The Effects of Computer-Tailored Smoking Cessation Messages in Family Practice Settings

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Background. Many conventional health education materials, such as pamphlets and booklets, are designed to reach as wide an audience as possible; they are therefore often lengthy and contain information irrelevant to many consumers. Computer technologies allow sophisticated tailoring of messages targeted to individual patients and free of irrelevant information.

Methods. In two studies in North Carolina (study 1, N=51; study 2, N=197), adult cigarette smokers were identified from a cohort of family practice patients. Cigarette consumption, interest in quitting smoking, perceived benefits and barriers to quitting, and other characteristics relevant to smoking cessation were collected. Based on this information, smoking cessation letters were tailored by computer to individuals. Smokers were randomly assigned to experimental (tailored health letters) or comparison groups (generic health letter in study 1, no health letter in study 2). Smoking status was assessed again at 4 months (study 1) or 6 months (study 2).

Results. Both studies found statistically significant positive effects of tailored health letters among moderate to light smokers. In study 1, 30.7% reported quitting after 6 months vs 7.1% in the control group ($P<.05$); in study 2, 19.1% vs 7.3% ($P<.05$).

Conclusions. Results from both studies indicate positive effects of computer-tailored smoking messages among moderate to light smokers. These findings are consistent with the focus of our computer-tailored program on psychological and behavioral factors related to smoking cessation. Smoking cessation outcomes may be enhanced by combining tailored messages with nicotine replacement therapies to treat physical dependency. Methods of tailoring health messages and incorporating the results into family practice are described.

Key words. Smoking cessation; computer tailoring; family practice. (*J Fam Pract 1994; 39:262-270*)

In medical care settings, printed materials such as pamphlets, letters, or booklets are among the most widely used media for health education and health behavior

change interventions. These materials are relatively inexpensive, can supply a level of detail most health professionals do not have the time or training to provide, and can reinforce messages already given by a health professional. Generally, printed health materials are designed to include as much information for as many potential readers as possible. Since potential readers represent a wide range of interests and health circumstances, the process of inclusion can result in long, dense messages that are largely irrelevant to most readers. Therefore, even the best conventional print materials may be disregarded by a majority of patients.

The continuing development of word processing and desktop publishing capabilities has enabled people without computer programming expertise to develop

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print materials personalized to specific characteristics of each reader.[1] These capabilities simplify the design and creation of multiple tailored versions of printed materials rather than a single standardized, generic version for all recipients. Health care professionals can tailor each version to one recipient with specified characteristics. In its simplest form, computer tailoring can generate letters beginning with each reader's own name and address. More sophisticated processes can be used to individualize elements of the content as well as the structure of printed materials.

With the capability to produce sophisticated, computer-tailored messages come new questions about material design. How much of a message should be tailored and how much should remain generic? Which individual characteristics should be used to customize the message? Just as tailoring clothing requires a set of specific, standard measurements of an individual, developing tailored health messages also requires a set of specific, standard measures taken from each patient. Three theoretical frameworks were used as guidelines in answering these questions for tailored smoking-cessation letters: the Health Belief Model,[2] the Transtheoretical Model of Change[3] and Attribution Theory.[4,5]

According to the Health Belief Model,[2] when persons perceive a *threat of disease*, they assess the *benefits* of and *barriers* to taking a recommended health action. If the perceived benefits of the action outweigh the perceived barriers, the model predicts a higher likelihood of taking and maintaining the recommended health action. We applied this model to the design of tailored health letters for smoking cessation, largely focusing our tailoring criteria on perceived benefits (improvement in health, encouragement from family and friends, and monetary savings[6]) and barriers (fear of weight gain, fear of failure, nicotine dependency, and perceived dependence on smoking for stress reduction[6]) associated with quitting smoking.

The stage-based Transtheoretical Model of Change[3] refers to the readiness of a person to make a particular behavior change. We tailored health letters differently to smokers in a *precontemplation* stage (when the smoker is not yet thinking about quitting) from letters to those in a *contemplation* stage (when the smoker is thinking about quitting within the next 6 months). For a smoker not expressing an interest in quitting, we focused on the perceived threat of smoking-related illnesses and the perceived benefits of quitting. For a smoker interested in quitting, the tailored message reinforced the smoker's stated perceived benefits of quitting while also addressing perceived barriers to quitting. According to the third theoretical framework used, Attribution Theory,[4,5] expectation of success is dependent on the perceived causes (attributions) of previous successes or failures on similar tasks. For example, "I failed to quit smoking because I'm a weak person with no willpower" is an example of an attribution for a previous failure that would make future success in quitting less likely. We used the constructs of Attribution Theory to alter smokers' perceptions of their previous failures, hoping that they would examine these failures critically, and subsequently develop better strategies for future quit attempts.

