Long-Term Results of a Smoking Reduction Program

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Introduction: There have been few comprehensive evaluations of smoking reduction, especially in health care delivery systems, and little is known about its cost, maintenance of reduced smoking, or robustness across patient subgroups.

Methods: A generally representative sample of 320 adult smokers from an HMO scheduled for outpatient surgery or a diagnostic procedure was randomized to enhanced usual care or a theory-based smoking reduction intervention that combined telephone counseling and tailored newsletters. Outcomes included cigarettes smoked, carbon monoxide levels, and costs.

Results: Both intervention and control conditions continued to improve from 3- to 12-month assessments. Between-condition differences using intent-to-treat analyses on both self-report and carbon monoxide measures were nonsignificant by the 12-month follow-up (25% vs. 19% achieved 50% or greater reductions in cigarettes smoked). The intervention was implemented consistently despite logistical constraints and was generally robust across patient characteristics (eg, education, ethnicity, health literacy, dependence).

Conclusions: In the absence of nicotine replacement therapy, the long-term effects of this smoking reduction intervention seem modest and nonsignificant. Future research is indicated to enhance intervention effects and conduct more comprehensive economic analyses of program variations.

Key Words: smoking reduction, mediators, randomized controlled trial, RE-AIM

There is need for practical, innovative programs that can reach and assist smokers. Despite considerable progress, there has been a plateau in terms of national smoking rates.1,2 The majority of current smokers do not participate when offered cessation assistance, and only about 5% of those who attempt to quit in a given year successfully do.1 Our research group has developed a smoking reduction intervention that is designed to be broadly applicable and integrated into other smoking modification options in a large managed care organization.3

This intervention was designed to fit the context of hospital-based cessation research.4 Presently there is a trend toward shorter hospital stays, including an increasing proportion of surgeries and other invasive medical procedures conducted in outpatient settings. This has limited the ability of hospital staff to intervene with patients on-site. Few studies have used a harm reduction (reduced consumption of cigarettes) approach. The rationale for this approach is that: (1) smoking reduction is becoming accepted as an alternative for individuals who do not want to quit smoking,3,5–9 (2) reduction seems to enhance later cessation,9 and (3) a large percentage of smokers decline to participate in cessation programs.3,10

The purposes of this study were to: (1) determine the effectiveness over 12 months of the smoking reduction program relative to an enhanced usual care condition in a practical randomized trial11; (2) assess the robustness of the program (moderator effects) across patient characteristics; and (3) estimate the costs of this program.

Methods

This trial was conducted at Kaiser Permanente Colorado (KPCO), targeting members 18 years of age or older, currently smoking 10 or more cigarettes per day, and scheduled for an outpatient surgery or diagnostic procedure (ie, mammography, sigmoidoscopy). It received KPCO Institutional Review Board approval. We used the KPCO electronic medical record to identify individuals who met the aforementioned eligibility criteria.

Recruitment

Members eligible for the program were notified by a personalized introductory letter from KPCO’s Chief of Preventive Medicine. An informed consent form and “opt out” postcard were included with the introductory letter. Members who did not decline via postcard were contacted by trained telephone interviewers.

Patients were excluded if they (1) smoked fewer than 10 cigarettes per day, (2) could not read or understand English, (3) canceled or postponed their medical procedure, (4) were interested in quitting smoking at that time, or (5) planned to leave the area before the follow-up assessment.
The medical procedure for each participant was used as a “teachable moment” to make changes in their smoking habits. Members were told that the study involved receiving phone calls and personalized mailed materials to help them reduce the number of cigarettes smoked. Patients who had difficulty deciding between quitting or cutting down were advised to attempt cessation and were referred to their choice of several health plan and state quit line cessation options.

Baseline survey assessments were completed using a computer-assisted telephone interview after which participants were randomly assigned to intervention conditions, using a computer algorithm developed by the project statistician. Those randomized to intervention began the first phone counseling session immediately upon completion of the baseline assessment. Participants also provided samples for the biochemical outcomes of the study. Recruitment took place between November 2004 and April 2006. Follow-up assessments were completed between February 2005 and September 2006.

Intervention

The intervention was based on social-ecological theory as described in more detail in Glasgow et al, and addressed the interplay among cognitive, interpersonal, and environmental components. A graduated reduction approach was used, with participants setting individualized goals.

Each counseling call used strategies to heighten participant self-efficacy to achieve and sustain reduced smoking levels. An assessment, goal setting, and barriers identification and resolution protocol was used to help participants improve confidence in their ability to reduce the number of cigarettes they smoked. Participants were encouraged to set an initial goal of a one-third reduction in number of cigarettes smoked. Based upon progress and self-efficacy, participants’ later reduction goals were individually tailored, although they were encouraged to attempt at least a 50% reduction as recommended by Windsor et al. This level was selected a priori as a clinically significant measure of reduction and to be a substantial enough reduction to address partial compensatory smoking. Those successful in achieving a 50% or greater reduction were then encouraged to consider cessation.

Intervention Delivery. The intervention was delivered across a 6-month time period and consisted of 4 telephone counseling sessions, 4 individually tailored newsletters, and 1 targeted newsletter. The intervention components were sequenced and gradually faded over time (Fig. 1). Each telephone counseling call was tailored to the individual based upon self-efficacy, barriers to reduction, and participants’ reduction goals. Newsletters included specific tailoring based upon data collected during the preceding telephone counseling call. The reduction program consisted of tailored behavioral and environmental change strategies (eg, avoiding high-risk situations, asking family and coworkers not to smoke in one’s presence).

Enhanced Usual Care Condition. Individuals randomized to the “usual care” (UC) condition participated in the recruitment/baseline call. Three quarterly, generic health education mailings were sent out on the same newsletter mailing schedule as the first, third, and fifth newsletters for the intervention. UC participants also participated in the same 3 biochemical sample assessments as intervention participants.

Measures

Outcomes. Both self-report and biochemical measures of smoking were collected at baseline, 3- and 12-month assessments by research staff separate from intervention phone callers. The self-report measure asked about the number of cigarettes smoked on (a) workdays and (b) nonworkdays the in the previous week, because preliminary research indicated differences in smoking rate between weekends and weekdays. A composite self-report measure of cigarettes per day was calculated based upon a weighted average \[\frac{[(5 \times \text{weekday rate}) + (2 \times \text{weekend rate})]}{7}\]. Carbon monoxide (CO) in expired breath samples was assessed using a Vitalograph CO monitor (Vitalograph Inc. Lenexa, KS).

Demographic and Moderator Variables. Background and potential moderator variables included age, gender, number of chronic illnesses, ethnicity, education, income, years smoked, cigarettes per day, other smokers in the home, if the patient’s physician had recommended quitting, and if cigarettes were purchased by the carton versus smaller quantities. Psychosocial variables included depressive symptoms as assessed by the 2 questions endorsed by the KP Care Management Institute National Depression Guideline (sensitivity = 96% and specificity = 57%). Health literacy was assessed by the 3-item scale of Chew et al, and nicotine dependency was assessed by 5 items from the Wisconsin Assay of Relapse and Dependence. Finally, support from family/friends was assessed via a single item asking participants to rate amount of support received for smoking reduction on a 5-point scale.

Cost Analysis. Using methods described in detail elsewhere, we conducted an economic analysis of the costs associated with the intervention. These analyses were conducted primarily from the perspective of a potential adopting organization or payer, such as Medicare or a health insurance plan. These analyses evaluate the cost of delivering the intervention compared with UC. Using data collected during the development and implementation of the program, we estimated total intervention costs, incremental costs associated with the intervention relative to UC and costs per participant. Costs included the recruitment of staff and participants; labor costs for phone counselors; production and mailing costs of tailored newsletters, and supplies.

Analyses. Repeated measures analyses were used to evaluate intervention effects and improvement from baseline to the 3- and 12-month follow-ups on self-reported and biochemical measures of smoking. Multiple regression analyses were conducted to identify moderator variables (using interaction terms) that altered the impact of intervention. A 2-tailed \( \alpha \) level of 0.05 was adopted for significance.
Results

Table 1 summarizes the baseline characteristics of participants. There were no significant differences between conditions. The majority of participants was older (average age = 55) female, white, smoked approximately a pack a day, and had smoked for almost 40 years. Most had multiple chronic conditions, with the mean being over 5 illnesses.

Implementation and Attrition

Seventy-nine percent of all intervention participants received at least 3 of the 4 phone calls, (96% of those who did not withdraw from the program), and 73% received 4 or more newsletters (89% of those who did not withdraw).

There were, however, challenges with retaining participants. As can be seen in Figure 1, more intervention than control participants received at least 3 phone calls and 4 newsletters, but there were still challenges with retaining participants.

FIGURE 1. Participant flow diagram.
control participants dropped out (a total of 37% vs. 18% by the 12-month follow-up, \( P < 0.05 \)). The pattern was for intervention participants to drop out at each phone contact. Because of the differential dropout, we relied primarily on intent-to-treat analyses that assumed missing cases were at their baseline level. For interpretive purposes, we also note results of complete cases analyses in instances in which results differed.

### Outcome Effects

The longer-term results on both behavioral and biochemical outcomes were disappointing. As shown in Table 2, only one between-group comparison was statistically significant (50% reduction at 3 months in favor of the intervention group, 15.9% vs. 7.7%), and by time of the 12-month follow-up this difference was no longer significant (25% vs. 18.6%). In complete cases analyses (not shown), this difference remained significant at the final follow-up (34.3% vs. 20.8%, \( P < 0.05 \)). For 2 of the endpoints (50% reduction in self-reported cigarettes per day and 50% reduction in CO levels), the control group showed noteworthy improvement from 3 to 12 months, which was also evident to a lesser extent for the intervention condition. For continuous measures of number of cigarettes per day and CO levels, there was only modest change from baseline for both experimental conditions. Finally, there were no differences between conditions on quitting.

As can be seen, 6.7% of participants in the intervention condition reported having quit by the 12-month follow-up, compared with 4.4% of controls.

### Moderator Analyses

To limit experiment-wide error rate, all potential moderators were evaluated using backward elimination stepwise regression. No moderators (significant interaction effect) were found for CO measures. One significant moderator was found for reduction in number of cigarettes per day at 12 months—number of comorbid conditions. One moderator was identified for reducing number of cigarettes smoked by 50% or greater—gender, but it was different.

### Costs

Excluding the recruitment costs, total intervention costs were estimated at $106,982 ($29,505 variable costs) for an estimated $652 marginal cost per intervention participant relative to UC. These findings translate to $7132 per patient.
that cut smoking by 50%. As shown in Table 3, almost a third of the overall costs were related to recruitment and overhead.

**Discussion**

This project demonstrates that it is feasible to implement a relatively large-scale smoking reduction program within the context of a health care system. We were successful in recruiting patients and delivering intervention phone calls and newsletters in a timely manner. The outcome results were generally negative. Although the pattern of results favored the intervention over UC on most measures, differences between conditions were not statistically significant for any intent-to-treat outcome at 12 months. Complete cases analyses were more encouraging and suggest the need for research on ways to enhance retention in such minimal intervention programs. As observed in some low-intensity smoking cessation studies, intervention participants maintained or even increased their reductions between 3 and 12 months. However, UC participants evidenced even larger improvements.

Contextual factors may partially explain this pattern, especially among control participants. Colorado increased its tobacco tax and implemented a statewide no smoking ordinance, both of which have been found to reduce cigarette consumption.22–24 Alternatively, the 3-month follow-up, which included biochemical assessment, may have been differentially reactive for the control condition. It would have been helpful to have collected process data to obtain participant perceptions on this issue.

The prospective cost data revealed important findings. The first is that participant identification and recruitment expenses were almost one-third of the total costs of the program. Such costs are often excluded from cost estimates,21 yet are an important and necessary part of program implementation. Second, although the actual costs of conducting the phone counseling calls, preparing and delivering the tailored newsletters were comparable, training and ongoing supervision of phone interviews cost almost as much as the former 2 categories combined. Unless the costs could be reduced or the program is shown to produce longer-term effects on smoking cessation rates,24 it is unlikely that health-care systems would adopt such a program.

Moderator analyses revealed that outcomes were generally consistent across a wide range of potential factors including dependence, smoking rate, health literacy, and depression screener scores. Only 2 potential moderators were significant in any analysis, and these were inconsistent across outcomes.

Limitations of this study include exclusion of Spanish-speaking smokers, the high attrition rate, and being conducted in only one health care setting. Strengths include the relatively comprehensive analyses of implementation, moderation, the collection of 12-month follow-up data including both self-report and biochemical measures, and data on program costs.

In summary, this study demonstrated that it was feasible to implement a smoking reduction program in the context of a health care system. However, the current program does not seem to produce beneficial long-term effects. Directions for future research might include adding components such as nicotine replacement therapy and evaluating if the “teachable moment” of an upcoming medical procedure actually enhances effects or if a broader, less expensive smoking reduction option might work as well.

**REFERENCES**


