Cost-effectiveness of the Clinical Practice Recommendations in the AHCPR Guideline for Smoking Cessation

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Victor Hasselblad, PhD; Timothy Baker, PhD

Context.—The Agency for Health Care Policy and Research (AHCPR) published the Smoking Cessation: Clinical Practice Guideline in 1996. Based on the results of meta-analyses and expert opinion, the guideline identifies efficacious interventions for primary care clinicians and smoking cessation specialty providers.

Objective.—To determine the cost-effectiveness of clinical recommendations in AHCPR’s guideline.

Design.—The guideline’s 15 recommended smoking cessation interventions were analyzed to determine their relative cost-effectiveness. Then, using decision probabilities, the interventions were combined into a global model of the guideline’s overall cost-effectiveness.

Patients.—The analysis assumes that primary care clinicians screen all presenting adults for smoking status and advise and motivate all smokers to quit during the course of a routine office visit or hospitalization. Smoking cessation interventions are provided to 75% of US smokers 18 years and older who are assumed to be willing to make a quit attempt during a year’s time.

Intervention.—Three counseling interventions for primary care clinicians and 2 counseling interventions for smoking cessation specialists were modeled with and without transdermal nicotine and nicotine gum.

Main Outcome Measure.—Cost (1995 dollars) per life-year or quality-adjusted life-year (QALY) saved, at a discount of 3%.

Results.—The guideline would cost $6.3 billion to implement in its first year. As a result, society could expect to gain 1.7 million new quitters at an average cost of $3,779 per quitter, $5,353 per life-year saved, and $1915 for every QALY saved. Costs per QALY saved ranged from $1,108 to $4,542, with more intensive interventions being more cost-effective. Group intensive counseling counseling exhibited the lowest cost per QALY saved, but only 5% of smokers appear willing to undertake this type of intervention.

Conclusions.—Compared with other preventive interventions, smoking cessation is extremely cost-effective. The more intensive the intervention, the lower the cost per QALY saved, which suggests that greater spending on interventions yields more net benefit. While all these clinically delivered interventions seem a reasonable societal investment, those involving more intensive counseling and the nicotine patch as adjuvant therapy are particularly meritorious.

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Since publication of the AHCPR Smoking Cessation Clinical Practice Guideline in April 1996, Dr Fiore has been consulting, receiving funding for clinical research studies, and/or speaking for SmithKline Beecham pharmaceutical company. Prior to 1994 (when work on the Guideline began), Drs Baker and Fiore had worked on clinical research studies funded in part by ALZA Corp, CIBA Geigy Corp, Eli Lilly Pharmaceutical, Lederle Laboratories, Glaxo Wellcome, SmithKline Beecham, and Hoechst Marion Roussel Inc. Prior to 1994, Dr Fiore had received honoraria for educational activities from CIBA Geigy, Eli Lilly, Marion Merrell Dow Inc, and Pierre Fabre-Diéu. The statements contained in this article are solely those of the authors and do not necessarily reflect the views or opinions of the Agency for Health Care Policy and Research.

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TOBACCO use has been cited as the chief avoidable cause of death in the United States, responsible for more than 420,000 deaths annually.1 Despite this, physicians and other practitioners fail to assess and counsel smokers consistently and effectively.2,4

This study analyzes the cost-effectiveness of the Agency for Health Care Policy Resource’s (AHCPR’s) Smoking Cessation: Clinical Practice Guideline.5 Released in April 1996, the guideline was developed over a 2-year period by a panel of smoking cessation specialists using extensive quantitative analysis of published effectiveness data. Recommendations include screening all presenting patients for tobacco use, advising patients who use tobacco to quit, and providing interventions that appear most efficacious. The recommendations were based on rigorous logistic regression meta-analyses of various cessation intervention outcomes, ranging from self-help materials to multiple group counseling lasting several hours or more. Recommendations were targeted specifically to 3 audiences: primary care clinicians, cessation specialists; and administrators, insurers, and purchasers of health care services.

Formulation of optimal health care policy requires an analysis of the costs of recommended interventions relative to their clinical effectiveness. This information is not readily available in the case of the AHCPR’s guideline. Few claims data exist to quantify current practice. Most counseling services are an integral part of physician-patient contacts with no separate billing, while other services, such as nicotine replacement and intensive counseling, are generally not covered by insurance and hence, do not produce a claims trail.

Finally, the benefits of stop-smoking treatments may be difficult to assess accurately. The immediate effect of efficacious treatment is smoking cessation, and this may or may not be related to immediate health benefits. Even when cessation leads to health benefits, these benefits are delayed many years, occurring...
through decreased morbidity or mortality across a wide range of illnesses. Many studies have found single smoking cessation interventions to be cost-effective. However, these studies do not provide cost-effectiveness data on the range of effective interventions that are both in current use and recommended for clinical practice by the AHCPR.

METHODS

General Approach

The cost estimates developed in this study were not based on individual patients. Instead, they were based on recommended resource inputs found in the guideline report. Similarly, estimates of the marginal effectiveness of interventions were taken from the guideline and were based on prospective clinical trial results.

Two general methodological approaches were taken, both incorporating a societal perspective. Under one approach, three quarters of all smokers were assumed to undertake a particular intervention during a year’s time. This represents the approximate percentage of current US smokers who have made a previous quit attempt. This answers the question, “What would be the cost-effectiveness of the guideline if all willing smokers could be encouraged to undertake one of the 15 interventions recommended by the guideline panel?” When the resulting 15 cost-effectiveness ratios are compared across all cessation interventions, this informs policymakers as to which interventions appear to be the most cost-effective.

