses were given using a Likert scale, where 0 = not at all supportive and 4 = very supportive. Finally, participants were asked, "Since using the website, are you now more motivated to quit smoking?" Again, we used a 5-point Likert scale, where 0 = not at all and 4 = very motivated.

Interventions

The basic content in both conditions is shown in Figure 2 and is as follows: (1) online quit guide and 5 unique self-help materials targeted to specific populations, all shown to be effective in previous studies with smokers [17-21], (2) links for reaching a cessation counselor for one-on-one help either by telephone or instant messaging, (3) an interactive list of clinical trials still recruiting smokers who wish to quit smoking, (4) an interactive smokers risk tool showing changes in the risk of death due to smoking based on the smoker's history and time of quitting, and (5) a series of empirically based statements about positive health changes that commonly follow cessation (see Figure 3 and Figure 4). The BB condition offered a forum where participants could respond to some seeded categories posted on the board or start their own message.

Figure 2. Screenshot of the smokefree.gov home page, UC condition

Figure 3. Screenshot (a) of the “Did You Know?” messages

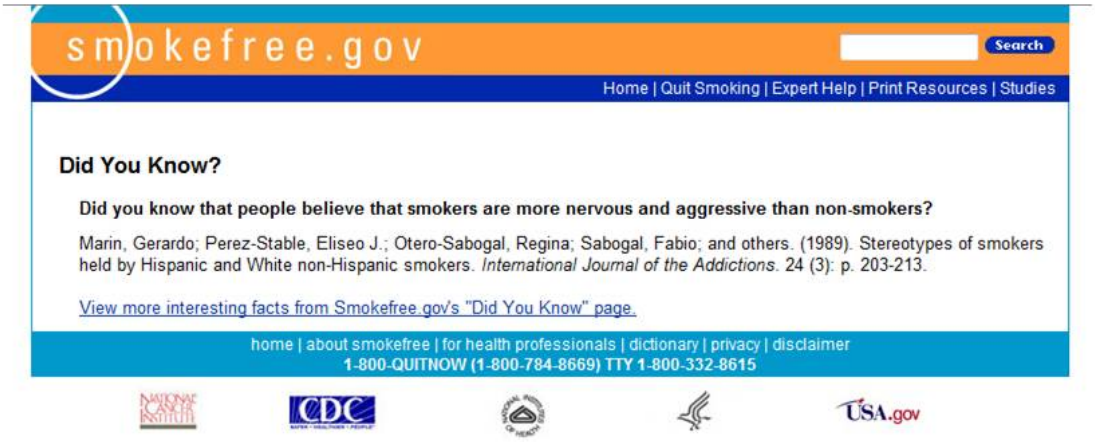
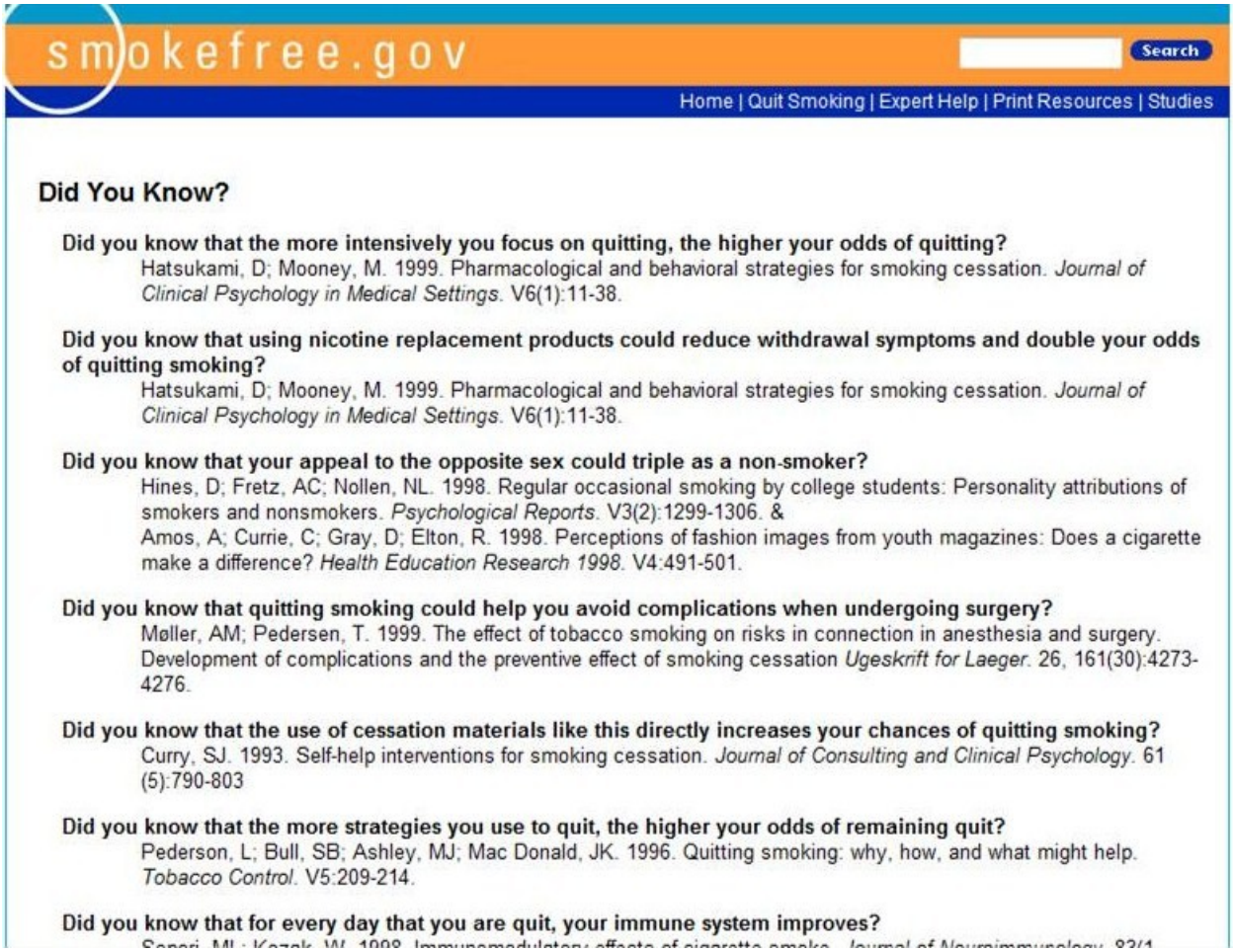


Figure 4. Screenshot (b) of the "Did You Know?" messages



All participants, regardless of condition assignment, received email reminders (eg, Quit Date Reminder, Follow-up Survey Reminder). During the first 2 weeks of the study, a period identified with the highest rates of relapse and study dropout, participants received 4 email reminders, unless they indicated in a previous email that they wished to discontinue their participation. Each email contained tips on quitting, a brief message encouraging use of the website, as well as the time frame of the future follow-up assessments. For example, a few days after enrollment, participants received an email that included their score on the nicotine dependence quiz along with a link to text on the website related to nicotine dependence. A subsequent email included information about health improvements (eg, lung function) associated with quitting after a certain amount of time and links to content that discussed commonly used medications.

Time Spent on Website

We calculated utilization by summing the time each participant spent on each page of the website. This calculation under-represents actual usage because at least a third of the resources listed for both groups contained links that took users outside the website (eg, live help, telephone help by state, clinical trials, certain self-help guides). Therefore, the data presented on site utilization may be a substantial under-reporting of actual total time participants spent on the website.

Three-Month Follow-Up

Three months after the quit date, participants were sent up to 2 emails with a link to the follow-up questionnaire. Those not completing the follow-up after 2 reminders were mailed the questionnaire with a postage-paid return envelope and a thank you note containing either a prepaid calling card worth 100 minutes within the continental United States or US$7.40 worth of postage stamps for the added inconvenience of completing mailed forms. Those not returning the mailed questionnaire were called up to 5 times for their responses.

Data Analysis

We used chi-square tests to test for associations between categorical variables (eg, yes/no) and 2-sided *t*tests to compare differences between relevant independent variables (eg, minutes of utilization). We used odds ratios along with 95% confidence intervals to express the proportion of nonsmokers for variables of interest (eg, days until quit date, medication use). Since there were no differences in participant characteristics across phases or experimental conditions, we aggregated the phase I and phase II data and collapsed across groups for the reported outcomes. We report both the ITT analysis, which treats all baseline participants who do not complete a follow-up survey as smokers, and the adherence analysis, which includes those who took part in the follow-up survey.

Results

Participant Demographics

Results from the analysis of the baseline demographics and smoking behavior are presented in Table 1. Initial analyses revealed no differences between treatment groups, so data are presented in aggregate form. Just under half of our sample were men (46.1%, n = 634). The average age of participants was 43.6 years. About half of the group had attained some college education (49.2%), with 12.9% attaining only high school (or the equivalent) or less. Most participants were non-Hispanic White (69.1%), with 16.9% non-Hispanic Black and 7.0% Hispanic.

The average cigarette use was just under a pack a day (18.3 cigarettes per day), and the average smoker reported a "moderate" dependence on cigarettes, with a score of 4.5 on the Faggerstrom Test of Nicotine Dependence (FTND). Most of the sample (68.4%, 929/1371) smoked within 30 minutes of waking, and 26.3% (n = 367) did so within the first 5 minutes after waking. Nearly all participants (94%) reported having made a previous quit attempt. On average, smokers rated their confidence in their ability to quit as 3.2/5.0, or moderately confident.

Baseline demographic characteristic were examined in relation to use of our website to determine whether or not it was appealing to as broad a cross-section of federal employees as possible, including racial minorities and those from diverse socioeconomic backgrounds. Demographics did not differ by experimental condition. Only 1 baseline characteristic predicted increased use of the website: lower annual income (P = .001).

Table 1. Participant demographics (n = 1375)

Variable	%[a]	No.
Female gender	53.9	741
Age, mean (SD)	43.6 (10.3)	1375
Education, highest level completed		
High school/GED[b] or less	12.9	176
Some college/Associate of Arts degree	49.2	671
College graduate	24.0	328
Post-graduate degree	13.9	190
Annual household income (US$)		
< 34,999	12.4	167
35,000 to 49,999	21.0	283
50,000 to 74,999	26.8	362
75,000 to 99,999	20.5	277
≥ 100,000	19.3	261
Ethnicity		
Hispanic	7.0	95
Non-Hispanic White	69.1	934
Non-Hispanic Black	16.9	228
Tobacco Dependency		
Cigarettes per day baseline, mean (SD)	18.3 (8.5)	1375
Nicotine Dependence (FTND), mean (SD)	4.5 (2.3)	1366
Age of first cigarette, mean yrs (SD)	16.1 (4.4)	1372
Age became a regular smoker, mean yrs (SD)	19.3 (5.3)	1369

[a]Numbers are percentages unless otherwise indicated.

[b]General Educational Development (equivalent of high school diploma).

Past and Concurrent Use of Cessation Aids

As with baseline variables, no differences were found between conditions regarding cessation aids, so data are presented for the combined groups. As shown in Table 2, use of pharmacotherapy during past cessation attempts and the current attempt was high. The majority of the participants had tried nicotine replacement therapy (NRT) in the past, and about half were using NRT during the current study. This was followed by some form of assistance through the Internet (35.7%), with 10.3% of that help from another cessation website. The least used types of help were the nicotine nasal spray and quitlines.

Table 2. Cessation aids used in the past and during the study period

Type of Cessation Aid	Use in Past (n = 1291)		Use During Study (n = 522)[a]	
	%	No.	%	No.
All Medication	77.5	1000	51.9	271
All NRT	71.3	921	43.3	226
Patch	58.7	758	28.0	148
Nicotine gum	41.7	538	15.7	82
Nicotine lozenge	10.0	129	0.8	42
Nicotine inhaler	6.4	83	2.1	11
Nicotine nasal spray	0.9	11	0.2	1
Zyban	34.9	450	15.3	80
Other antidepressants	6.7	86	3.3	17
Internet	35.7	460	NA	NA
Other cessation websites	10.3	133	5.7	30
Chat room/BB	6.8	88	NA	NA
Other				
Self-help materials	19.7	254	9.0	47
Hypnosis/acupuncture	17.0	219	2.1	11
Group/individual counseling	13.3	172	2.9	15
Other cessation materials	12.9	167	6.3	33
Quitlines	1.4	18	1.0	5
No cessation help	15.0	194	34.0	179

[a]NA = not asked.

Utilization of Pages

We were limited in our comparisons of popular requested website pages because some of the features consisted of other National Institutes of Health and US Health and Human Services resources that required external links, such as telephone and text messaging support and studies looking for participants. However, within the pages that were internally hosted (between 150 and 196 pages depending on condition), 8 of the top 10 most visited pages on our website were from an HTML version of the National Cancer Institute's guide "Clearing the Air," which we labeled the "Online Guide to Quitting." Visits to these pages did not notably differ between the UC and BB conditions, except for very minor differences in the ranking positions (see Table 3). The leading topics viewed from the guide included Preparing to Quit, Initial Phases of Quitting, and Nicotine Addiction.

Table 3. Usage of tools (pages) on smokefree.gov, by condition

BB Condition	Hits	UC Condition	Hits
Guide/preparing_to_quit.html	437	Guide/nicotine_addiction.asp	413
Guide/initial_phases.html	389	Guide/preparing_to_quit.html	400
Guide/nicotine_addiction.asp	388	Guide/initial_phases.html	360
Guide/staying_quit.html	314	Index.asp	320
Guide/medicines.html	307	Guide/medicines.html	298
Guide/considering_quitting.html	299	Guide/considering_quitting.html	287
Index.asp	295	Guide/staying_quit.html	265
Info.html	281	Info.html	264
Guide/withdrawal symptoms.html	271	Guide/withdrawal symptoms.html	251
Pop_triggers.asp	242	Pop_triggers.asp	240

Time Spent on the Website

Table 4 presents data for time spent on the website by various subgroups of users. For the pages on the website that did not take people outside of smokefree.gov, the average number of minutes spent for either condition was 14.4 minutes (n = 1083). This calculation excluded time devoted to answering any questionnaire items. Time on the website was higher for those assigned to the BB condition versus the UC condition and was nearly double for those who returned a follow-up questionnaire (vs dropouts), those who reported abstinence (vs still smoking), and those who made a serious quit attempt by abstaining for at least 24 hours (vs those who did not). The longest time spent on the website (30 minutes) was for those whose quit attempt began in the 5 days prior to registering for the study. Past or present use of medication did not influence time spent on the website.

Table 4. Time (in minutes) spent on website, by study participation and quitting behavior[a]

	Yes (min, No.)	No (min, No.)	*t* test
Assigned to BB condition	18.0, 526	11.1, 557	$t_{1081} = 2.5$, $P = .01$
Returned follow-up questionnaire	21.2, 456	9.6, 627	$t_{1081} = 3.7$, $P < .001$
Serious quit attempt (smokers)	22.4, 260	10.4, 730	$t_{988} = 2.3$, $P = .02$
7-day abstinence at 3 months	23.4, 82	13.8, 1000	$t_{1081} = 2.6$, $P = .01$
Quit attempt before enrollment date	29.4, 77	12.5, 304	$t_{379} = 3.6$, $P = .001$

[a]Sample size varies based on complete records for both minutes of use and the variable reported.

Bulletin Board Use and Smoking Cessation

Among those assigned to the BB condition, only 242 opted to look at the Bulletin Board feature by clicking on the link, and of those visiting the link, only one third (81/242) either selected an individual message to view or posted a message. This low utilization rate (81/684, or 11.8%) limited our ability to analyze the impact of bulletin board use on cessation.

Smoking Cessation and Reduction

In Table 5, we present cessation outcomes across experimental conditions 3 months after enrolling in the study. When counting nonresponders (63%, n = 829) as smokers (ITT), 6.8% of participants said that they had been quit for 7 consecutive days. When making no assumptions about nonresponders (adherence sample), 17% said that they had quit smoking. When limiting our analysis just to smokers who had initiated a quit attempt during the 5 days before study entry or on the day of entering the study, the ITT quit rate 3 months later was 29.6%. With our adherence sample, this quit rate was 44.4%. Outcomes did not significantly differ by condition. For participants who were still smoking and who also completed follow-up (n = 339), the number of cigarettes smoked per day dropped from 17.8 to 13.1, which was statistically significant (t_{338}= 12.3, $P < .001$). This did not differ by condition. The change in cigarettes per day was significant for both groups (UC: 17.6 to 12.8, n = 177, t_{176}= 9.3, $P < .001$; BB: 18.0 to 13.5, n = 162, t_{161}= 8.0, $P < .001$).

Table 5. Abstinence rates among respondents, by ITT or adherence sample

Variable	Abstinent (7-Day)[a]			
	All % (n/N)	UC % (n/N)	BB % (n/N)	*P*
ITT	6.8 (93/1375)	6.9 (48/691)	6.6 (45/684)	.79
Quit within 5 days before study	29.6 (24/81)	35.1 (13/37)	25.0 (11/44)	.33
Adherence sample	17.0 (93/546)	17.2 (48/279)	16.9 (45/267)	.91
All medication/users	19.9 (54/271)	18.7 (25/134)	21.2 (29/137)	.61
NRT users	21.2 (48/226)	19.7 (23/117)	22.9 (25/109)	.55
Quit within 5 days before study	44.4 (24/54)	48.1 (13/27)	40.7 (11/27)	.59

[a]n = number abstinent, N = number within subgroup.

Social Support

Nearly 80% of participants reported having a lot of social support for their quitting effort (79.4%, 965/1216). Extent of support felt by participants did not differ by experimental condition (UC: 78.0%, 475/611; BB: 81.0%, 490/605, *P*= .14); 14.5% (176/1216) of participants said they felt somewhat supported in their quit efforts, and only 3.5% (42/1216) said that they had little or no support, with 2.7% (33/1216) undecided.

Satisfaction and Motivation to Quit

For those providing a follow-up questionnaire, the vast majority said that the website was useful (87.6%, 446/509) and that they

were more motivated to quit smoking after having used the intervention (81%, 419/517). Those who reported being satisfied with the website did not differ by experimental condition (UC: 90.2%, 238/264; BB: 84.9%, 208/245, *P*= .08) nor did those who said that they were more motivated to quit (UC: 82.0%, 219/267; BB: 80.0%, 200/250, *P*= .58). This was contrary to our expectation as we expected that those in the BB condition would rate the website more favorably than those in the UC condition.

Discussion

This RCT-based pilot study assessed utilization of, satisfaction with, and impact of 2 versions of smokefree.gov among smokers who wanted help with quitting and who worked for the federal government. The average length of time spent on the website was underestimated because only about three quarters of the content was internally hosted. Despite this, the average time on the website and the satisfaction with materials (among followed participants) was high compared with similar public health websites [22], particularly for those who stayed in the study or made a serious quit attempt. This was true regardless of experimental condition. Time on the website was longest for those who stayed in the study, for those who quit at 3 months, and for those who made a serious quit attempt either in the 5 days prior to the study or afterward. This suggests that interest in our materials was heightened for those in the early stages of cessation, when self-help materials may be particularly relevant [23]. Given the strong effect that having made a recent quit attempt had on outcomes in this study, future Web-based research should consider continuing to include this group. This will help to facilitate comparisons across studies while benefiting a group of smokers who appeared to be actively searching for cessation support.

The observation that nearly 90% of followed users reported satisfaction with the website and that 80% reported greater motivation to quit smoking after using the site is consistent with other research highlighting the website's quality [24]. However, we are mindful that satisfaction with the website and motivation are lower among those who opted not to use it or to discontinue participation in the study.

While our sample had higher income and education than smokers generally do, it was more racially diverse than those from other large US studies and had greater gender parity [23,25] as well as higher use among participants from lower socioeconomic levels. This could be related to the more varied materials on the website, including the self-help guide written in Spanish ("Guia para Dejar de Fumar") and the one developed for African American smokers ("Freedom from Smoking"). Additionally, as our sample was comprised of federal employees, and many government employment positions strongly encourage applicants from diverse backgrounds, we may have reached a more diverse group of smokers than many other studies simply due to the recruitment approach used in the current study [7,11,12].

Across all cessation materials on the site, the most frequently used was the HTML "Online Guide to Quitting," which included topics known to be of greatest interest in the earliest days of the quitting process. Some of the selections (eg, medications, withdrawal symptoms) informed our decision to later expand these content areas in subsequent updates to the site.