This paper presents two studies conducted among patients of community-based family physicians to determine the impact of computer-tailored smoking cessation letters. Using the theoretical frameworks described, the tailoring algorithms for smoking cessation included (1) perceived benefits of and barriers to smoking cessation, (2) stage of change with respect to smoking cessation, and (3) previous attempts to quit smoking and their associated attributions. We describe and discuss the measures and methods we used to create computer-tailored smoking cessation letters, and those letters' effects on smoking cessation. We also describe existing programs for tailored smoking cessation messages and methods for tailoring health messages in primary care practice settings.

Methods

Study 1

SAMPLE AND DESIGN

During March and April 1990, trained interviewers used a computer-assisted telephone interviewing system to collect data from 397 adult patients of a large family practice office in a mid-sized city in North Carolina. Eligible patients were those aged 40 to 65 years who had seen a family physician in the practice no more than 6 months before being interviewed, had telephones with available and working numbers, did not share a household with someone else from the sample list of patients who had recently seen a family physician in the practice, and were mentally and physically capable of being interviewed. The median length of an interview was 13 minutes. Thirty-eight people (10%) either refused to participate or did not complete the interview. Interviewers did not attempt to complete interviews with patients who (1) according to family members' reports, were physically impaired and unable to come to the telephone, (2) had extreme difficulty hearing or speaking on the telephone, or (3) in the trained interviewers' judgment, seemed unable to understand the interview questions. Of the 359 who completed the interview, 72 (20.1%) reported "smoking a tobacco cigarette, even a puff, in the last week." This sample of

cigarette smokers was randomly assigned to receive one of two smoking-cessation health letters, and was reinterviewed approximately 4 months after the baseline interview.

MEASURES

At baseline, we determined each patient's smoking status, asking if he or she had "smoked a tobacco cigarette, even a puff, in the last 7 days." We assessed each smoker's stage using questions derived from Prochaska and DiClemente's Transtheoretical Model.[3] Subjects who said they were not interested in quitting within the next 6 months were classified as "precontemplators." Smokers who were interested in quitting were asked whether they were interested in quitting within the next 30 days. If not, they were classified as "contemplators." Smokers who were interested in quitting within the next 30 days were classified as a "preparation" stage.

Following questions on smoking stage, smokers were asked why they were interested in quitting (perceived benefits), and what might keep them from succeeding if they were to try quitting (perceived barriers). Participants were also asked to determine their risks of acquiring smoking-related illnesses if they continued smoking and their risks if they quit smoking. Finally, smokers were asked if they had tried but failed to quit in the past. Smokers who had made previous unsuccessful attempts to quit smoking were asked to consider the cause of the failure. Attribution for the failure was assessed by asking whether the cause was something within themselves or an external situation, whether the cause was within or beyond their control, and whether the cause was changeable or unchangeable.

At follow-up, those identified as smokers at baseline were again asked whether they had "smoked a tobacco cigarette, even a puff, in the last 7 days." If so, interviewers repeated the smoking-related questions asked at baseline, plus a few questions regarding "the health information you may have received in the mail."

TAILORED SMOKING LETTERS

A library of text and graphic files was created to address health-related beliefs, smoking stages, and attributions for previous failures. Messages were pretested in physician waiting rooms among patients not included in the sample. The brief health letters were written in a simple, newsletter style, and each segment could be preceded or followed by many possible text combinations. Desktop publishing techniques were used to coordinate placement of texts in a standardized letter layout. Specifically, interview data from smokers in the experimental group were transferred from an SAS[7] data set to an ASCII file that delineated

which text segments each smoker should receive. Data in each smoker's ASCII file were then read by a Microsoft Word[8] program that compiled the appropriate texts. The algorithms could create more than 55,000 different versions of the tailored health letters, each one relevant to a smoker's individual characteristics. Only if two people gave identical responses in the baseline interview would two smokers receive the same tailored health letter.