Under the second scenario, panel experts were queried regarding the likelihood of patients choosing one of the 5 counseling interventions with or without nicotine replacement. These probabilities were used to weight the costs and quit rates of the interventions. The result was a combined global cost-effectiveness ratio for the guideline as a whole, which answers the question, “How much would the guideline likely cost per life-year saved or quality-adjusted life-year (QALY) if adopted by practitioners, given the expected preferences of smokers for different interventions?”

Calculation of Cost-effectiveness Ratios

A cost-effectiveness ratio for a specific smoking cessation intervention can be decomposed into 4 components: (1) the cost of physicians screening the US patient population; (2) the cost of physicians advising smokers; (3) motivating unwilling smokers to try and quit; and, (4) the quit rate. The intervention cost is calculated as the weighted sum of the cost of the physician screening, advising, and motivation costs, which are incurred repetitively during several annual office visits, added to similar screening costs of hospitalized patients. Direct intervention cost of hospitalized patients were debited from those incurred by ambulatory patients. This avoids double counting such costs, as only 1 quit attempt was assumed during a year’s time regardless of whether a smoker was an inpatient.

Identification of Direct Interventions

The amount of counseling that smokers receive depends largely on patient and/or physician preferences. Based on the guideline, we modeled 5 possible counseling options that a patient may choose after receiving advice from a physician: (1) minimal, (2) brief, (3) full, (4) individual intensive, and (5) group intensive. The level of provider time and number of sessions vary widely among these 5 options. The first 3 interventions involve primary care clinicians, assumed to be physicians, while intensive counseling is performed by smoking cessation specialists. Each of the counseling options was analyzed both by itself and in conjunction with nicotine replacement (transdermal nicotine and nicotine gum).

Time Inputs

The assumptions that we made concerning the providers and length of time required for each intervention scenario are outlined in Table 1. The guideline recommends that health professionals screen all adult patients (aged 18 years or older) for smoking status during each office visit or hospitalization. We assumed that this task is performed by a registered nurse (RN) and that it requires 1 minute of provider time.

Following the identification of a smoker, initial smoking cessation advice is provided by physicians in either an office or a hospital setting. This task involves delivering a clear, strong, and personalized message urging the smoker to quit. We assumed that this would take 1 minute of physician time and that all smokers would be advised to quit at each of their office visits or sometime during the course of their hospitalization. Patients unwilling to quit after receiving initial advice are provided with a motivational intervention that involves an additional minute of physician time. We assumed all smokers would require a motivational intervention during at least 2 annual office visits or during the course of hospitalization.

Minimal, brief, and full counseling interventions are provided to smokers willing to make a quit attempt. These are delivered by primary care clinicians and involve increasing amounts of physician time. Among these 3 interventions, full counseling involves the greatest amount of physician time—15 minutes during an initial visit with two 10-minute follow-up visits. When nicotine replacement is used, an extra 3 minutes was allocated to the minimal, brief, and full counseling interventions to account for the time required to prescribe the pharmacotherapies and instruct patients in their use.

The individual intensive and group intensive counseling interventions begin with screening and advising tasks performed by primary care clinicians. Patients are then referred to a smoking cessation specialist. We assumed that smokers undergoing an individual intensive intervention receive 6 counseling ses-
sions that are each 30 minutes long. The first session involves 10 minutes of physician time for the purpose of assessing the patient and prescribing pharmaceutical therapy and an additional 30 minutes of time with an RN. The remaining time is divided between an RN with health education experience and a psychologist (three 30-minute visits for the former and two 30-minute visits for the latter). Across the 5 sessions, there is a total of 10 minutes of physician time, 80 minutes of RN time, and 60 minutes of psychologist time. We assumed that group intensive counseling is delivered to groups of 10 patients over 7 sessions that are each 1 hour long. Under this scenario, a physician is also available for a portion of the first session (in this case, 20 minutes). The remaining time for the first group session and sessions 2 through 7 involves an RN and a psychologist. These 2 professionals jointly provide services, and each contributes a total of 400 minutes of time across all sessions.

**Input Costs**

Physicians are the most costly provider group among primary care clinicians. Their costs include not only a return to their own time input but also any overhead costs associated with maintaining their practice. Other studies have used physician charges, but very few patients or insurers pay full charges today. Medicare rates were used instead, under the assumption that they more accurately reflect the physician's true marginal cost of providing an office visit. To determine the per minute cost of physician time for the initial intervention, per patient 1994 Medicare allowed charges for 10-, 20-, 30-, 45-, and 60-minute visits were calculated based on Current Procedural Terminology (CPT) codes for new patients receiving services in an office or another outpatient setting. They were then adjusted for medical services inflation through 1995. Next, a per minute cost was calculated for each visit code using the specified time intervals and a weighted average taken across visit types to account for differences in patients with respect to length of visit.

Based on this approach, we estimated that the Medicare effective physician allowable charge per minute for an initial visit was $1.97 in 1995. Using the same method, we estimated that the average per minute cost of physician time for follow-up office visits was $2.20. We used the CPT codes for subsequent hospital care to estimate initial physician advice and counseling costs in a hospital setting, ie, $1.92 per minute. We assumed that hospitalized patients would receive follow-up after discharge in an office or outpatient setting at the same $2.20 cost per minute.

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**Table 1.** Resource Utilization Assumptions

<table>
<thead>
<tr>
<th>Interventions for Primary Care Clinicians</th>
<th>Minimal Counseling</th>
<th>Brief Counseling</th>
<th>Full Counseling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screening for tobacco use Registered nurse</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Advice to quit Physician alone</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Initial cessation counseling Physician alone</td>
<td>3</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>Physician with patch or gum</td>
<td>6</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>Follow-up counseling</td>
<td>3-6</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>First follow-up physician visit</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
</tr>
<tr>
<td>Second follow-up physician visit</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
</tr>
</tbody>
</table>

| Intensive Interventions for Smoking Cessation Specialists | Individual Use Intensive Use Group Use Intensive Use |
|----------------------------------------------------------|------------------------------------------------------|-----------------------------------------------------|
| Screening for tobacco use Registered nurse               | 1                                                     | 1                                                    |
| Advice to quit Physician                                 | 1                                                     | 1                                                    |
| Cessation counseling sessions Physician                  | 10                                                    | 20                                                   |
| Registered Nurse                                         | 80                                                    | 400                                                  |
| Psychologist                                             | 60                                                    | 400                                                  |

*Data from Fiore et al.*
1. Patients selected a smoking cessation specialist are first screened in an office or hospital setting and advised to quit by a primary care clinician.
2. Counseling time for "individual intensive" patients is distributed over five 30-minute sessions.
3. Counseling time for "group intensive" patients is distributed over seven 1-hour sessions.

We used estimates from the US Bureau of Labor Statistics for mean weekly earnings to calculate the per minute cost of RN and psychologist time. In 1995, the average weekly earnings of RNs and psychologists were $729 and $658, respectively. Assuming that these professionals work an average of 40 hours each week, the per minute labor cost of RNs is $0.59, and for psychologists, the per minute labor cost is $0.29. To account for additional fringe and overhead costs, we doubled their salaries. Medicare physician claims already include a practice cost allowance and were not adjusted further.

The guideline recommends that patients receive educational materials during the course of their smoking cessation intervention. While physicians and hospitals often receive self-help pamphlets from government agencies or antismoking groups free of charge, there is a cost associated with these materials that is incurred by society at large. For each intervention scenario, we assumed that patients would receive 2 educational pamphlets during their counseling session at a total societal cost of $2.00 per patient per intervention.

The guideline recommends that providers offer nicotine replacement therapy to all smokers except in special circumstances, eg, pregnant women. Guideline recommendations were followed on the amount and dosages that each patient should receive. A complete smoking cessation intervention using the patch requires that patients use different dosages over a period of 8 weeks. We used the 1995 average wholesale price as an estimate of the cost of nicotine replacement. The average cost of an 8-week supply of the patch is $219.23. Nicotine gum is available under 1 brand name in 2-mg or 4-mg doses. Both doses come in boxes of 96, and the average wholesale price per box is $35.85 and $63.29, respectively. We assumed that patients use nicotine gum for the first 3 months of their quit attempt and chew an average of 10 pieces per day. This requires a single patient to purchase 10 boxes of gum. Therefore, complete treatments with 2-mg gum and 4-mg gum cost $388.50 and $632.50, respectively.

- Only a portion of patients willing to undergo an intervention quit successfully. We assumed unsuccessful quitters would purchase only a 4-week supply of the patch or gum. For transdermal nicotine, the average cost for the first month of patches is $114.38. A 4-week supply of nicotine gum requires approximately 3 boxes of gum at a cost of $116.55 for 2-mg gum or $189.87 for 4-mg gum.

**Resource Costs by Intervention Activity**

Table 2 displays our cost estimates of the guideline's recommended smoking cessation interventions. These estimates assume that patients first encounter a physician during the course of a routine office visit. All the interventions have the same cost per participant for preintervention screening ($0.60), advice ($1.97), and motivation ($1.97). For participant direct
Table 2—Smoking Cessation Costs per Participant*

<table>
<thead>
<tr>
<th>Cessation Intervention</th>
<th>Total Cost per Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without nicotine replacement</td>
<td></td>
</tr>
<tr>
<td>Medical counseling</td>
<td>14.51</td>
</tr>
<tr>
<td>Brief counseling</td>
<td>37.79</td>
</tr>
<tr>
<td>Full counseling</td>
<td>75.55</td>
</tr>
<tr>
<td>Individual intensive counseling</td>
<td>104.50</td>
</tr>
<tr>
<td>Group intensive counseling</td>
<td>53.14</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>With transdermal nicotine</td>
<td></td>
</tr>
<tr>
<td>Medical counseling</td>
<td>246.25</td>
</tr>
<tr>
<td>Brief counseling</td>
<td>262.93</td>
</tr>
<tr>
<td>Full counseling</td>
<td>300.69</td>
</tr>
<tr>
<td>Individual intensive counseling</td>
<td>323.73</td>
</tr>
<tr>
<td>Group intensive counseling</td>
<td>272.37</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>With nicotine gum</td>
<td></td>
</tr>
<tr>
<td>Medical counseling</td>
<td>415.52</td>
</tr>
<tr>
<td>Brief counseling</td>
<td>432.20</td>
</tr>
<tr>
<td>Full counseling</td>
<td>459.96</td>
</tr>
<tr>
<td>Individual intensive counseling</td>
<td>403.10</td>
</tr>
<tr>
<td>Group intensive counseling</td>
<td>414.84</td>
</tr>
</tbody>
</table>