Abstinence rates and smoking reduction reported in this study are comparable to other online interventions [7,8,11,26]. One study had better outcomes, with an 18% ITT quit rate [27], but recruited its participants through existing online smoking cessation support groups and among smokers who sought help for cessation online. This study also provided incentives for follow-up. This recruitment method contrasts sharply with ours, which used a largely disseminated email to federal employees within different government departments to explore and evaluate content, and which did not promise any incentive.

The high use of medication during the study had a small (4%) but favorable effect on cessation. Outcomes for those using medication in our study were similar to those reported by Strecher et al [11], who reported outcomes only for NRT users. Given the high rate of medication use among smokers willing to quit, future studies should consider reporting outcomes for those using/not using medications rather than attempt to exclude these users.

Despite research showing a strong interest in a bulletin board or similar feature [7], including our internal surveys with federal employees [16], actual use of this tool was low. A number of possibilities could account for this. First, users knew that they were taking part in a formal study that monitors site activity and were reminded of this each time they had to re-enter log-in information to view or post messages. This may have had inhibited use. Second, responses to postings generally occurred with a few days of the initial post rather than a few hours, as has taken place in other settings [22]. The delayed response to messages may have limited meaningful exchanges and discouraged individuals from posting additional messages. Third, it may be that individuals who anonymously search out help for their cessation are disinclined to use a social support tool [13] or already have a support network, such as the vast majority of participants in our study. Fourth, other research has shown that former smokers are significantly more likely to become active members of a bulletin board community than those who are planning a quit attempt [12]. Perhaps those who have already achieved some level of abstinence are less fearful of failure and more willing to share messages of encouragement compared to those who are at the beginning of the quitting process. Finally, bulletin board communities may require a minimum threshold of activity that is much larger than is possible with the number of participants we recruited. In general, a much better understanding of the conditions that lead to demand for this feature, particularly in light of the popularity of this feature in other settings, is needed.

In considering appropriate methodology for assessing Web-based features and the efficacy of Web-based interventions within real-world contexts, there are a number of challenges. Some researchers have argued that it is important to exclude smokers who are participating in any other forms of cessation help in order to detect the independent effect of a website intervention on cessation. However, attempting this would be both impractical and potentially unethical if those other forms

of cessation assistance are effective. In the real world, in which the role of Internet searches and use is increasing, successful cessation often means employing a number of strategies simultaneously. Of significant concern is that attrition rates are extremely high, both in our study and in those throughout the field of WATI research, where anonymity is emphasized. It is possible that we could have obtained a higher response rate with additional emails or calls. However, we were mindful that attrition can actually increase when participants are contacted more frequently than ours were [14].

Limitations

This study has several limitations. First, the population was made up of government employees and contractors with above-average education and therefore is not necessarily generalizable to the general population of smokers online. We were limited to surveying only government employees or contractors due to restrictions that limit burdening the public with surveys. Second, similar to many other eHealth interventions [13], our attrition was high despite use of multiple methods of follow-up. Future studies may wish to highlight the importance of collecting follow-up data with participants before they sign up for the intervention. Third, we cannot rule out possible contamination between conditions. To limit the number of occurrences where this may have taken place, we examined the records of all baseline questionnaires entered on any given day and looked for similar demographics, smoking histories, usernames, and time of entry. We found only one instance where entries were suspicious (same date, similar time, and similar demographics/smoking history) and then removed this record from the dataset. Fourth, we used a very primitive measure of website use/utilization, which did not include more sophisticated methods that have been used in the field [7,28].

Conclusions

Despite these limitations, our results point to the importance of an individual's engagement in the treatment process and available resources. We found that smokers who fully participated in the evaluation of smokefree.gov and used the site were satisfied with the content provided. Use (measured by time) was highest for those who quit on, or a few days prior to, the study start date. Given that most WATI studies simply ask smokers to answer "yes/no" to the question of whether or not they are ready to quit smoking, it is very likely that those included for study have already begun such an attempt. Future studies should ask about any recent quit attempts (eg, within a few days) as well as the willingness of the participant to utilize treatment materials. Both factors seem critical to treatment engagement and future success in abstinence. As noted previously, the potential impact of Web-based interventions for which effects will be small lies in the extensive reach of the Internet and its ability to reduce obstacles to treatment availability.

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Conflicts of Interest

None declared.

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Abbreviations

ACS: American Cancer Society
BB: bulletin board condition
FTND: Faggerstrom Test of Nicotine Dependence
NRT: nicotine replacement therapy
RCT: randomized controlled trial
UC: usual care condition
WATI: Web-assisted tobacco intervention

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Original Paper

Utilization of Smoking Cessation Informational, Interactive, and Online Community Resources as Predictors of Abstinence: Cohort Study

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Abstract

Background: The association between greater utilization of Web-assisted tobacco interventions and increased abstinence rates is well recognized. However, there is little information on how utilization of specific website features influences quitting.

Objective: To determine the association between utilization of informational, interactive, and online community resources (eg. bulletin boards) and abstinence rates, with the broader objective to identify potential strategies for improving outcomes for Web-assisted tobacco interventions.

Methods: In Spring 2004, a cohort of 607 quitplan.com users consented to participate in an evaluation of quitplan.com, a Minnesota branded version of QuitNet.com. We developed utilization measures for different site features: general information, interactive diagnostic tools and quit planning tools, online expert counseling, passive (ie, reading of bulletin boards) and active (ie, public posting) online community engagement, and one-to-one messaging with other virtual community members. Using bivariate, multivariate, and path analyses, we examined the relationship between utilization of specific site features and 30-day abstinence at 6 months.

Results: The most commonly used resources were the interactive quit planning tools (used by 77% of site users). Other informational resources (ie, quitting guides) were used more commonly (60% of users) than passive (38%) or active (24%) community features. Online community engagement through one-to-one messaging was low (11%) as was use of online counseling (5%). The 30-day abstinence rate among study participants at 6 months was 9.7% (95% Confidence Interval [CI] 7.3% - 12.1%). In the logistic regression model, neither the demographic data (eg, age, gender, education level, employment, or insurance status) nor the smoking-related data (eg, cigarettes per day, time to first morning cigarette, baseline readiness to quit) nor use of smoking cessation medications entered the model as significant predictors of abstinence. Individuals who used the interactive quit planning tools once, two to three times, or four or more times had an odds of abstinence of 0.65 (95% Confidence Interval [CI] 0.22 - 1.94), 1.87 (95% CI 0.77 - 4.56), and 2.35 (95% CI 1.0 - 5.58), respectively. The use of one-to-one messages (reference = none vs 1 or more) entered the final model as potential predictor for abstinence, though the significance of this measure was marginal (OR = 1.91, 95% CI 0.92 - 3.97, P = .083). In the path analysis, an apparent association between active online community engagement and abstinence was accounted for in large part by increased use of interactive quitting tools and one-to-one messaging.

Conclusions: Use of interactive quitting tools, and perhaps one-to-one messaging with other members of the online community, was associated with increased abstinence rates among quitplan.com users. Designs that facilitate use of these features should be considered.

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KEYWORDS

Internet; behavior change; smoking; smoking cessation; self-help; interactive; social support; virtual communities; cohort study; multivariate logistic regression; path analysis

Introduction

Improving delivery of tobacco treatment services is a national health priority [1,2]. The Internet is a promising channel to reach a large number of smokers [3]. Approximately 70% of US adults report at least occasional use of the Internet with 60% having Internet access in their homes [4]. Recent trends that demonstrate increasing Internet access among diverse groups are particularly encouraging. Searching for health information online is common, and it is estimated that by 2004 over eight million people had searched online for help to stop smoking [5].

There are several ways in which an individual who is considering stopping tobacco use might find assistance on the Internet. Website visitors may find useful information on how to quit smoking. A recent meta-analysis suggests that simply providing general self-help materials results in a modest increase in quit rates (OR = 1.24, 95% CI 1.07 - 1.45) [6]. Provision of tailored feedback further increases quit rates when compared to untailored or general self-help materials (OR = 1.42, 95% CI 1.26 - 1.61) [6]. A series of randomized studies have demonstrated a modest benefit to providing individually tailored self-help information via the Internet [7-10]. In addition to self-help information, the Internet provides an opportunity for people interested in quitting to receive assistance from others [3,11,12]. Assistance may come from trained experts who can provide advice online on how to overcome specific barriers to quitting. Support may also come from peers who are members of an online community organized around the issue of quitting. An early study by Schneider et al found higher rates of short-term abstinence among individuals randomized to receive access to discussion forums [13]. An observational study by Cobb et al found that engagement with the online community was positively associated with successful quitting [12].

A consistent finding in the evaluation of Web-assisted tobacco interventions is the positive association between website utilization and success in quitting. Lenert reported a positive association between the number of online cessation modules completed and short-term abstinence rates [14]. Cobb reported a positive association between time spent at the website and cessation outcomes. Saul reported a strong association between the number of website visits and abstinence rates at 6-month follow-up [15]. In the American Cancer Society QuitLink study, Pike et al randomized smokers to one of five interactive websites [16]. While there was no overall difference between any of the interactive sites versus a static control site, individuals randomized to interactive websites with higher utilization rates were more likely to succeed in quitting. The authors concluded that interactive smoking cessation websites with high utilization levels can increase quit rates among smokers looking online for help in quitting.

Typically, website utilization has been measured simply in terms of number of modules completed, number of visits, or time spent on the site [10,12,14-17]. Very little information is currently available regarding utilization rates for different site features (eg, general information, tailored self-help functions, and various online community features) and how these patterns of use are associated with quitting. This information is critical to identify potential strategies for improving outcomes for Web-assisted tobacco interventions. If individuals benefit primarily from tailored feedback, then sites could be designed (or redesigned) to highlight this feature more prominently. If individuals benefit primarily from active engagement with the online community, then websites could be altered to facilitate this connection.

In this paper, this critical gap in the literature is addressed by examining in detail the association between utilization of specific website features and cessation outcomes. The website under study is quitplan.com, a Minnesota branded version of QuitNet.com. The quitplan.com website offers general information, tailored feedback, and expert counselor services, as well as a large online community.

Methods

Setting

ClearWay Minnesota, a non-profit organization created as part of the state's settlement with the tobacco industry, provides free access to quitplan.com for all Minnesota residents. Since its initial offering in 2003 through July 2008, over 300,000 individuals have visited the site with over 36,000 registering for services making quitplan.com the most widely used of ClearWay Minnesota's cessation programs [18]. This study was reviewed by the University of Minnesota's Institutional Review Board and determined to be exempt under federal guidelines 45 CFR 46.101 (b) for existing data.

quitplan.com Services

Content and programming for quitplan.com is provided by QuitNet.com. The QuitNet service has been described elsewhere in detail [12]. QuitNet incorporates national tobacco treatment guidelines as a model for best practice for online cessation interventions.

The QuitNet website has an "open" design that is intended to give users easy access to all site features. Information on quitting is presented to site users in the form of general information

guides, interactive tools that provide tailored feedback, and online support from expert counselors. General information guides address different stages in the quitting process (eg, Making the decision to quit, Getting ready to quit, Quitting, and Staying quit), quit smoking medications, and frequently asked questions (eg, dealing with symptoms of quitting, including symptoms of withdrawal, weight concerns, etc). There are two categories of interactive tools available at quitplan.com. The first set may be considered diagnostic tools and provide smokers with information about their smoking behaviors. These include the Fagerstrom Tolerance Questionnaire [19], a "Why do you smoke?" questionnaire (adapted from National Cancer Institute Materials), and a Stage of Change [20] assessment. A second set of interactive tools assists individuals in planning their quit attempts. This includes tools to assist in setting quit dates, selecting a medication to help them to quit, and keeping track of days of life and dollars saved since quitting smoking. Individual counseling is available from online counselors. Counselors are certified through the Massachusetts Tobacco Treatment Specialist Training Program [21] and manage the "Ask the Expert" forum where site users may post questions.

The quitplan.com website also allows users to connect to the large QuitNet online community of current and former tobacco users. Site users may browse public discussion boards and forums (bulletin boards) to view posts by members of the online community. Site users may interact with other members by making posts to these public forums or by sending private internal email directly to other members. Approximately 2000 messages per day are posted in public forums with thousands more exchanged privately.

Study Design

This study recruited new registrants to quitplan.com from February 2 to April 13, 2004. In order to be eligible, registrants had to (1) be Minnesota residents, (2) be aged 18 years of age or older, (3) be registered as a current tobacco users, and (4) have not already reported quitting at the time of registration. Of 1295 quitplan.com registrants during this period, 1006 were eligible for this study and received an invitation to enroll in the study and complete a follow-up survey in 6 months. An offer of US $10 was made for completion of this survey in 6 months. Of the 1006 eligible registrants, 607 (60.3%) consented to participate in this study.

Follow-up consisted of a mixed-mode follow-up survey using an initial online survey followed by a phone survey of online non-respondents. Participants were mailed a pre-notification letter 6 months after program registration and then sent an email inviting them to complete an online evaluation survey. Reminder emails were sent to non-respondents 3 and 7 days after this initial email. Online survey non-respondents were contacted by phone 12 days after the initial email. The response rate to the follow-up survey was 77.6% (n = 471/607) with 39.4% (n = 239) completing the online survey and 38.2% (n = 232) completing the phone survey.

Measures

Three data sources are used for this study: registration data, detailed site utilization data, and evaluation survey results. Demographic and clinical variables collected during online registration include age, gender, education, insurance status, readiness to quit, cigarettes smoked per day, and time to first morning cigarette.

To record website utilization information, the QuitNet application server uses a metadata-based tracking model to log all interactions between participants and the system into a relational database. The model is similar to the commonly used W3C Resource Description Framework (RDF) data description model [22], in that it uses three pieces of data (subject-predicate-object, called a triple) to describe any occurring event. This model can include basic page view information ("user 123 viewed page xxx"), fine grained information on content ("page view 2132132 included content xyz"), or feature utilization data ("user 123 successfully completed the quit date wizard"). Each triple is stored in a unique row and contains a unique user identifier and session identifier (which form the subject) and a timestamp, which together, when linked to additional tables describing users and their visit information, comprise a complete tracking system. This not only allows for traditional reporting on "page views" but also high-level reporting on feature utilization.

For the purpose of this analysis we created seven unique utilization measures capturing use of quitplan.com's informational resources and engagement with the online community. Measures 1 - 4 below assess utilization of different informational resources. Measures 5 - 7 assess engagement with the online community. These measures were defined as follows:

1. General Information: the number of times a user viewed any of the general information guides (ie, Quit Guide, Medication Guide, Frequently Asked Questions).
2. Interactive Diagnostic Tools: the number of times the individual used the Fagerstrom Tolerance Questionnaire, What makes you smoke?, or Readiness to Quit questionnaires.
3. Interactive Quit Planning Tools: the number of times the individual used interactive tools to (a) set their quit date, (b) select a quit smoking medication, or (c) track days and dollars saved since quitting.
4. Counselor Services: number of questions submitted to online expert counselors.
5. Passive Community Engagement: the number of times the user viewed or read discussion board, forum, or journal posts by other community members.
6. Active Community Engagement: the number of times the user made a post to a public discussion board, forum, or journal.
7. One-to-One Messaging: the number of messages sent privately to other community members using the website's internal email system.

The primary outcome is self-reported abstinence for the 30 days prior to the 6-month follow-up evaluation. In determining abstinence, all non-respondents are considered to be continuing to smoke. The follow-up survey also assessed use of smoking cessation medications (nicotine patch, nicotine gum, other nicotine replacement therapy, or bupropion/Zyban) since registration.

Analysis

Consistent with other studies, raw counts for utilization of different site features were highly skewed. These measures were categorized and median values were reported for each utilization measure category. The correlation between different utilization measures was assessed using a Spearman rho correlation matrix to account for use of categorical measures. Bivariate association between utilization measures and abstinence rates was assessed using Pearson's chi-square statistic. Logistic regression examined the independent effect of each utilization measure. The dependent variable was self-reported 30-day abstinence. The predictor variables were entered in five blocks using a forward step-wise approach. The first block included demographic characteristics; the second block included smoking variables; the third block included stage of change; the fourth block consisted of the use of any stop smoking medication since quitplan.com registration; and the fifth block consisted of the use of the seven categorical utilization measures.

Considerable interest has been focused on the role of the online community in encouraging smoking cessation. To examine the direct and indirect association between engagement with the online community and abstinence outcomes, path analysis was performed comparing results from two models. Model 1 examined the relationship between Active Community Engagement and Abstinence. Model 2 examined the direct and indirect effects of Active Community Engagement after consideration of potential mediators identified in the logistic regression model described above. Bivariate comparisons and logistic regression models were preformed using SPSS 16.0. Path analyses were performed using AMOS 16.0 software from SPSS Inc.

Results

Demographic Characteristics

The demographic and smoking related characteristics of participants are shown in Table 1. The average age of study participants was 38.0 (SD 11.9) years. The majority of participants were female and had completed at least some education after high school. A large majority of site users were employed and had health insurance. The majority of participants smoked more than 15 cigarettes per day and nearly one in three reported smoking within 5 minutes of awakening in the morning. At registration, approximately half of participants reported being in the preparation stage of change. The remainder were in the contemplation or precontemplation stages of change.

Table 1. Participant characteristics

	N = 607	%
Age		
18 - 24	82	13.5
25 - 34	177	29.2
34 - 44	171	28.2
45 - 54	123	20.3
55 or older	54	8.9
Gender		
Male	216	35.6
Female	391	64.4
Education [a]		
High School or less	100	18.0
Some college	268	48.1
College graduate	189	33.9
Employment Status [a]		
Unemployed/other	151	25.2
Employed for wages	449	74.8
Health Insurance [a]		
Uninsured	79	13.5
Insured	506	86.5
Cigarettes/day		
< 15	168	27.7
15 - 24	296	48.8
25+	143	23.6
Time 1st a.m. Cigarette		
Within 5 minutes	180	29.7
6 - 30 minutes	259	42.7
31 - 60 minutes	100	16.5
After 60 minutes	68	11.2
Readiness to quit		
Precontemplation or Contemplation	302	49.8
Preparation	305	50.2

[a]Sum less than 607 due to item non-response

Website Utilization

Participants' utilization of specific website features is shown in Table 2. Utilization of each of these features was significantly correlated with global utilization measures such as total number of visits to the website and total time spent on the site. Correlations of specific utilization scales with total number of site visits ranged from 0.30 ($P < .001$) for use of counselor services to 0.71 ($P < .001$) for use of interactive quit planning tools.

Use of informational resources was more common than passive or active engagement with the online community. The most commonly used resources were the interactive quit planning tools. Nearly 80% of participants used these tools on at least one occasion, and nearly one-third of participants used these quit planning tools more than four times. The next most commonly used informational resources were the general information guides with over half of participants viewing one or more information guides. Use of the interactive diagnostic tools was less common with somewhat less than half of participants using this resource. Counselor services were used only rarely with less than 5% of participants posting one or more questions to the expert-moderated forums.

Passive engagement with the online community (ie, reading discussion board posts) was more common than active engagement (ie, posting messages). Approximately 40% of participants viewed any posts made by other members of the online community. Active engagement with the community was less common with only approximately one in four participants making any public post. One-to-one messaging between members of the online community was similarly rare with only one in ten participants taking advantage of this feature.

A matrix demonstrating the correlation between these seven utilization measures is shown in Table 3. The highest correlation was 0.617 between the passive and active community engagement measures. The next highest correlation was between use of general information features and the interactive quit planning tools (0.522). Correlations were generally low between use of any counselor services and any of the other utilization measures (all correlations < 0.30).

Table 2. Website utilization patterns in the 6 months after initial registration

Informational Resources	Median	Range	N	%
General Information	# times guides viewed			
None	0	0	245	40.4
Low	1	1 - 2	113	18.6
Med	4	3 - 5	134	22.1
High	10	6 - 46	115	18.9
Interactive Diagnostic Tools	# times used			
None	0	0	335	55.2
1	1	1	127	20.9
2	2	2	61	10.0
3+	3	3 - 7	84	13.8
Interactive Quit Planning Tools	# times used			
None	0	0	139	22.9
1	1	1	145	23.9
2 - 3	2	2 - 3	143	23.6
4+	6	4 - 63	180	29.7
Counselor Services	# questions sent			
None	0	0	578	95.2
1 or more	1	1 - 2	29	4.8
Passive Online Community Engagement	# of post viewed			
None	0	0	374	61.6
Low	2	1 - 5	112	18.5
High	20	6 - 56	121	19.9
Active Online Community Engagement	# of public posts made			
None	0	0	463	76.3
Low	1	1 - 2	72	11.9
High	7	3 - 42	72	11.9
One-to-One Messaging	# of private messages sent			
None	0	0	543	89.5
1 or more	3	1 - 643	64	10.5

Table 3. Correlation matrix for utilization measures (N = 607)[a]

	Interactive Diagnostic Tools	Interactive Quitting Tools	Counselor Services	Passive Online Community Engagement	Active Online Community Engagement	One-to-One Messaging
General Information	.513	.522	.205	.479	.387	.327
Diagnostic Tools		.509	.226	.361	.309	.215
Quitting Tools			.210	.510	.469	.308
Counselor Services				.256	.278	.275
Passive Online Community Engagement					.617	.470
Active Online Community Engagement						.494

[a]Spearman rho coefficients all significant $P < .001$

Predictors of Abstinence

Counting non-respondents as smokers, the self-reported 30-day abstinence rate among the 607 study participants was 9.7% (n = 59/607, 95% CI 7.3% - 12.1%). The relationship between utilization of specific website features and abstinence rates is shown in Table 4. In these bivariate comparisons, there was a positive association between self-reported 30-day abstinence rates and use of general information resources, interactive quit planning tools, counselor services, active community engagement, and one-to-one messaging. Neither passive community engagement nor use of the interactive diagnostic tools was significantly associated with abstinence.

In the logistic regression model, neither the demographic data (eg, age, gender, education level, employment, or insurance status) nor the smoking-related data (eg, cigarettes per day, time to first morning cigarette, baseline readiness to quit) entered the model as significant predictors of abstinence. Of the 471 survey respondents, 236 (50.1%) reported use of any smoking cessation medications. Use of smoking cessation medications was not associated with 30-day abstinence at follow-up (abstinence 14.0% for medication users vs 11.1% for non-users, $P = .34$). Medication use did not enter into the regression model (was not significant predictor). Of the seven utilization measures, only two were significant and entered the model: Interactive quit planning tools and one-to-one messages. As a group, the indicator variables representing utilization of interactive quit planning tools, but not the diagnostic tools, were significant with a *P*-value of .03. Compared to individuals who made no use of these tools, individuals who used the interactive quit planning tools once, two to three times, or four or more times had an odds of abstinence of 0.65 (95% CI 0.22 - 1.94), 1.87 (95% CI 0.77 - 4.56), and 2.35 (95% CI 1.0 - 5.58), respectively. The use of one-to-one messages (reference = none vs 1 or more) entered the final model though the significance of this measure was marginal (OR = 1.91, 95% CI 0.92 - 3.97, $P = .083$).

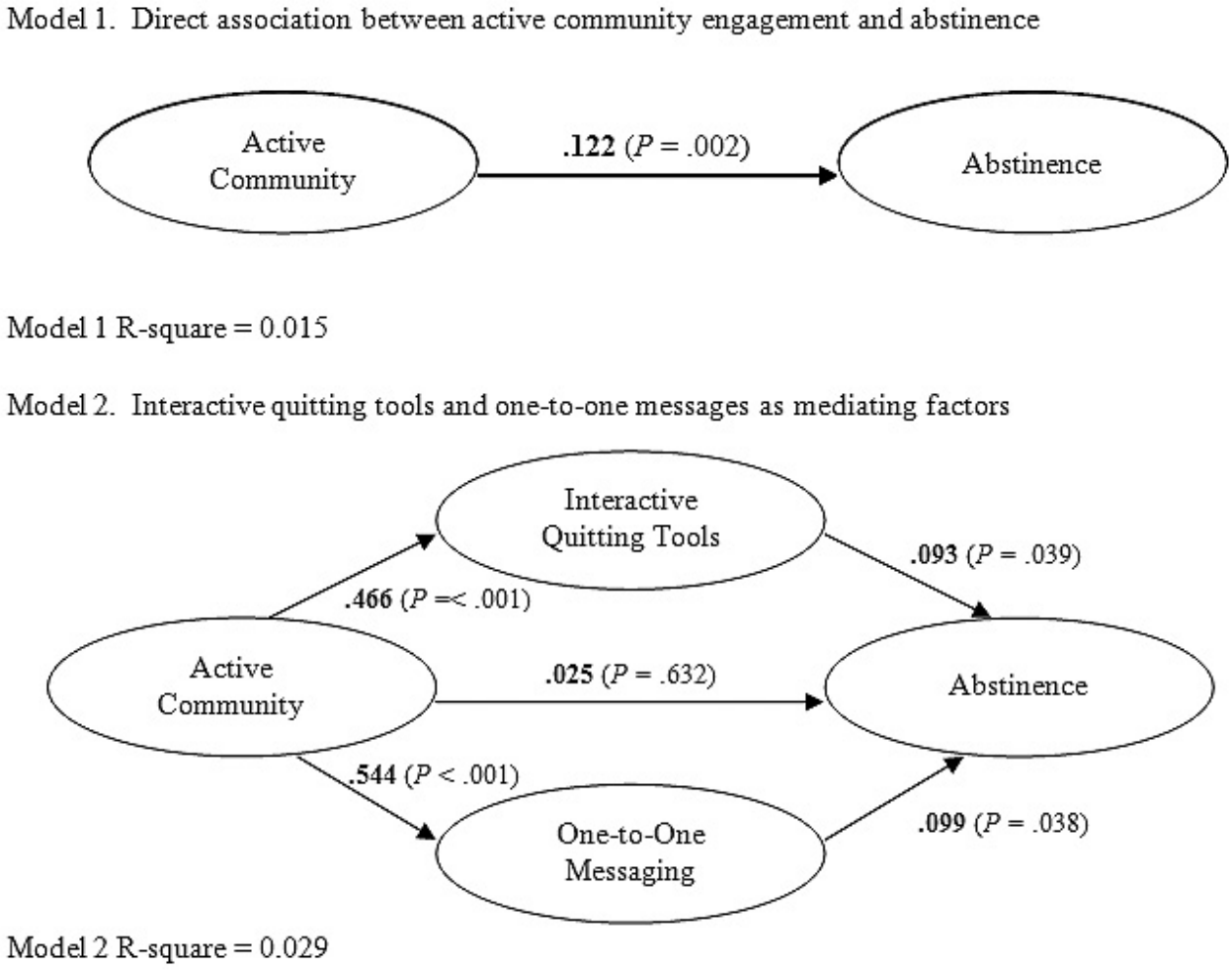
The results of path analyses are shown in Figure 1. Model 1 is consistent with the results of the bivariate comparison showing a positive association between active community engagement and 30-day abstinence (path coefficient 0.122, $P < .001$). Model 2 explores the direct and indirect effects of active community engagement. Utilization of interactive quit planning tools and one-to-one messaging options were included as potential mediating variables in the path model based upon the findings of the final logistic regression model. In Model 2, active community engagement predicts both use of interactive quitting tools and one-to-one messaging. Each of these variables in turn predicts 30-day abstinence.

An examination of the path coefficients in Model 2 illustrates how the active community path coefficient (0.122) from Model 1 consists of a direct effect on abstinence (0.025) and indirect effects acting through increased use of interactive quit planning tools (.466 x .093 = .043) and one-to-one messaging (.544 x .099 = .054). In fact, these indirect effects for interactive quitting tools (0.043) and one-to-one messaging (0.054) account for a large part (.097/.122 = 79.5%) of the apparent association between active community engagement and abstinence. After accounting for these indirect effects, the direct effect between active community engagement and abstinence is no longer significant.

Table 4. Comparison of website feature utilization and 30-day abstinence rates

	30-day Abstinence				*P*-value
	No		Yes		
	N	%	N	%	
General Information					.004
None 0 views	229	93.5	16	6.5	
Low 1 - 2 views	101	89.4	12	10.6	
Med 3 - 5 views	124	92.5	10	7.5	
High 6 - 46 views	94	81.7	21	18.3	
Interactive Diagnostic Tools					.266
None	309	92.2	26	7.8	
1 use	112	88.2	15	11.8	
2 uses	52	85.2	9	14.8	
3+ uses	75	89.3	9	10.7	
Interactive Quit Planning Tools					.003
None	130	93.5	9	6.5	
1 use	139	95.9	6	4.1	
2 - 3 uses	127	88.8	16	11.2	
4+ uses	152	84.4	28	15.6	
Counselor Services					.041
None	525	90.8	53	9.2	
1 or more use	23	79.3	6	20.7	
Passive Online Community Engagement					.198
None 0 views	342	91.4	32	8.6	
Low 1 - 5 views	102	91.1	10	8.9	
High 6 - 56 views	104	86.0	17	14.0	
Active Online Community Engagement					.003
None 0 posts	425	91.8	38	8.2	
Low 1 - 2 posts	66	91.7	6	8.3	
High 3 - 42 posts	57	79.2	15	20.8	
One-to-One Messaging					.001
None	498	91.7	45	8.3	
1 or more	50	78.1	14	21.9	

Figure 1. Path analysis of active community engagement and abstinence rates



Discussion

Overview

In this observational study of a statewide smoking cessation website, we found an association between the use of interactive quitting tools providing tailored feedback and abstinence rates at 6-month follow-up. Given this finding, it is encouraging to note that nearly 80% of website users made use of one or more of the interactive quit planning tools available through quitplan.com. The finding of positive associations with abstinence related specifically to use of these quit planning tools is consistent with the focus of these tools on key aspects of evidence-based behavioral interventions (ie, setting a quit date, using pharmacological therapy, and follow-up assessment after the quit date) recommended in tobacco treatment guidelines [1].

The abstinence rate observed in this study is consistent with findings from other studies that offered online interactive or tailored feedback. Though timing of the evaluations differ, Etter found that access to a more versus less tailored online program had modest effect on abstinence (10.9% vs 9.8%, $P = .003$) [7]. Swartz et al found that providing tailored online video increased abstinence (12.3% vs 5.0%, $P < .015$) [9]. Pike found a modest benefit to interactive sites with higher versus lower utilization (12.2% vs 10.2%, $P < .05$) [16]. Only Strecher et al reported substantially higher abstinence rates related to an online tailored cessation program (20.1% vs untailored 15.9%, $P < .001$), though in this study all participants had purchased nicotine patches [8]. In total, these findings suggest at most a modest benefit from the use of current smoking cessation websites and substantial room for improvement in the effectiveness of online cessation services.

Interesting findings regarding the potential contribution of different aspects of the online community merit further discussion. Only a minority of participants engaged with the online community in either a passive or active fashion. Interaction with “online experts” was even more rare, a finding that has been reported previously for an online smokeless tobacco intervention [23]. In this study we did not find any association between passive engagement with the online community (ie, reading posts by other members) and abstinence rates. Active engagement with the community at large (through posting to public discussion boards and forums) appeared to be associated with increased abstinence rates in bivariate comparisons. However, logistic regression modeling indicated that active engagement was not an independent predictor of abstinence. Path analyses suggested that the contribution of active community engagement is primarily indirect through an association with increased use of interactive quit planning tools and the one-to-one messaging feature, both of which contribute

to greater abstinence rates. These findings suggest a potentially important role for the online community in maintaining user engagement and steering new users to effective resources. Our findings suggest that one-on-one interactions may be needed to provide enough substantive support to assist cessation. Operators of smoking cessation programs might consider website redesign to facilitate these connections.

There was not an independent association between viewing of general information guides and abstinence rates after controlling for utilization of interactive quit planning tools. This is consistent with results of meta-analyses which demonstrate a greater benefit of tailored compared with untailored self-help materials [6]. There was also no independent benefit to site users engaging online with expert counselors. In this case, it may be that use of counselor services was too low to detect a meaningful effect. Future efforts may involve strategies to increase site user engagement with the available expert support functions.

Limitations

There are several limitations to consider when interpreting the findings presented here. First, it is important to acknowledge this was an observational study and not a randomized controlled trial. We are therefore not able to make causal claims related to the use of different website features and abstinence rates. Selection bias (both in the initial study participation and in website utilization) or unmeasured factors (eg, use of telephone or other counseling services) could have influenced the observed associations. These findings therefore may not generalize to the larger population of smokers who use Web-based cessation services. Second, the findings here are based upon visitors to one (albeit high volume) stop smoking website. Differences in website design would be expected to influence utilization. For example, a site might require completion of certain features as part of registration or strongly promote use of website features in a specific order (ie, “tunnel” design). Besides this basic architecture, other design features such as level of interactivity and incorporation of audio and video might influence utilization. Danaher et al reported much higher utilization for an interactive, “media-rich” website compared to a static text-based comparison site [23]. Thus, our findings on utilization and associations to abstinence for the quitplan.com website may not generalize to other smoking cessation websites, particularly those with substantial differences in design. Third, while this paper advances the knowledge of the potential effects of different types of website features, more fine-grained analyses are still needed. For example, information on the precise timing of the utilization of different website features, and the content and quality of messages exchanged with other members, could further clarify the role of online community engagement in cessation outcomes.

Despite these limitations, the findings reported here contribute to the understanding of effective Web-based tobacco interventions. At present, tailored interventions appear to be a key—and perhaps the key—component to include when creating an effective cessation website. Designers seeking to create effective cessation websites should incorporate interactive assessment and tailored feedback and find ways to feature these resources prominently. Further study of the role that online communities may play in the cessation process is clearly warranted. Future studies could seek to identify and characterize members of online communities who are particularly helpful to others. Eventually interventions may be designed to enhance the quality of online interactions (perhaps through the provision of training in evidence-based practices) to maximize the direct and indirect benefits of online communities.

Conflicts of Interest

None declared.

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Abbreviations

RDF: Resource Description Framework

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