About 23.5% of Americans smoke, and more than 70% of those who do say that they want to quit. The vast majority of smokers try to quit without professional help (80%); however, only about 10% succeed. This article focuses on the development of a model for using Internet technologies to help smokers quit on their own. The approach uses a widely recognized cognitive/behavioral model for treatment of addiction, including the use of mood management techniques to support smokers during their quit efforts.

Among “self-help” smoking cessation applications, computer-based methods are among the most effective. Most computer smoking cessation software works by administering a questionnaire and then producing printed educational materials tailored to the smoking cessation needs of individuals. Until recently, educational materials were printed documents either delivered in person or sent by surface mail. The delays, expense, and logistical obstacles involved in these modes of delivery had limited the number of installments that could be delivered to smokers and, potentially, the effectiveness of computer interventions. However, the Internet has changed these logistics, making it practical to repeatedly contact an individual with well-timed educational materials. A multiple contact model better parallels most clinical cessation programs, which teach cessation skills in multiple sessions conducted over an extended period. Furthermore, some evidence suggests that in person-to-person cessation interventions (e.g., counseling, group sessions), multi-contact programs are more effective than single contact programs.

The software described in this article used a multi-contact intervention model to implement its cognitive/behavioral intervention. The application com-
combined both web-based and e-mail components within an integrated software environment and attempted to alter smokers’ behaviors over an 8-week period. The challenge with this delivery model is sustaining the interest of smokers over a long enough period and providing sufficient educational materials to allow the smoker to cease smoking and permanently change his or her behaviors. Our hope was that a combination of high-quality content, interactive tracking tools, and tailored e-mail messages would keep smokers involved with the site and allow them to benefit from the intervention.

**Methods**

**Intervention**

The cognitive/behavioral intervention had eight different modules. Modules covered topics that included monitoring of moods, replacing the positive reinforcement that smokers received from nicotine with other pleasant activities, and “talking back” to harmful thoughts. Each module included the text of the lesson, exercises illustrating lesson materials, and, most importantly, tools for self-monitoring of behaviors to help participants internalize behavioral changes and coping strategies taught in each lesson. For example, the first module taught smokers how to become conscious of their smoking behaviors by tracking the number of cigarettes they smoked each day and displaying reported values on a graph.

**Website**

To deliver this intervention, we developed a website that presented the cognitive/behavioral and other materials to subjects. Modules were presented one at a time. The website tracked participants’ completion of each module and, after completion of each module, made a new behavioral monitoring tool available to the participant. The site also monitored participants’ completion of lessons relative to their enrollment date and automatically sent an e-mail message reminding them to return to the site to work on a new lesson if it had not been viewed by the appropriate week of the program. However, we thought it unwise to restrict participants access to educational modules, and we allowed participants to go through the lessons at a faster pace if they desired.

The user interface of the web site followed a relatively standard model for the web and is summarized in Figure 1. The design was hierarchal. After logging into the site, a participant came to the home page. This page offers various options presented as links on two sides of the home page. Participants had two primary choices: (1) to view educational materials (cognitive/behavioral modules or other materials described below), the links to which were on the left hand side of the page, or (2) to use a self-monitoring tool, the links to which were on the right hand side of the page. Specific educational materials or self-monitoring tools were accessed through second-order menus as shown on the left side of Figure 1.

Although the primary focus of the intervention was to teach mood management methods, we recognized that a large body of more practical knowledge might be helpful to smokers in their quit efforts. We added educational materials to the site that included content designed to enhance motivation, assist smokers with preparing for their quit date, help them cope with physical withdrawal, decide whether to use adjunctive pharmacologic therapies, and manage the psychological aspects of addiction. These materials were put up on the website for smokers to browse. Although they are important, we decided not to focus participants’ attention on these materials in a directed way, because it would distract from the time and attention that they should be giving to the mood management course. Rather than leave the viewing of this material to chance browsing, however, we created a second channel to present this information using electronic mail messages. This channel provided smokers with access to relevant materials timed to best support their quit effort. For example, information about how to develop a “personal checklist” to get ready for a quit effort is relevant to smokers a few days before they decide to quit, but not in the weeks afterward. Individuals were sent mail messages, at appropriate times based on their quit dates, with links to relevant content on the site. Other content was sent at other strategic times. Figure 2 summarizes the entire intervention experienced by participants with both mood management lessons and e-mail links to educational materials.

**Evaluation**

To study the effectiveness of this combined system, we conducted a pilot study in which we recruited potential participants over the web using an existing mailing list. Smokers who had completed a previous web-based survey on cessation needs and who had failed to quit were sent an e-mail message announcing a new online study. Respondents were screened (by web questionnaire) according to strict eligibility criteria on readiness to quit. Participants who met...
these criteria were offered enrollment in the trial. Baseline assessment data included information about demographics, smoking history, symptoms of depression, and the degree of addiction to nicotine. Outcome measures collected by web questionnaire and telephone at least 30 days after study enrollment included (1) the proportion of participants making a serious quit effort (defined as 24 hours or more of complete abstinence from smoking); (2) the number of smokers who successfully quit (defined as 7-day period of complete abstinence from cigarettes with no slips); and (3) the number of smokers who had significant reductions in cigarette use (defined as a 50% or more reduction in daily cigarette usage). The effect of exposure to the intervention was assessed by dividing participants into quartiles of exposure and comparing outcomes using the chi-square test. Participants' beliefs about the effect of the site on their intention to quit and overall helpfulness were assessed on a 4-point Likert-type scale.