Following the baseline interview, either a tailored or a standardized letter was mailed to each subject according to prior random assignment. Each health letter was accompanied by a cover letter with a digitized signature on the physician's letterhead. The envelope bore the physician's logo and address label.

STANDARDIZED SMOKING LETTERS

The standardized, or generic, health letter, typifying usual care communication, was an adaptation of the National Cancer Institute's "Quit for Good"[9] pamphlet. Messages from this publication addressed general benefits of and barriers to quitting smoking. Whereas the tailored health letters addressed only the issues that, according to the baseline interviews, were relevant for the individual recipients, the generic health letters addressed a variety of factors that *might* be relevant to recipients. To minimize differences in appearance, tailored and generic health letters were similar in length, type face, and stationery.

STATISTICAL ANALYSES

Assignment to the experimental group (that is, subjects who received the tailored health letters) or the comparison group (those who received the generic health letters) was an independent variable for all analyses. Analyses were adjusted for significant demographic predictors of smoking cessation using an analysis of covariance model. Effects of the intervention were also examined within demographic groups (age, sex, and education level) and within light-smoking as opposed to heavy-smoking consumption categories. We hypothesized that lighter smokers would benefit more from our tailored health letters, since tailoring for cognitive and behavioral factors alone would likely have little effect on heavy smokers. Because heavy smokers generally score higher on measures of nicotine dependency, they tend to have poorer outcomes from smoking-cessation efforts[10] and benefit more from nicotine replacement therapies.[11] Since our tailored print intervention included no provision for nicotine replacement therapy, we analyzed the effects of the intervention for the sample as a whole and for the sample of moderate and light smokers (<20 cigarettes per day).
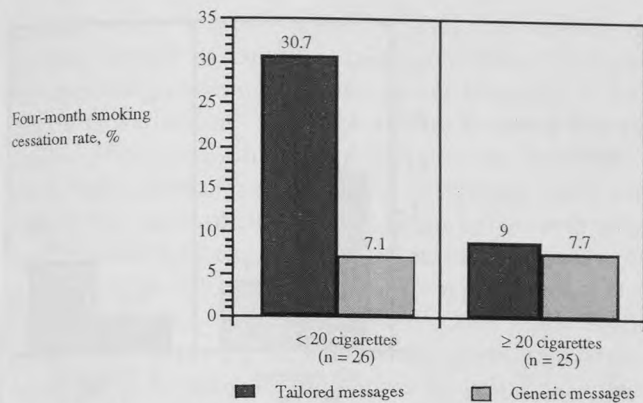
Figure 1. Four-month smoking cessation rates among family practice patients receiving either computer-tailored cessation messages or generic cessation messages, stratified by number of cigarettes smoked per day (N=51). Cessation rates for tailored and generic message groups differed significantly among patients smoking <20 cigarettes per day (adjusted for age, education, and sex; F=4.8, P<.05) but not among patients smoking ≥20 cigarettes per day.

Results

Of the 72 smokers at baseline, 67.7% were female, the average age was 49.5 years, and the average number of cigarettes smoked per day was 17.4. A total of 51 smokers (70.8% follow-up response rate) completed follow-up interviews over the telephone. No significant differences in follow-up rates were found in the experimental group, by age, education, sex, or number of cigarettes smoked. In study 1, age was found to be moderately associated with smoking cessation at follow-up (younger smokers were more likely to have quit). Differences between study 1 and study 2 were addressed by adjusting for age, level of education, and sex in the analysis models of both studies.

Smoking cessation rates were 20.8% among those receiving tailored health letters and 7.4% among those receiving generic health letters (adjusted for age, education, and sex, F=3.4; P<.10). No significant differences in intervention effects were found among patients in specific age, sex, or education categories. However, as hypothesized, significant effects of the tailored health letters were found among moderate to light cigarette smokers (Figure 1). Of moderate to light smokers who received tailored health letters, 30.7% reported quitting smoking approximately 4 months later, vs 7.1% of moderate to light smokers who received the generic smoking cessation letters (adjusted for age, education, and sex, F=4.8; P<.05).

To examine cessation rates that might have been obtained with a larger follow-up response rate, we used a worst-case scenario, treating all nonrespondents at follow-up as smokers. In this scenario, cessation rates among moderate to light smokers would have been 25.0% in the experimental group and 5.3% in the comparison group (adjusted for age, education, and sex, F=6.0; P<.05).

Methods

Study 2

SAMPLE AND DESIGN

During July and August 1992, 1484 adult patients from 12 community-based, group family practice physicians' offices in North Carolina completed a self-administered questionnaire assessing smoking status and daily cigarette consumption as well as seven other health-related behaviors (eg, alcohol use, exercise, and diet) and three screening practices (mammography, Papanicolaou smear, and cholesterol testing). Eligible patients were those aged 18 to 75 years who received medical care at one of the 12 participating physician practices. Patients who entered the practice during the data collection period were approached by trained graduate student research assistants, who determined their eligibility, explained the study, and asked the patients to complete the questionnaire while waiting to see a health care provider. Thus, the initial sample included all patients who were seen by a family physician in the practice on the days when a graduate assistant was present.

Of 2044 eligible patients, 1588 (77.7%) agreed to participate. Response rates ranged from 65% to 95% across the 12 practices. Refusers were disproportionately male, and, by research assistants' estimates, older. The primary reasons given for not participating were "not interested in completing the questionnaire" (61%) or "too sick" (18%). Of the 1588 patients who completed a questionnaire, 104 had to be removed from the study because of incomplete data. Data presented here are from the remaining 1484 patients. Of this group, 410 (27.6%) reported "smoking a cigarette, even a puff, in the last week." Smokers were asked if they were interested in quitting within the next 6 months. Respondents who were not interested in quitting within this period (precontemplators) were neither sent health letters nor included in these analyses. Smokers interested in quitting within the next 6 months (n=296, 72.2% of smokers in the sample) were randomly assigned to receive either a tailored health letter or no letter. Note that in study 1, comparison group subjects received a generic smoking cessation letter, whereas in study 2, comparison group subjects received no smoking cessation letter.

Both groups were reassessed approximately 6 months later to determine smoking status. Data were collected using

a combination of mailed surveys and follow-up telephone interviews of nonrespondents.

Measures, letter tailoring, and analyses. Measures were similar to those used in study 1 with several notable changes. As in study 1, each smoker's stage of change and perceptions of the benefits of and barriers to quitting smoking were assessed at baseline. Subjects were also asked whether they had tried but failed to quit in the past, and about perceived health risks and benefits. Letter-tailoring procedures were also similar to those used in study 1. However, since messages related to perceived threat of smoking-related illnesses were thought to be primarily relevant for smokers moving from the precontemplation into the contemplation stage, and precontemplators were not included in study 2, much less emphasis was placed on the measures of the perceived threat of smoking related illnesses. Finally, we eliminated measures of causal attribution. Attribution measures, while considered important, were difficult to measure and did not transfer well to a self-administered questionnaire. Subjects in study 2 (experimental group) who reported previous smoking cessation failures were sent tailored health letters including only general messages aimed at refocusing their causal attributions of the failure. Adjustments made to the data collection and tailoring algorithms resulted in health letters that could be sent in roughly 5000 combinations, many fewer than the number of combinations possible in study 1. Sample tailored letters are presented in the Appendix.

Analysis procedures were similar to those used in study 1. Assignment to experimental (tailored health letters) or comparison (no letter) group was an independent variable in all analyses. Analyses were adjusted for significant demographic predictors of smoking cessation using an analysis of covariance model. Effects of the intervention were also examined within demographic groups (age, sex, and education level) and within light-smoking as opposed to heavy-smoking consumption categories. As in study 1, those who had reported smoking at baseline were asked whether they had "smoked a cigarette, even a puff, in the last 7 days." If so, interviewers repeated the smoking-related questions asked at baseline, and asked a few questions about "the health information you may have received in the mail."

Results

Of the 296 smokers at baseline, 66.9% were female. The average age was 36.7 years, and the average number of cigarettes smoked per day was 17.7. A total of 197 smokers (67% response rate) completed follow-up surveys.
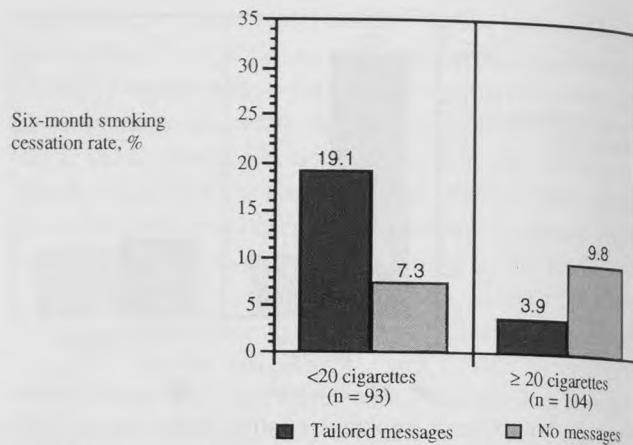

Figure 2. Six-month smoking cessation rates among family practice patients receiving either computer-tailored cessation messages or no messages, stratified by number of cigarettes smoked per day (N=197). Cessation rates for tailored and no message groups differed significantly among patients smoking <20 cigarettes per day (adjusted for age, education, and sex; F=4.6; P<.05) but not among patients smoking ≥20 cigarettes per day.

Respondents did not differ significantly from nonrespondents by experimental group or education level. Respondents were more likely to be older and female than nonrespondents. Education was associated with cessation at follow-up: smokers with more education were more likely to report having quit. Analyses in both studies were therefore adjusted for age, level of education, and sex.

As in study 1, significant effects of the tailored health letters were found for only the moderate to light cigarette smokers (Figure 2). Among moderate to light smokers who were sent tailored health letters, 19.1% reported quitting smoking approximately 6 months later, compared with 7.3% of moderate to light smokers who were sent no smoking cessation letter (adjusted for age, education, and sex, F=4.6; P<.05). Also similar to study 1, no significant differences in smoking cessation were found between patients in specific demographic groups.

We again examined cessation rates that might have been obtained with a larger follow-up response rate by using a worst-case scenario: treating all nonrespondents as smokers at follow-up. In this scenario, cessation rates among moderate to light smokers would have differed significantly: 13.2% in the experimental group and 4.8% in the comparison group (adjusted for age, education, and sex, F=4.6; P<.05).

Discussion

Results from both studies indicate that computer-tailored smoking cessation information has a positive effect. These

findings add to a growing body of evidence supporting the effectiveness of computer-tailored messages for cigarette smoking cessation,[12] breast cancer screening,[13] and dietary fat reduction.[14] In both studies reported here, a positive effect of tailoring was found only among moderate to light smokers, which is not surprising, given the difficulty of altering smoking-cessation behavior among heavy smokers in the absence of nicotine replacement therapy.[11] Our tailoring focused only on psychosocial factors and included no provision for nicotine replacement therapy. Integrating psychosocial and physiologic treatments by combining tailored smoking cessation letters and nicotine replacement therapy might be of greater assistance to heavy smokers.

Study 1 included all patients who smoked cigarettes, regardless of interest in quitting. In this first study, health letters were tailored using elements of three psychosocial models of health-related behavior, particularly the Health Belief Model.[2] Among patients not interested in quitting smoking, we tailored messages to emphasize the perceived threat of smoking-related illness and the benefits of quitting smoking (including health and monetary benefits and support from family and friends). For smokers interested in quitting smoking, we tailored messages to address benefits of quitting smoking and perceived barriers to quitting (including stress, anxiety, fear of weight gain, pressure from other smokers, and fear of failure).

In our second study, only the patients who indicated interest in quitting smoking in the next 6 months or sooner received tailored health letters. All messages targeted perceived benefits of and barriers to quitting smoking. These changes resulted in a smaller number of possible message combinations in the study 2 experimental intervention than in the study 1 intervention. We do not know, however, if the smaller intervention effects found in study 2 are related to these alterations. Both studies were relatively small, and cessation rate differences between the studies may have been related to chance, to differences that existed in the study logistics and methods (for example, the longer follow-up interval in study 2), or to historical effects of different study periods. The similarities of these two studies, however, far outweigh their differences. Each study included patients from a sampling frame of nearly all patients visiting the family practice, collected similar data on smoking-related characteristics from each patient, and sent out tailored messages using similar computer algorithms.

Tailoring health letters to individual characteristics of patients allowed us to present in clear detail only the information most relevant to each patient. We think the elimination of extraneous information increased the likelihood that patients would read their health letters. The sheer length of generic self-help manuals and pamphlets may discourage effective use of these materials, whereas tailored materials, which include only relevant information, can maximize vividness and persuasiveness. Tailoring also allows for the provision of more information concentrated on a few key topics rather than less information on a larger number of topics, as is typical with pamphlets or short self-help guides. Further, the process of creating tailored information can also benefit the physician-patient interaction. The questions on which we based tailored messages were brief, direct, and easily asked in a 3- to 5-minute smoking-cessation consultation. The answers to questions about benefits, barriers, and readiness to change behavior can be easily incorporated into immediate physician recommendations and advice.

How feasible computer tailoring is in practice depends a great deal on the type of practice. Large health maintenance organizations (HMOs), such as Kaiser Northwest, already use computer algorithms to prompt and remind patients to engage in health-related actions.[15] Many smaller medical offices use computers to track patients for billing purposes, and the dissemination of software to track patients for routine medical procedures is increasing. Simple data-collection methods and software designed to track, remind, and educate patients probably will continue to be integrated into the billing software of personal computers.

Computer-tailored letters can be developed using existing word processing software (eg, Microsoft Word[8]) that enables a user to combine a data document of relevant patient variables (eg, name and smoking-related characteristics) with a master document containing the tailored letter structure. Specific messages can automatically be placed into the tailored letter structure on the basis of the variables identified in the data document. An alternative to creating one's own tailoring program is to purchase software that has preprogrammed messages and master documents. This eliminates the time-consuming process of creating appropriate master documents and messages. Computer software designed to assist health professionals in the creation of their own tailored messages is likely to be available by the time this article is published. Finally, a number of pharmaceutical companies are currently using computer-tailored patient education messages as a behavioral adjunct to prescription medications.

In a focus group discussion conducted during the development of these computer-tailored messages, one physician described how her father, also a physician, had personally written letters to all the mothers in his practice, telling them about a new oral polio vaccine and the importance of having their children vaccinated. While the benefits of handwritten letters to patients probably far outweighs those of our computer-tailored health letters,

today's daily patient load makes a handwritten approach difficult, if not impossible. Unfortunately, in many large practices, lengthy, impersonal, generic pamphlets and newsletters have taken the place of personal correspondence. Our use of modern computer technology is an attempt to enable today's busy health professionals to recapture the benefits of yesterday's personalized attention. We view this technology as a tool not to replace but to enhance the quality of physician-patient communications.

References

1. Skinner CS, Seigfreid JC, Kegler MC, Strecher VJ. The potential for computers in patient education. Patient Educ Counseling 1994; 22:27–34.
2. Becker MH. The health belief model and personal health behavior. Health Educ Monogr 1974; 2:324–473.
3. Prochaska JO, DiClemente CC. Stages and processes of self-change of smoking: toward an integrative model of change. J Consult Clin Psychol 1983; 51:390–5.
4. Weiner B. An attributional theory of motivation and emotion. New York, NY: Springer-Verlag, 1986.
5. Försterling F. Attributional conceptions in clinical psychology. Am Psychol 1986; 41:27–37.
6. Hill HA, Schoenbach VJ, Kleinbaum DG, Strecher VJ, Orleans CT, Gebski VJ, Kaplan BH. A longitudinal analysis of predictors of quitting smoking among participants in a self-help intervention trial. Addict Behav 1994. In press.
7. SAS user's guide: statistics, version 5. Cary, NC: SAS Institute, 1985.
8. Microsoft Word user's guide: version 5.0. Redmond, Wash: Microsoft Corporation, 1992.
9. Quit for good. Bethesda, Md: National Institutes of Health, National Cancer Institute, 1983. APR report No. NIH-NCI-83-2494.
10. Killen JD, Fortmann SP, Telch MJ, Newman B. Are heavy smokers different from light smokers? A comparison after 48 hours without cigarettes. JAMA 1988; 260:1581–5.
11. Fagerström KO. Towards better diagnoses and more individual treatment of tobacco dependence. Br J Addict 1991; 86:543–7.
12. Velicer WF, Prochaska JO, Bellis JM, DiClemente CC, Rossi JS, Fava JL, Steiger JH. An expert system intervention for smoking cessation. Addict Behav 1993; 18:269–90.
13. Skinner CS, Strecher VJ, Hospers HJ. Physician recommendations for mammography: do tailored messages make a difference? Am J Public Health 1994; 84:43–9.
14. Campbell MK, DeVellis BM, Strecher VJ, Ammerman AS, DeVellis RF, Sandler RS. The impact of message tailoring on dietary behavior change for disease prevention in primary care settings. Am J Public Health 1994; 84:783–7.
15. Vogt TM. Paradigms and prevention. Am J Public Health 1993; 83:795–6.