The effectiveness of Smoking Cessation Interventions

The guideline uses long-term quit rates as its effectiveness indicator. Primarily using a modified intent-to-treat analysis technique, the researchers who support the guideline panel drew from peer-reviewed, published clinical trial literature based on at least 5 months of follow-up data to calculate percentages of individuals who successfully quit smoking using different interventions. Meta-analyses evaluated basic treatment characteristics such as counseling format (eg, individual vs group), duration of treatment, and use of pharmacotherapy. Studies that included the same intervention were grouped together, screened to ensure methodological rigor, and analyzed using either fixed or random effects logistic models. The guideline odds ratios (ORs), which indicate an intervention’s marginal effectiveness, are generated by exponentiating the logistic regression coefficients obtained from 56 studies in the meta-analyses.

From the meta-analyses, the average baseline “no intervention” quit rate was 8.8% vs 10.7% for minimal counseling, 12.1% for brief counseling, and 18.7% for full counseling lasting more than 10 minutes, all excluding pharmacotherapy. The baseline and intervention quit rates for intensive counseling (4-7 sessions) were 10.4% and 22.6%, respectively. Baseline quit rates vary by intervention owing to different samples and “self-help” activities among the various control groups in the clinical trials. Odds ratios for the patch and gum use and above counseling alone were found to range between 2.1 to 2.6 and 1.4 to 1.6, respectively. Intervention-specific marginal quit rates were derived by subtracting the underlying baseline quit rate.

Despite statistically controlling for “all-comers” vs “want-to-quit” subjects, the logistic coefficients estimated from the meta-analyses generated unreasonably high baseline quit rates (eg, 8.8%) for 2 reasons: many studies include only want-to-quit subjects, and some control subjects receive very low-intensity cessation interventions (eg, self-help materials). To apply the results of the meta-analyses to the entire US smoking population, the ORs derived from the analyses were applied to the underlying 3-month- or more quit rate of all smokers (ie, all-comers) in the United States. We assumed this rate was 5% (vs 5.7% for smokers quitting for at least 1 month). To illustrate our method, the estimated OR for brief counseling was 1.4, implying roughly a 40% gain in quitters. Using the most conservative ORs for the patch (2.1), the combined OR for brief counseling with the patch is 2.94 (ie, 1.4×2.1). Multiplying the underlying 5% quit rate by 2.94, after converting it into an OR (0.05/ 0.96=0.0526), results in an estimated OR of 0.153. Converting this OR back into a percentage quit rate equals 0.134 (ie, 0.156/(1+0.156)). Finally, subtracting the underlying 5% quit rate gives 8.4% as the marginal quit rate of brief counseling using the patch as adjuvant therapy. This is a more conservative estimate than one based on the average quit rate of the control groups in the clinical trials. Using the 8.4% baseline would have produced almost 60% more quitters.

Sensitivity analysis (discussed below) was also applied to the percentage of smokers willing to make a quit attempt during the year. To recognize that not all quitters stay abstinent, a 45% relapse rate is applied as well to the marginal quit rates. The 45% figure is based on considerable relapse data showing that most relapses typically occur within the first 6 months. Therefore, this figure estimates the relapse rate for subjects who have already passed the time of maximal relapse risk. Long-term follow-up data show that, of subjects who have been abstinent for 1 year, only some 80% or so will relapse over the subsequent 5 years. After 5 years relapse occurs, but the rate is extremely low. Also, after prolonged abstinence, the rate of relapse is approximately balanced by cessation occurring through subsequent quit attempts.

Quality-Adjusted Life-Years Saved

The guideline does not differentiate interventions by patient age. All smokers, regardless of age, are deemed candidates to try to quit. Moreover, the clinical trial results do not differentiate quit rates by intervention by age group. Quit rates were applied uniformly to the age- and sex-specific distribution of smokers and then were converted into years of life saved using published and unpublished 8.3% baseline developed by Piccinelli and Franks. The authors calculated sex- and age-specific years of life saved using life expectancy data for smokers and never smokers taken from Rogers and Powell-Griner, Fliscella and Franks' extrapolated mortality rates for smokers vs never smokers using a 20-year phase-in period.
based on mortality ratios of long-term quitters to never smokers derived from the American Cancer Society’s Cancer Prevention Study II. They also made a quality-of-life adjustment to the raw years-of-life-saved figures using an index of years of healthy life constructed from questions on the National Health Interview Survey (NHIS). Assuming that marginal quit rates apply uniformly to all age groups, an overall estimate of life-years saved was derived by weighting expected years saved within age group by the actual distribution of smokers by age group and by the uniform quit rate. Men aged 25 to 29 years are expected to gain 1.31 years of life, discounted at 3%, which is equivalent to 2.34 QALYs. Older men, aged 65 to 69 years, only save 0.47 years of life (0.69 QALYs). Women gain more years of life from quitting than men. Female quitters aged 25 to 29 years save 1.48 life-years (1.94 QALYs), while those aged 65 to 69 years save 1.11 life-years (1.08 QALYs). Given the current distribution of smokers, we calculated a weighted average of 1.46 life-years saved per quitter (1.97 QALYs). Our analysis (and the analysis of Fiscella and Frank) assumes a 3% discount rate for life-years saved. Sensitivity analyses were performed at 0% and 5%.

Table 3 shows the intervention’s marginal quit rates, expected number of quitters, and life-years and QALYs saved for each of the guideline interventions. If intensive counseling with transdermal nicotine were provided to three quarters of smokers in the United States willing to try to quit during a year’s time, it would generate the largest number of quitters, 3,546,000 (6,602,000 QALYs). Minimal counseling without pharmacotherapy results in the fewest quitters, 159,000 (373,000 QALYs). Based on patient preferences for the various interventions (discussed next), adoption of the guideline could be expected to generate 1,671 million additional quitters and nearly 3.3 million QALYs, discounted at 3% (Table 3).

### Intervention Decision Probabilities

In actual practice, patients and providers vary in their intervention preferences, and it is highly unlikely that all smokers would choose the same intervention. While group intensive counseling costs less per quitter than any of the other interventions, very few patients would actually choose this treatment option. Conditional probabilities incorporating willingness to quit and preferences concerning format and use of pharmacotherapy were calculated for the 15 interventions. Our baseline assumes that 25% of the US adult population smokes and that 75% of smokers would be willing to make a quit attempt in a year’s time. The 75% estimate reflects the total percentage of smokers who will try to make a quit attempt in a given year and reflects the increase in cessation attempts caused by introduction of the guideline interventions (eg, brief interventions offered across diverse health care settings). Based on the expert opinion of the guideline panel, we assumed that 40% of smokers would choose brief counseling, 30% would choose full counseling, 25% would choose minimal counseling, and 5% would choose intensive counseling (2.5% individual intensive counseling and 2.5% group intensive counseling). We further assumed that 75% of all smokers who are willing to try to quit, regardless of the length of counseling they choose, would use pharmacotherapy. Among those willing to use pharmacotherapy, 88% would choose the patch and 17%, nicotine gum. In our model, for example, 1.879% (0.25 × 0.75 × 0.40 × 0.75 × 0.88) of the entire US population would undergo brief counseling alone, 4.67% (0.25 × 0.75 × 0.40 × 0.75 × 0.88 × 100) would likely receive brief counseling and transdermal nicotine, and 0.166% (0.25 × 0.75 × 0.40 × 0.75 × 0.17 × 100) 0.25 would undergo brief counseling using nicotine gum as adjuvant therapy. When summed across the 15 interventions, the percentages add to the 18.75% of the entire US population who would be expected to undergo a quit attempt.

Sensitivity analysis of the decision probabilities involved testing the 75% rate of those who are willing to try and quit at 50% and 100%. The 5% relapse rate (after 5 months of abstinence) was also tested at 35% and 55% in some simulations.

### Basic Parameters

Each of the smoking cessation scenarios that we modeled is based on a common set of basic parameters. As of January 1, 1996, the US resident population older than 18 years was estimated by the US Bureau of the Census at 195 million. The probability of smoking is based on the NHIS, which found that, in 1993, 22% of the US adult population smoked cigarettes. We assumed that the proportion of the population who smoked remained constant between 1993 and 1996, producing approximately 48,745,000 adult smokers in 1996.

Our estimate of the number of physician office visits per year is based on the National Ambulatory Medical Care Survey. This study found that there was a total of 6,097,870 office visits in the United States in 1992 among the population aged 15 years and older, resulting in 3.11 physician office visits per year per adult.

Smokers have higher physician office and hospital utilization rates than people who have never smoked. Rice et al found that, on average, smokers experienced about 6% more physician office visits and spent 27% more days in the hospital than never smokers. If the ratio of the average number of physician visits among smokers vs nonsmokers is 1.06, and the average number of visits

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*Table 3—Expected Annual Number of Quitters and Life-Years Saved by Smoking Cessation Intervention, Assuming 75% of Smokers Attempt to Quit Once During the Year*  

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Marginal Quit Rate, %</th>
<th>Quitters, † No. in Thousands</th>
<th>Life-Years Saved, ‡ No. in Thousands</th>
<th>Quality Life-Years Saved,$ No. in Thousands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal counseling alone</td>
<td>0.94</td>
<td>189</td>
<td>276</td>
<td>373</td>
</tr>
<tr>
<td>With patch</td>
<td>6.70</td>
<td>1,347</td>
<td>1,968</td>
<td>2,558</td>
</tr>
<tr>
<td>With gum</td>
<td>3.68</td>
<td>1,734</td>
<td>1,072</td>
<td>1,449</td>
</tr>
<tr>
<td>Brief counseling alone</td>
<td>1.96</td>
<td>374</td>
<td>546</td>
<td>738</td>
</tr>
<tr>
<td>With patch</td>
<td>8.40</td>
<td>1,609</td>
<td>2,467</td>
<td>3,333</td>
</tr>
<tr>
<td>With gum</td>
<td>4.95</td>
<td>995</td>
<td>1,454</td>
<td>1,964</td>
</tr>
<tr>
<td>Full counseling alone</td>
<td>6.20</td>
<td>1,247</td>
<td>1,821</td>
<td>2,460</td>
</tr>
<tr>
<td>With patch</td>
<td>16.00</td>
<td>3,217</td>
<td>4,700</td>
<td>6,348</td>
</tr>
<tr>
<td>With gum</td>
<td>10.90</td>
<td>2,192</td>
<td>3,022</td>
<td>4,325</td>
</tr>
<tr>
<td>Intensive counseling alone</td>
<td>6.62</td>
<td>1,331</td>
<td>1,845</td>
<td>2,627</td>
</tr>
<tr>
<td>With patch</td>
<td>16.64</td>
<td>3,346</td>
<td>4,868</td>
<td>6,602</td>
</tr>
<tr>
<td>With gum</td>
<td>11.60</td>
<td>2,312</td>
<td>3,378</td>
<td>4,563</td>
</tr>
<tr>
<td>Combined intervention</td>
<td>. . . .</td>
<td>1,669</td>
<td>2,459</td>
<td>3,294</td>
</tr>
</tbody>
</table>

*Data from Fieno et al and Fiscella and Franks. Ellipses indicate not applicable.  
† The number of quitters is rounded to the nearest 10.  
‡ Life-years (discounted 3%) were derived using a 1.46 adjustment factor. The adjustment factor represents the average life-years saved per quitter given the current distribution of smokers and expected life-years saved for each sex-specific age group.  
$Quality-adjusted life-years (discounted 3%) were derived using a 1.97 adjustment factor. The adjustment factor represents the average life-years saved per quitter given the current distribution of smokers and expected quality-adjusted life-years saved for each sex-specific age group.  
Different quit rates were not available for “individual counseling” vs “group intensive counseling.” Therefore, the same quit rate (6.62%) was used for both interventions.  
† The variable was derived by weighting the individual interventions by the likelihood of smokers choosing each intervention.
per capita is 3.11, then the average smoker would experience 2.25 visits while nonsmokers would average 3.06 visits. We estimated that 158,580,925 physician office visits were made by smokers (3.25 * 48,475,000) in 1992.

Using NHIS estimates of the distribution of short-term hospital episodes by age and sex, we calculated that there were 29,651,906 admissions among the adult population aged 18 years or older of a total of 32,315,795 admissions, excluding newborn and psychiatric, reported by the American Hospital Association (AHA) in its 1998 survey of hospitals. Therefore, there were approximately 0.149 admissions per adult resident (29,651,906/194,990,000). We assumed that because smokers experience 27% more hospital days per year than nonsmokers, they would also be 27% more likely to be admitted to the hospital. We calculated that 17.8% of smokers would experience an inpatient stay during the year, while only 15.9% of nonsmokers would be admitted, using the formula: 0.149 = 0.05 × 1.27 × ARNS + 0.75 × ARNS), where ARNS indicates the estimated admission rate of nonsmokers. These estimates generated 8,653,757 smoker admissions (0.178 * 48,5 million smokers). However, among the general population, only 80.5% of admissions are unique hospital admissions, according to NHIS estimates; the remaining 19.5% are readmissions. We calculated that the total number of unique smoker admissions eligible for an intervention would be 6,966,275, assuming each patient would undergo a smoking intervention only once on an inpatient basis during a year’s time.

### RESULTS

### Cost-effectiveness of Individual Interventions

Table 4 shows cost-effectiveness ratios for 15 smoking cessation interventions that are described in the guideline. These results were derived by assuming that 75% of smokers would make 1 quit attempt during the year with all using a particular intervention. Hence, the figures answer the question, “What would be the guideline’s cost-effectiveness if all willing-to-quit smokers undertook a single intervention?” Cost per quitter among the counseling interventions without pharmacotherapy ranged from a low of $2,128 for full intensive counseling to a high of $7,922 for minimal counseling. Cost per QALY (discounted at 3%) was lower and therefore better, ranging from $1,108 for group intensive counseling to $4,015 for minimal counseling.

As the amount of clinician time increases, intervention costs and the number of quitters both increase while the cost per quitter decreases (except for individual intensive counseling). Group intensive counseling is a particularly low-cost intervention, excluding patient time costs, even though it involves the greatest amount of patient-clinician time (seven, 1-hour sessions). This is because it generates a large number of new quitters because of its intensity of contact and because intervention costs are shared across groups of 10 patients, which lowers the cost per quitter even further.

Adding pharmacotherapy increases the cost of each intervention, but it also increases their marginal effectiveness substantially. When using transdermal nicotine (the patch) as adjunct therapy to each of the counseling interventions, the cost per quitter ranged from $2310 for group intensive counseling, which is slightly less cost-effective, to $4,745 for minimal counseling, which is far more cost-effective than it would have been without nicotine replacement. This translated to $1,171 and $2,406 per QALY, respectively. The cost per quitter for counseling with nicotine gum ranged from $3,856 for group intensive counseling to $5,862 for minimal counseling. The cost per QALY ranged from $1,822 to $4,542, respectively.

### Cost-effectiveness of Combined Interventions

Table 5 shows total costs, number of quitters, life-years saved, and the ultimate cost-effectiveness of the combined smoking cessation guideline, derived by weighting each of the individual intervention’s costs and benefits by the likelihood of a smoker choosing it. For example, the total cost of minimal counseling without nicotine replacement is $9,578,727. This was derived by assuming that only 6.25% of smokers (0.25 * 0.25) would receive this intervention. Direct intervention costs would be $33,105,285 vs $30,473,492 in total preintervention costs (screening, advice, and motivation). Minimal counseling without pharmacotherapy would generate 12,000 quitters under the combined guideline, 17,000 life-years saved, and 23,000 QALYs saved.

Overall, the average cost per quitter was $3,779; the average cost per life-year saved, $2,557; and the average cost per QALY saved, $1,915.

Brief and full counseling with pharmacotherapy are expected to generate the preponderance of both costs and benefits, in part because they are more costly and efficacious; but it is also because they are among the most popular choices for trying to quit, i.e., 24.9% opt for brief counseling with the patch and 18.7% for full counseling with the patch.

Based on the guideline and the likely cessation intervention preferences of patients, it would cost $65.4 million annually to screen, motivate, and provide 75% of ambulatory and hospitalized smokers with the intervention of their (expected) choice. Screening, advice, and motivation account for $90.9 million, or 15.4%, of the total cost. Implementation of the guideline would result in 1.67 million new quitters during the first year, with more than 90% resulting from brief and full counseling using the patch. The figure of 1.67 million new quitters is derived from the 48.7 million smokers in the United States figure. We assumed that 36.6 mil-
Table 5—Cost-effectiveness of the Combined Agency for Health Care Policy and Research Resource Guideline*

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Costs, $ in Thousands</th>
<th>Quitters,† No. in Thousands</th>
<th>Life-Years Saved,§ No. in Thousands</th>
<th>Quality-Adjusted Life-Years Saved,¶ No. in Thousands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without nicotine replacement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimal counseling</td>
<td>93,579</td>
<td>12</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>Brief counseling</td>
<td>234,730</td>
<td>37</td>
<td>55</td>
<td>74</td>
</tr>
<tr>
<td>Full counseling</td>
<td>279,425</td>
<td>93</td>
<td>137</td>
<td>184</td>
</tr>
<tr>
<td>Intensive counseling</td>
<td>29,908</td>
<td>8</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Group counseling</td>
<td>18,186</td>
<td>8</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>With transdermal nicotine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimal counseling</td>
<td>996,787</td>
<td>210</td>
<td>308</td>
<td>415</td>
</tr>
<tr>
<td>Brief counseling</td>
<td>1,766,540</td>
<td>422</td>
<td>617</td>
<td>833</td>
</tr>
<tr>
<td>Full counseling</td>
<td>1,637,972</td>
<td>603</td>
<td>881</td>
<td>1,190</td>
</tr>
<tr>
<td>Intensive counseling</td>
<td>150,075</td>
<td>52</td>
<td>76</td>
<td>103</td>
</tr>
<tr>
<td>Group counseling</td>
<td>120,769</td>
<td>52</td>
<td>76</td>
<td>103</td>
</tr>
<tr>
<td>With nicotine gum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimal counseling</td>
<td>205,581</td>
<td>23</td>
<td>34</td>
<td>45</td>
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<tr>
<td>Brief counseling</td>
<td>335,762</td>
<td>59</td>
<td>73</td>
<td>98</td>
</tr>
<tr>
<td>Full counseling</td>
<td>346,709</td>
<td>82</td>
<td>120</td>
<td>162</td>
</tr>
<tr>
<td>Intensive counseling</td>
<td>31,443</td>
<td>7</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Group counseling</td>
<td>25,841</td>
<td>7</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Combined intervention</td>
<td>6,307,337</td>
<td>1,669</td>
<td>2,439</td>
<td>3,294</td>
</tr>
</tbody>
</table>

*Data from Froom et al6 and Flascola and Franks.6
†The number of quitters was discounted by 45% to account for post-follow-up relapse.
§Life-years (discounted 3%) were derived using a 1.64 adjustment factor. The adjustment factor represents the average life-years saved per quitter given the current distribution of smokers and expected life-years saved for each sex-specific age group.
¶Quality-adjusted life-years (discounted 3%) were derived using a 1.57 adjustment factor. The adjustment factor represents the average life-years saved per quitter given the current distribution of smokers and expected quality-adjusted life-years saved for each sex-specific age group.

This value was derived by weighing the individual interventions by the likelihood of smokers choosing each intervention.

The cost-effectiveness ratios proved quite sensitive to the discount rate used to adjust life-years saved. When QALYs were discounted by 5%, the cost for the guideline was $226 per QALY saved—two thirds more; without any discounting, the guideline would cost only $745 per QALY saved—61% less.

At press time, a new analysis by CDC estimated that the baseline, 3-month quit rate for smokers is 4.6% (C. Husten, MD, MPH, unpublished data, November 1997). We tested the sensitivity of our combined model to the new baseline and found that the cost per QALY increased to $204,854, or 6.9%.

The sensitivity of the relapse rate was tested at 35% and 55%. The lower relapse rate decreased the guideline cost per QALY to $1820 (a 15.4% decline). Increasing the relapse rate to 55% raised costs per QALY by 22% to $2340, which is still a low figure.

Treatments that involve more direct intervention time and 1 or more follow-up visits can have substantial patient costs. For each intervention, we estimated the costs associated with patient travel and cessation counseling time. Travel time for initial physician visits was excluded because patients would have incurred these costs in the absence of the smoking cessation intervention. Patient-specific time costs associated with each smoking cessation intervention (including travel to follow-up or intensive counseling sessions) were calculated assuming that patients would travel an average of 1 hour (round-trip) for each visit. Patient time per intervention ranged from 5 minutes for minimal counseling to 54 minutes for group intensive counseling, ie, seven 1-hour sessions plus 7 additional travel hours. According to the Bureau of Labor Statistics, in 1995, the median weekly salary of full-time wage and salary workers was $479. We assumed an average workweek was 40 hours long and calculated an average per minute patient opportunity cost of $0.20 ($479/2,080 minutes). Group intensive counseling involved the greatest amount of travel and direct intervention time (seven 1-hour visits), costing each participant $1,685 in lost time for other activities.

As the intensity of the interventions increases, they become more sensitive to patient opportunity costs. Group intensive counseling without pharmacotherapy experienced the greatest change in cost per QALY, rising from $1,108 when patient costs were ignored to $3,446 when they were included in the analysis, more than tripling the estimate. Still, minimal counseling and brief counseling without pharmacotherapy remained less cost-effective at $4,132 and $2,844 per QALY saved, respectively. However, when patient costs were incorporated into the analysis of interventions without pharmacotherapy, group intensive counseling with 7 sessions became less cost-effective than full counseling with 2 follow-up sessions, eg, $3,446 per QALY vs $1,975 per QALY. Adding patient costs to the combined interventions increased overall cost per QALY from $1,195 to 2,167 (13%).

COMMENT

These analyses demonstrate that full implementation of the guideline throughout 1 year could cost $5.3 billion annually, or $2,321 per capita. For this investment, society could expect to gain approximately 1.67 million new quitters over and above the current baseline 5% quit rate after allowing for a 45% relapse rate among those abstinent for 5 months from the day of cessation. These quitters could expect to enjoy 2.1 million extra life-years (3.3 million extra QALYs), even after discounting by 9%. Given that smokers at all ages experience reduced life expectancy and survival rates20 certainly many younger quitters would enjoy more productive years of employment.

For $2,587, society could expect to save another life-year by implementing the guideline. Given the negative health associated with smoking, the cost-effectiveness of the guideline is even better on a QALY basis, ie, $1,915. The more intensive the cessation intervention, the lower the cost per year of life saved. While all interventions seem a reasonable societal investment, those involv-
ing more intensive counseling and the nicotine patch are particularly meritori-
ous. Nicotine gum with counseling is also more effective than counseling alone, al-
though it does not generate as many new quitters as the patch.

A study like ours naturally has sev-
eral limitations. Results reflect only the first year of guideline implementa-
tion. It is not at all clear how the success rates of the various interventions would change, if at all, with repeated years of the guideline. Clinical trials data were un-
available to build a dynamic, recurring inter-
vention model.

Differences in marginal quit rates by intervention with respect to age, sex, se-
verity of illness, and motivational level could not be determined through meta-
analysis because of small samples. How-
ever, our model uses a sex- and age-spe-
cific distribution of smokers when con-
structing average life-years and QALYs saved per quitter.

Further, it is probably unrealistic to assume the same permanent marginal quit rate for all willing smokers who are triaged through a single intervention. Nevertheless, we believe the quit rates give a reasonable guide to the relative advantages of the various interventions.

Following previous cost-effectiveness studies of smoking cessation interven-
tions, we excluded lifetime medical ex-
penditures from our analysis. Whether lifetime medical expenditures should be included in cost-effectiveness analyses has been debated in the literature.24,25 Warner and Luco26 argue that offsetting the lower medical costs of nonsmokers in their working lifetimes by higher medi-
cal costs because of their longer lives ig-
nores the consumption (and productivity)
gains from living longer.

In any event, recent analyses27 has shown that net medical costs over a per-
son’s lifetime are $22599 higher for US smokers (in discounted 1990 dollars) during his or her remaining lifetime than people who never smoked. Simply count-
ing the excess medical costs of smokers to age 65 years averages $9000 to $11000.28 Subtracting excess medical costs from the guideline’s average cost per life-year saved would turn the ratio negative, implying that smoking cessa-
tion interventions actually save more in lifetime medical expenditures than they cost, initially. By excluding all excess lifetime medical expenditures from our analysis, we believe the guideline could be considered even more cost-effective than reported above.

Moreover, our analysis does not at-
ttempt to compare the psychosocial costs of smoking as a treatment, such as the pain and suffering of nicotine withdrawal, with the pain and suffering produced by other preventive interventions. Such issues are certainly important in evaluating the net benefits of preventive interventions.

Relative to other medical inter-
ventions, all the smoking cessation interven-
tions recommended in the guideline appear cost-effective and should be pro-
moted. Tengs et al29 reviewed 500 life-
saving interventions and adjusted them for inflation (all costs are expressed in 1993 dollars), discount rate (all findings converted to 5% discount rate), exclusion of indirect costs, and consistent effective-
ness measures (years of life saved).

The costs of the AHCRP’s guideline are $3559 per life-year saved when dis-
counted at a comparable 5% rate. Several well-targeted prevention strategies listed in the study by Tengs et al29 show very low cost-effectiveness ratios as well, including a 1-time screening for cervical cancer for women older than 64 years ($3052) and pneumonia vaccination for people older than 64 years ($1760). Other screening strategies targeted at younger age groups cost considerably more, in-
cluding an annual mammography for women aged 40 to 49 years ($81744) and hypertension screening for men aged 40 years ($52375). Smoking cessation interven-
tions are all the more remarkable in that the guideline is not targeted to any one population group.

The guideline’s cost-effectiveness ratio is favorable relative to most other medical interventions, confirming Eddy’s30 treat-
ment of smoking cessation as the ‘‘gold standard’’ by which all other screening tests can be compared. Of course, the guideline does not address public health strategies aimed at stopping smoking that may be even more cost-effective relative to clinical smoking cessation treatments.

In summary, our findings reinforce the guideline’s central challenge to cli-
icians, insurers, purchasers, and ad-
misters to promptly and intervene uni-
versally with all smokers presenting in a health care setting.

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