**Observations**

E-mail invitations sent to 1,048 smokers yielded a total of 49 U.S. resident enrollees who stated they were prepared to quit in the next 30 days and met other eligibility criteria. Forty-two of the 49 enrollees completed the baseline research questionnaire, and 40 of the 49 set a date that they would quit smoking. Of these 40 individuals, 10 completed all 8 course modules. The median number of return visits to the site was also two, with the upper quartile of 7. The mean age of enrollees was 46 years; 78% were female, 84% were Caucasian, and 75% had some college education. The average number of cigarettes smoked per day was 19 (standard deviation = 9.7).

Follow-up data were obtained in 26 individuals (18 by telephone, 3 by mail, and 5 via the web, at a minimum of 30 days of follow-up). Results were not obtainable in 23 participants. Loss to follow-up occurred when we were unable to contact participants by telephone and there was no response to mail surveys. Ninety-two percent of respondents (24 of 26) made a serious quit effort, as indicated by quitting for at least 24 hours. The overall quit rate at 30+ days among enrollees (assuming those lost to follow-up continued to smoke) was 18% (9 enrollees). An additional 16% of subjects (8 enrollees) had a 50% or greater drop in cigarette usage, even though they had relapsed. Assuming that subjects who did not respond to follow-up requests continued to smoke, exposure to the educational materials appeared to increase the chances of quitting. Persons viewing zero, one, or two lessons had a 29% chance of quitting or significantly reducing cigarette usage; those viewing 3 or 4 lessons had an 82% chance; and those viewing 5 or more lessons had a 45% (Pearson's chi-square = 8.9 [df = 1], p = 0.012).

Respondents had a generally favorable view of the site; 78% of respondents to the follow-up survey reported that the site had increased their intention to
quit and 94% felt that the site had helped their quit efforts. Participants completing the telephone questionnaire (n = 21) were evenly divided about the value of different parts of the site. E-mail reminder messages and tracking tools received similar ratings (5.9 vs. 5.5 of 10, p = 0.44), but ratings were only weakly correlated (Pearson correlation coefficient = 0.18) with each other. In open-ended questions, several subjects commented that the main website was complex and difficult to navigate. At least one subject said that the frequent e-mail messages were annoying. Another subject highly valued the messages, saying that they made her feel as though she was not going through the quitting process alone.

Discussion

The results of this pilot study provide both cause for optimism and concern to those who hope to capture the attention of Internet users to change unhealthy behaviors such as smoking. Cause for optimism is found in the reported effects of the site on responders. Even if the site had no effect on nonresponders, results suggest that nearly half of participants engaged in a serious quit effort and, at 30 days or more of follow-up, nearly one-third had either quit entirely or reduced reported cigarette consumption by 50%. These results, although quite preliminary, suggest that the intervention may be effective and call attention to the potential usefulness of the web in smoking cessation programs.

Cause for concern can be found in the low proportion of users completing the educational materials on the site. Not all individuals who enrolled in the study were highly committed to quitting. Only 80% actually set a quit date, and many dropped out as the study progressed. Because it is relatively easy to enroll in an Internet intervention, the smokers who use this method may be less motivated than smokers who attend cessation clinics or seek help from a physician. The design of smoking interventions for the web may need to take this lower level of commitment into consideration.

Lessons Learned

Feedback from participants and our own retrospective review of the design of the site identified several potential issues. One problem that may have inhibited effective use of the site by participants is its relatively complex design. The design focused on browsing as the primary activity by which participants would acquire information. Smokers accessed different parts of the site from a central menu, drilling down into different portions to access educational materials or self-monitoring tools. Users were guided in their navigation of the site with directions and suggestions tailored to the users’ level of progress.
through the study, written in the “white space” between hot link options, which told them what to do next and how to get there. In retrospect, this design makes it difficult for users to jump from one type of activity to another. Following the directions to perform the next recommended activity requires considerable attention and effort, perhaps too much effort. Furthermore, finding new content on the site is relatively difficult.

A further problem may have been an overemphasis on use of text for delivery of content. Although the site provided interactive graphic tools with each lesson to help subjects monitor and reinforce their behaviors, the lessons themselves were relatively ordinary text materials. It could be that the educational materials on the site were simply not entertaining enough to hold users’ attention. This is a difficult trade-off for website designers. Entertainment that does not inform is expensive (in terms of production cost) and ultimately a distraction from education content.

The use of e-mail reminders to redirect participants back to the site to complete lessons had limited success. For some individuals, this was an effective technique. For others, the approach may have resulted in unwanted “spam” e-mail messages that were perceived as nuisances and probably deleted before they were read.

Our experience with this pilot study suggests that design of Internet applications that motivate changes in health behavior may need to differ from applications designed to educate and inform. Although education and information are important first steps in the change process, developers of health care applications take significant risks if they depend on users browsing to find the right information. An undue emphasis on self-directed learning may saddle participants with complex and difficult to navigate interfaces that inhibit learning and the transfer of information. Furthermore, the need to practice skills and monitor progress, as part of behavioral change, can conflict with the goals of providing users free access to navigate a site. E-mail is a powerful adjunct to websites, allowing the designers to send, at their initiative, content to participants that supplements and enhances web-based materials. The combination of these two channels makes it practical to develop high-intensity sustained Internet interventions for smoking cessation.

References: