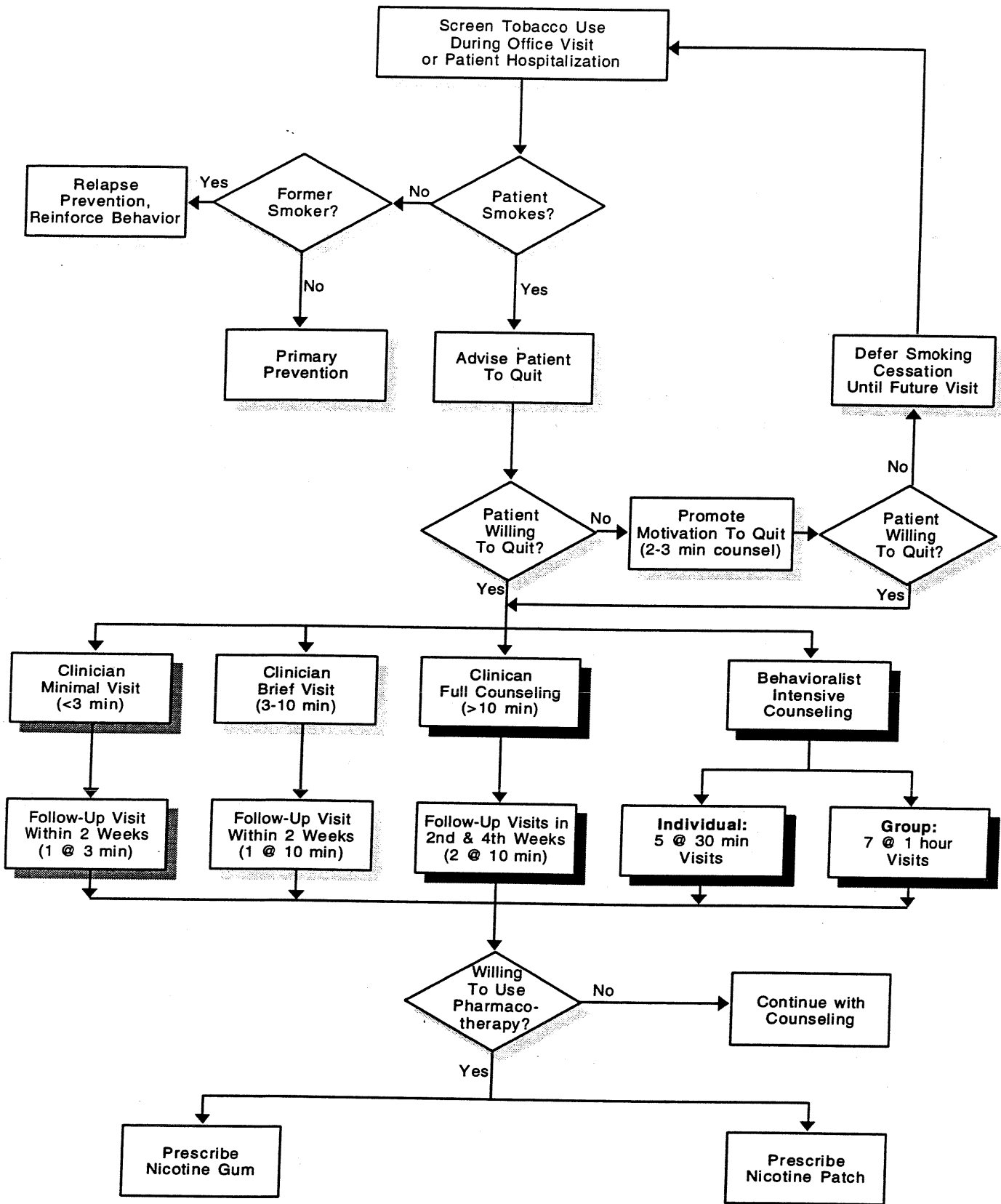


Figure 3-1. AHCPR Smoking Cessation Guideline



training of the provider, patient preference, etc.” The panel suggested that providers choose the appropriate intervention given these constraints.

Following is a summary of the recommendations made by the panel in the seven smoking cessation dimensions:

Provider

- Selection of provider should be based on factors such as training, time constraints, access to smokers, etc., rather than as a member of a specific professional discipline, e.g., physician.
- All care personnel and clinicians should repeatedly and consistently deliver smoking cessation interventions to their patients. Smoking cessation interventions should be delivered by as many types of providers as is feasible given available resources.

Format

- Smoking cessation interventions should include either individual or group counseling/contact.

Self-Help Intervention

- When feasible, smokers should be provided with access to support via telephone hotline/helpline.
- Multiple types of self-help materials should be made available to smokers.

Intensity of Person-to-Person Contact

- Every smoker should be offered at least a brief (3-10 minutes) or minimal intervention (3 minutes or less) whether or not the smoker is referred to an intensive intervention.

Content of Smoking Cessation Intervention

- Smoking cessation interventions should help smokers recognize and cope with problems encountered in quitting and provide social support as part of this treatment.
- Smoking cessation interventions that use some type of aversive smoking procedure may be used with smokers who desire such treatment or who have been unsuccessful using other interventions.
- Due to insufficient evidence to support the effectiveness of interventions that involve negative affect, cue exposure, hypnosis, or acupuncture, the panel chose not to make recommendations concerning these intervention types.

Duration of Treatment and Number of Treatment Sessions

- Smoking cessation interventions should last as many weeks as is feasible given available resources.
- Clinicians should strive to meet at least four times with quitting smokers if resources permit.

Smoking Cessation Pharmacotherapy

- In the absence of medical contraindications or other special circumstances, patients should be offered nicotine replacement therapy for smoking cessation.
- If nicotine replacement is being prescribed for light smokers (10-15 cigarettes per day or less), physicians should consider lowering the starting dose.
- Both transdermal nicotine (the patch) and nicotine gum are considered effective therapies. However, the patch is preferred for routine clinical use because it is associated with fewer compliance problems and requires less clinical time and effort to train patients in effective use.
- Due to limited research evidence concerning the use of nicotine nasal spray, Clonidine, antidepressants, anxiolytics/benzodiazepines, and silver acetate, recommendations were not made concerning these pharmacotherapies.

3.3 Special Populations

The panel examined a number of special populations/issues and developed recommendations that addressed differences in gender, race, and ethnicity. The *Guideline* also considers interventions for pregnant women, children and adolescents, and hospitalized smokers as well as smokers who were concerned about weight gain during their quit attempt. Finally, the available evidence concerning appropriate cessation techniques for smokeless tobacco use was reviewed and recommendations were made.

3.3.1 Gender, Race, and Ethnicity

Many of the special populations that the *Guideline* considers were not incorporated into our cost-effectiveness analysis because the *Guideline* recommendations do not affect intervention costs or variations in their effects are unknown. A smoker's gender, age, race, ethnicity, presence of psychiatric comorbidities, and concern about gaining weight do not change whether or not he/she receives an intervention or the type of intervention provided, with the exception of tailoring messages. So we assumed that these special population considerations would not affect the intervention's cost. While concern about weight gain may influence a smoker to use nicotine gum, we assumed that this was accounted for in the intervention probabilities that we incorporated into our analysis. We did, however, consider gender and age differences in the years of life that an intervention might save.

3.3.2 Pregnant Women

The *Guideline* recommends that pregnant women who smoke should be offered nonpharmacological interventions that are at least as intensive as those provided to nonsmokers. It also recommends that nicotine replacement therapy should only be used if the risk of continued smoking outweighs the risk of the pharmacotherapy and potential concomitant smoking. While nonpharmacological interventions are recommended for pregnant women, we did not attempt to adjust for lower utilization of transdermal nicotine or the nicotine gum among this population.

3.3.3 Children and Adolescents

Our analysis focused on interventions for the adult smoking populations. While there is no evidence to suggest that children and adolescents would not benefit for the interventions outlined in the *Guideline*, we assumed that this population is not screened, advised, or provided smoking cessation interventions. Because little research evidence existing concerning smoking cessation among the adolescent population, we question whether these young smokers can be easily identified through a standard office screening process and whether they would experience the same willingness to quit as the general population. Also, the effects of smoking cessation interventions among adolescents may vary from the general population. Therefore, we chose to exclude them from our cost-effectiveness analysis.

3.3.4 Hospitalized Patients

One special population that our analysis addresses is hospitalized smokers. The *Guideline* recommends that every hospitalized patient be screened for smoking, assisted with quitting, and provided with advice and assistance on remaining abstinent after discharge. To account for this special population, we assumed that smokers are identified either through the course of an office visit to a primary care clinician or during hospitalization. This is reflected in the intervention flowchart, which begins with two distinct groups of patients: office versus hospitalized. According to the *Guideline*, hospitalized patients should be provided with the same treatments listed as effective elsewhere in the *Guideline*, including nicotine replacement therapy. Therefore, we assumed that hospitalized patients follow the same intervention track as patients identified during an office visit. Hospitalized patients may or may not have seen a physician in the office prior to the hospitalization. If not, as

might be the case with heart attack victims, they are new candidates for the *Guideline*. During the hospitalization, they will be encouraged to quit and likely will have much higher quit rates due to a greater willingness to try and quit. They also should have higher costs as a result of trying harder. For hospitalized patients already screened previously in the office, they, too, should have higher costs because they will be counseled yet again to quit during their acute admission. They may enjoy fewer years of extra life, however, because they will likely be older on average.

3.4 Exclusions

There are a number of smoking cessation interventions for which the *Guideline* panel did not make recommendations. Failure to recommend a technique usually resulted from a lack of research and did not necessarily imply that the treatment was ineffective.

3.4.1 Smokeless Tobacco

While the *Guideline* recommends the same psychosocial interventions for users of smokeless tobacco as cigarette smokers, there is little research evidence addressing pharmacological therapies for this population. Our analysis focuses on smoking cessation. Therefore, we did not address the cost effectiveness of any interventions directed to smokeless tobacco users.

3.4.2 Alternative Therapies

The Panel examined the research evidence for the efficacy of Clonidine, antidepressants, anxiolytics/benzodiazepines, and silver acetate as smoking cessation pharmacotherapy. The *Guideline* does not recommend any of these treatment. The Panel chose not to recommend Clonidine because five of the seven studies reviewed did not include adequate follow-up time and three of the studies did not meet the meta-analytic selection criteria. The Panel also indicated concern regarding side effects and the tendency for as many as 25 percent of patients to discontinue use because of them. The Panel came to no conclusion regarding the use of antidepressants or anxiolytics/benzodiazepines. Because research evidence is lacking, they chose not to recommend these therapies. Finally, based on three randomized trials, the Panel found that the use of silver acetate as either a primary or an adjunctive treatment for smoking cessation was not supported.

3.4.3 Primary and Relapse Prevention

The *Guideline* considers follow-up provided to patients after their smoking cessation intervention and the necessary steps taken to motivate patients to quit and avoid relapse. The *Guideline* suggests that all patients who receive an intervention be assessed for abstinence at the completion of treatment. Those patients who abstain from smoking should receive relapse prevention, which consists of reinforcing the patient's decision to quit, reviewing the benefits of quitting, and assisting the patients in resolving any residual problems arising from quitting (e.g., weight gain, depression). The *Guideline* also recommends that those patients who relapse be assessed for their willingness to quit. Those willing to quit should receive a smoking cessation intervention, while

those unwilling to quit should receive an intervention designed to promote willingness to quit that consists of reviewing the risk and rewards of quitting in a manner that is relevant to the patient.

Our cost-effectiveness analysis of the *Guideline* does not include the costs of providing primary prevention to nonsmokers. We also excluded the cost of providing relapse prevention. While patients may be advised to quit and receive motivational messages from their health care providers multiple times in a single year, we assumed that they would only make one quit attempt. Our analysis assumes that smokers who make a quit attempt and fail will wait at least a year before undergoing another smoking cessation intervention.

4.0 Cost-Effectiveness Methodology

4.1 Challenges in Costing the *Guideline*

In this chapter, we describe some of the aspects of the *Smoking Cessation Guideline* that make it uniquely challenging from a costing perspective.

4.1.1 Converting Cessation Rates into Life-Years Saved

The *Guideline* uses smoking cessation rates, or quit rates, as its sole outcome of interest. The panel relied on meta-analyses, which were based on randomized controlled trials with follow-up for at least 5 months after the designated quit day. Evidence tables presenting the results of these analyses indicate both the odds ratio and success rate demonstrated by varying interventions.

From the perspective of *Guideline* development, the use of quit rates as the outcome of interest is most appropriate as it provides the information necessary to determine if a given intervention is effective and how well it works relative to some baseline (usually no intervention). From an economic perspective, however, the rate of smoking cessation is of limited use because it is an intermediate outcome. The value of smoking cessation is found in the diseases averted, years of life saved, and improved health functioning. So in order for quit rates to be used for the purpose of comparative economic analysis, they need to be converted into measures that demonstrate the improvement in health realized through quitting. Not only will this more clearly illustrate the benefits of smoking cessation, but it will also allow one to compare smoking cessation to other health-related interventions that use similar measures of effectiveness.

4.1.2 Willingness to Undertake Interventions

Several of the *Guideline's* recommendations allow discretion on the part of patients or physicians concerning the smoking cessation intervention. Issues such as the willingness or preference of patients for certain interventions make it difficult to ascertain the exact number of individuals who would be provided with certain interventions. For example, the *Guideline* recommends that clinicians screen all

patients to determine their smoking status. This activity would be performed on all patients regardless of their smoking status or interest in quitting. Then, the entire population of smoking patients would be advised to quit. However, only a portion of willing smokers would be provided with further assistance under the *Guideline's* model intervention. Costing the *Guideline* requires identifying the probability that a given patient will receive a particular service or combination of services (e.g., screening and advice versus screening, advice, and counseling). Probabilities of patients willing to try and quit using various interventions were based on expert *Guideline* panel opinion, usually from their own research.

4.1.3 Overlapping Interventions

The model interventions for primary care clinicians and smoking cessation specialists incorporate a number of dimensions, making it difficult to determine the combined intervention effect. The *Guideline* suggests that primary clinicians screen patients to determine smoking status, advise smoking patients to quit, provide self-help materials, provide brief or minimal counseling to willing patients, offer nicotine replacement when appropriate, and provide follow-up. These recommendations are based on separate meta-analyses examining different provider types, intervention formats, self-help materials, intensity of person-to-person contact, and nicotine replacement. While these individual meta-analyses provide the necessary evidence to support the individual *Guideline* recommendations, any synergistic or offsetting effects resulting from the combination of multiple dimensions is unknown. For example, the length of counseling is strongly related to the number follow-up visits. Simply adding the individual effects will greatly overstate the quit rates applicable to longer counseling sessions. Where significant correlation is found, our strategy was to use the simple average effect of one of the dimensions. For example, quit rates under full counseling were not augmented by the marginal effects of more follow-up visits under the assumption they were already being reflected in the full counseling quit rate.

4.1.4 A Single Versus Multiple Guideline Intervention Costing

As with many of AHCPR's *Guidelines*, the *Guideline* for smoking cessation involves several interventions.² This suggests two costing alternatives. Under one approach, each intervention would be costed separately, assuming that all willing patients undertake the intervention. The resulting cost-effectiveness ratios would have a "what if" interpretation, answering the question: *What would be the cost per quitter and per life-year saved if all willing smokers went through the specific intervention?* Such a comparison is valuable in determining the relative costliness per quitter or life-year saved of each intervention under optimal conditions.

Realistically, though, smokers have very definite preferences in terms of the type and intensity of smoking cessation program they are willing to undertake. Some who have never tried to quit may be interested only in a minimal counseling session with their physician while others who have failed with minimal interventions may be ready for more extensive interventions, including the use of nicotine replacement. This suggests a second approach that uses preference probabilities to derive an overall cost-effectiveness ratio for the entire *Guideline*. Each of the interventions is weighted in terms of the likelihood of smokers being willing to undertake them. Ratios can be presented on an all-or-nothing basis for each intervention or weighted to produce an overall *Guideline* cost-effectiveness ratio. For example, if only 10 percent of smokers would be willing to undertake intensive counseling, the final number of quitters would be much lower than if 50 percent were willing to try this intervention. While varying probabilities are not assumed to affect the average cost of the counseling costs themselves, which are on a per participant basis, they do affect the up-front screening, advice, and motivation costs when expressed on a per quitter basis. Low willingness rates raise these costs per quitter and make some less popular interventions less cost effective unless the model assumes patients and physicians choose among a set of interventions.

Thus, our approach involves both a "what if" scenario, at one extreme, where all smokers undertake an intervention, and a second scenario that takes into consideration the differential likelihood of

patients undergoing various interventions. The product is a set of cost-effectiveness ratios plus an overall global cost-effectiveness ratio for the *Guideline* as a whole.

4.1.5 Smoker-Specific Versus Population Costs

The limited number of smoking cessation cost studies in the literature (e.g., Cummings, 1989; Oster, 1984, 1986, 1988) perform cost-effectiveness analyses of counseling and pharmacotherapy on a hypothetical sample of smokers. Their results answer the question: What would be the cost per quitter or life-year saved if all (or a sample of) smokers underwent the intervention. It is not always clear whether the quit rates used in these studies involve "all comers" or just patients who "want-to-quit." Presumably quit rates based on all comers would be much lower given that most smokers are unwilling to try and quit during any one visit with their physician. Moreover, the studies are vague regarding the preliminary screening, advice, and motivation interactions with patients before the actual intervention takes place. AHCPR's *Smoking Cessation Guideline*, by contrast, is very explicit in identifying all of these activities (plus relapse prevention) in addition to various counseling and pharmacotherapy interventions. If the cost-effectiveness analysis is limited to just the direct intervention counseling, the results in terms of cost per quitter or life-year saved will be biased downwards. This is because the *Guideline* recommends screening and other costs to be incurred on both nonsmokers and smokers who are unwilling to quit at the time of their visit and who do not receive the intervention.

For example, intensive intervention with behavioralists will involve several visits. However, most patients are unwilling to undergo such an intervention. Hence, the additional gains in terms of quit rates, while relatively high, apply only to a small portion of the patient population. Yet, screening costs are being incurred on all patients and advice and motivation costs are incurred on smokers. When put on a per quitter basis, these costs will be much higher for an intervention that most smokers are unwilling to undertake.

The issue of up-front screening and advice/motivation costs is what distinguishes costing the *Guideline* from more traditional, narrowly defined, costings of direct interventions alone. The *Guideline* recommends that very minor costs be incurred on every patient every time he/she sees a

²It differs in the important respect that most other *Guidelines* first classify patients by severity of illness before recommending more or less expensive interventions.

physician during the year. These costs add up when summed over 600 million office visits and over 32 million hospitalizations. The research question is how sensitive these costs are to the gains in quit rates and the relative willingness of smokers to undertake the various interventions.

4.1.6 Office Versus Hospital Intake

The *Guideline* recognizes two locations of patient-physician contact: the office and the hospital. While the length and nature of the interventions are quite similar in each setting, the types of personnel involved and some of the willingness probabilities can be quite different.

The question of redundancy also must be addressed. Practically all hospitalized patients will also see a physician one or more times in the office before and after their spell of illness. We costed each location separately, producing different cost-effectiveness ratios for the same type of intervention. A more sophisticated model then considered the overlap in sites. Hospital- and physician-based interventions were integrated into a single model, which was designed to avoid double counting the cost and effects.

A third issue concerns the sensitivity of the quit rates and life-years saved to the locus of initial patient-physician contact. Asymptomatic patients seeing the physician in the office for a routine checkup are likely to be less willing to try and quit on such a visit. Moreover, the expected gains in life-years from quitting are also likely to be less than if a patient has been hospitalized for an acute illness. Expert panel opinion and studies support a differential willing-to-quit rate by location, but we are unable to account for possible differences in life-years saved among two populations. The problem is one of catching smokers at different points in their life cycle of smoking-related problems. The overall life-years saved figures would apply to asymptomatic smokers considering quitting during an office visit. Hospitalized smokers, on the contrary, are part of the group of all smokers who have definitely incurred a smoking-related illness (assuming that is what the admission is for). Were we able to separate the two groups of smokers into "healthy ambulatory" and "unhealthy hospitalized," we could apply two different life expectancy rates, but the lack of data made this approach infeasible. In any event, the cost per life-year saved under the *Guideline* for hospitalized patients should be considered an overestimate, assuming these patients have more to gain from quitting than asymptomatic smokers.

4.1.7 Voluntary Compliance

By their very nature, guidelines do not imply mandatory compliance. The willingness of patients to undertake a smoking cessation intervention is strictly voluntary. Moreover, unlike other medical interventions where people see a direct and immediate benefit, e.g., open heart surgery, vaccination, most smokers do not recognize the correlations between their smoking and numerous medical problems later in life. In costing the *Guideline*, we must assume that every smoker who is willing to quit undertakes a given intervention in order to construct alternative cost-effectiveness ratios. An intervention with twice the cost-effectiveness ratio is interpreted to be half as efficient at saving life-years. This answers the important policy question: What if all smokers chose to undertake a given intervention?

But willingness to quit varies systematically by intervention. Smokers are less willing to undertake interventions that involve more follow-up visits. Thus, in order to produce an overall cost-effectiveness ratio that better mirrors smokers' preferences, we apply unequal probabilities of undertaking various interventions—again, based on expert opinion and the literature. This scenario answers the question: Given the expected choices of smokers regarding interventions, what is the *Guideline's* average cost-effectiveness?

4.1.8 Lack of Claims Data

Knowledge about current physician practice regarding smoking cessation is primarily limited to patient and physician survey results. According to the National Center for Health Statistics, in 1987, only 33.6 percent of former smokers and 49.5 percent of current smokers reported that they were ever advised by their doctor to quit (NCHS, 1989). Slightly higher rates have been reported by physicians. Wells *et al.* (1986) used data from the Physician Practice Survey to evaluate the practices of general and subspecialty internists in counseling their patients about smoking. They indicated that only 3 percent of all internists reported that they never counsel patients about smoking. However, those internists that did counsel were more oriented toward tertiary care with only 52 percent reporting that they counsel more than 75 percent of all smokers as opposed to 82 percent who reported counseling more than 75 percent of smokers with chronic lung disease.

Beyond surveys that provide some estimate of the proportion of smokers who have received advice or

counseling from physicians, there are few data available to provide more detailed information about the level and types of smoking cessation activities under current practice. Physicians Current Procedural Terminology (CPT) codes, which physicians use to report a detailed description of the services that they provide, do not have a designation for smoking cessation interventions. These services might be reported under the codes relating to counseling and/or risk factor reduction interventions for new and established patients, services that are provided to healthy individuals for the purpose of promoting health and preventing illness or injury. However, while these codes consider length of visit and whether the intervention was provided in an individual or group counseling setting, distinctions are not made between different types of preventive issues (e.g., smoking, diet, exercise, sexual practices). Therefore, it is impossible to isolate those preventive health services that are specifically intended to help individuals quit *smoking*. Furthermore, smoking cessation advice provided to individuals with symptoms or established illnesses would not be included.

Equally limiting for the purpose of costing the *Smoking Cessation Guideline* is the International Classification of Diseases (ICD-9). These are codes used to identify episodes of illness on claims and are particularly reliable for acute conditions where the episode of illness begins with hospitalization (Mitchell, 1995). Interestingly, there is a ICD-9 code for *tobacco use disorder*, which is considered a nonspecific principal diagnosis code that may trigger a PRO review. These data, however, are unlikely to identify smokers who receive smoking cessation counseling during the course of a periodic examination or individuals who have developed a smoking-related illness such as emphysema and who are provided help to quit smoking but for whom the related illnesses is the principal diagnosis rather than the smoking cessation intervention.

Drug utilization data are available for both transdermal nicotine and nicotine gum. Currently, the patch is available under four different brand names, and one drug manufacturer has FDA approval to provide nicotine gum. However, claims data will likely include only a fraction of all smokers who receive nicotine replacement therapy. Fiore *et al.* (1992) reported that an early response of third-party payers was to withhold reimbursement for transdermal nicotine replacement therapies. While research evidence demonstrating the effectiveness of the nicotine patch may increase the number of third-party payers covering the cost of

these prescriptions, a large portion of the costs are probably still borne completely by patients and would not appear in claims databases.

4.1.9 Specifying Resource Use

The *Guideline* Panel avoided choosing among multiple effective interventions recognizing that the selection of certain smoking cessation strategies may be a function of practical matters such as time available, training of providers, patient preference, and available financial resources. For example, intensive interventions require more time and resources than less intensive options, yet they are generally more effective. In this case, the *Guideline* recognizes the expense of the interventions by recommending that they be used pending the availability of resources. While this approach allows providers to choose from among a range of effective interventions considering fiscal constraints, it is unclear which providers will be financially capable and willing to provide certain interventions.

4.1.10 Differential Relapse Rates by Intervention

A final challenge to costing the *Guideline* involves relapse rates. All cessation programs experience relapses, but the rates likely vary by intervention. The meta-analyses upon which the effectiveness measures are based rely on 5- or 12-month abstinence rates. Regrettably, some patients relapse after these periods.

Lacking data on different relapse rates by intervention, we assume constant 35 percent rates, then test the assumption through sensitivity analysis. The basic relapse rate is based on the National Health and Nutrition Examination Survey published in CDC (1990).

4.2 Summary of Approach

4.2.1 Stylized Interventions

The *Smoking Cessation Guideline* addresses a number of issues and strategies for encouraging smokers to quit. Not all of the recommendations can be evaluated, either because of time and resources or due to the lack of valid cost and/or outcomes information. For example, the *Guideline* presents several alternative formats (e.g., individual versus group counseling) and self-help materials (e.g., videos versus pamphlets). While these can be costed, we lack the information necessary on quit rates to distinguish their effects from the broad underlying

effect of counseling. The *Guideline* also offers recommendations regarding dosages for nicotine replacement, such as 4 mg gum versus 2 mg gum for highly dependent smokers. Again, we do not have information on quit rates of varying dosages in order to calculate cost-effectiveness ratios. Without differing quit rates, the less intensive, less costly intervention will always have the higher cost-effectiveness ratio.

Furthermore, the *Guideline* meta-analyses and panel evaluations have concluded that not enough evidence exists to establish the effectiveness of a number of other interventions. This includes the use of Clonidine, antidepressants, anxiolytics/benzodiazepines, and silver nitrate, as well as acupuncture. Consequently, these interventions will not be included in the cost analysis.

For the above reasons, a narrower set of stylized interventions will be the focus of the cost-effectiveness analysis. They are stylized in the sense that not all recommendations are presented and evaluated. The actual *Guideline* interventions are richer in detail than what we are able to analyze. The major intervention strategies can be stratified according to

- Setting
 - Physician's office
 - Hospital
- Length of physician visit contact
 - Minimal (<3 minutes)
 - Brief (3-10 minutes)
 - Counseling (>10 minutes)
- Follow-up visits with physician
 - One 3-minute visit
 - One 10-minute visit
 - Two 10-minute visits
- Intensive counseling
 - Individual (5 @ 30-minute sessions)
 - Group (7 @ 1-hour sessions)
- Nicotine Replacement
 - None
 - Patch
 - Gum

While these strata generate many possible combinations, not all were recommended by the *Guideline* panel. First, for smokers in the physician's office, the minimal visit would have a 3-minute follow-up visit and no pharmacotherapy. The brief visit is linked with one 10-minute follow-up visit while two follow-up visits are recommended with an initial full counseling visit greater than 10 minutes. Nicotine replacement is recommended with either brief or counseling visits. Patients may also choose intensive counseling, which can be either

individual or group counseling for different numbers and session lengths. Again, pharmacotherapy is recommended but not required.

4.2.2 Interventions by Primary Care Clinicians

Thus, we performed a cost-effectiveness analysis examining a series of smoking cessation interventions outlined in the *Guideline*. This involved estimating the costs and benefits of the following smoking cessation activities:

- Screen all patients on every office visit to determine smoking status;
- Advise smoking patients to quit;
- Promote motivation to quit among unwilling patients;
- Assess individual and environmental factors of willing patients;
- Counsel willing patients for 3, 7, or 15 minutes on initial visit;
- Provide willing patients with self-help education materials;
- Offer nicotine replacement to willing smokers; and
- Provide one or two follow-up visits.

Follow-Up Counseling. The panel recommended follow-up counseling (either through face-to-face contact or via telephone) within a 2-week period following the quit date (preferably within the first week) and a second follow-up visit within a month after the quit date. Consistent with the *Guideline's* recommendations for primary care clinicians, this stylized intervention implies additional costs beyond physician counseling.

Nicotine Replacement. Two adjuvant interventions will incorporate nicotine replacement therapy. The *Guideline* recommends such therapy for all willing patients without medical contraindications. Costing interventions that include nicotine replacement therapy will require estimates of patient willingness to use either therapy, their costs, and their marginal quit rates. We derive assumptions of transdermal nicotine replacement and nicotine gum compliance based on the literature and the panel's expert opinion (see Section 4.4.1). The cost of transdermal nicotine patches and nicotine gum are estimated using reported wholesale prices and a nonrandom survey of pharmacies and expert panel recommendations.

The *Guideline* presents results of a series of meta-analyses examining the effectiveness of transdermal nicotine replacement and nicotine gum interventions. Based on the results of six nicotine patch meta-analyses, the *Guideline* reports that transdermal

nicotine replacement approximately doubles smoking cessation rates over those experienced among placebo group participants. The panel reviewed four meta-analyses of nicotine gum use and concluded that nicotine gum improved quit rate by approximately 60 percent relative to control groups. See Section 4.4.2 for marginal quit rates.

4.2.3 Intensive Interventions by Smoking Cessation Specialists

The *Guideline* recommends that clinicians refer willing patients to smoking cessation specialists for intensive interventions. Recognizing that only a minority of patients will choose such an alternative, we assumed that a portion of the patients who are screened and advised by primary care clinicians will select to receive an intensive intervention. This involved estimating the costs to perform the following smoking cessation activities:

- Screen all patients to determine smoking status;
- Advise smoking patients to quit;
- Promote motivation to quit among unwilling patients;
- Assess individual and environmental factors for willing patients; and
- Refer willing patients to behavioralists for four to seven sessions lasting 20-30 minutes each conducted over a period of 2-8 weeks.

The first three activities are provided in an office or hospital setting by a nurse and physician. The costs and assumptions associated with these activities will parallel those previously mentioned. The remaining two activities, the assessment of individual and environmental factors and the provision of counseling, will be conducted by a smoking cessation specialist during the patient's first counseling session. The *Guideline* recommends that multiple providers be used. One strategy would be to have a health care clinician deliver messages about the health risks of smoking and benefits of quitting while a nonmedical clinician would deliver psychosocial or behavioral interventions. We will assume that the providers who assess and counsel patients under the intensive intervention are primarily nonmedical behavioralists, although we include a portion of physician time to assist in assessing patients and/or prescribing pharmacotherapy.

Quit rates under this scenario will be based on the *Guideline's* meta-analyses. Similar to the other scenarios, we will assume that 35 percent of those

smokers who quit as a result of intensive counseling will relapse and will not benefit from additional years of life saved. As with the less intensive intervention, the smoking specialist scenario will apply a 5 percent discount rate to life-years saved. The *Guideline* also recommends that individuals who receive intensive counseling also receive nicotine replacement and nicotine gum for willing patients. The same costs as under the primary care scenarios will be used, as well as the same effectiveness odds ratios for pharmacotherapy. However, because intensive counseling, alone, is more effective, the use of pharmacotherapy as adjuvant therapy produces a higher marginal quit rate than it does when used with less intensive physician counseling.

4.3 Mathematical Cost-Effective Models

Constructing a cost-effectiveness ratio for an intervention can be decomposed into four components, i.e.,

$$CE_i = \frac{CS + CADV + CMOT + DC_i}{\Delta Q_i (YRS/Q)}$$

$$CE_i = \frac{CS}{\Delta Q_i (YRS/Q)} + \frac{CADV}{\Delta Q_i (YRS/Q)} + \frac{CMOT}{\Delta Q_i (YRS/Q)} + \frac{DC_i}{\Delta Q_i (YRS/Q)} \quad (4-1)$$

where CE_i = the marginal cost-effectiveness of the i th smoking intervention, CS = total screening costs, $CADV$ = total costs of advising smokers to quit on each visit, $CMOT$ = total costs of motivating smokers to quit who are unwilling to try on the current visit, DC_i = total direct costs for the i th intervention, ΔQ_i = the underlying increase in the number of quitters due to the intervention, and (YRS/Q) = the expected number of life-years gained for a quitter (usually discounted). The first component of equation (4-1) is the screening costs of the U.S. patient population per gain in the number of quitters or, if one wishes, per life-year saved. The second and third components are the *Guideline* costs of giving advice to smokers and motivating unwilling smokers to try and quit, also expressed on a per quitter or life-year saved basis for the i th intervention. The fourth component is the

direct costs incurred in helping smokers quit, again expressed per quitter or per life-year saved.

Initial screening costs apply to all patients seen in the physician's office or hospital, and are derived as the following product:

$$CS = \left[\frac{CS}{V} \right] \cdot \left[\frac{V}{POP} \right] \cdot POP, \quad (4-2)$$

where CS/V = screening costs per visit, V/POP = visits per capita, and POP = potentially screenable population (i.e., adult population).

The number of quitters in the denominator of the first (and all) components of equation (4-1) can be decomposed by setting

$$\Delta Q_i = POP \cdot pb[S] \cdot pb[W_i] \cdot \Delta QR_i, \quad (4-3)$$

where $pb[S]$ = the probability of a patient being a smoker, $pb[W_i]$ = the probability of a smoker being willing to undertake the i th intervention, and ΔQR_i = marginal quit rate due to the intervention, equal to the difference in the ratio of quitters to smokers between the i th intervention and the baseline quit rate. Inserting equations (4-2) and (4-3) into the first component of the cost-effectiveness formula (4-1) gives

$$\frac{CS}{\Delta Q_i} = \frac{[CS/V] \cdot [V/POP]}{pb[S] \cdot pb[W_i] \cdot \Delta QR_i}, \quad (4-4)$$

ignoring for the time being the factor that converts quit rates into life-years saved. The numerator of equation (4-4) is a constant per capita outlay unrelated to the type of intervention. Under the *Guideline*, all patients are screened as to smoking status on every visit. The denominator rises or falls, however, with either the assumed willingness to undergo an intervention or the gain in the quit rate from a particular intervention. Thus, interventions that are more attractive to smokers wanting to quit or that are more effective in promoting abstinence will lower the up-front screening costs per new quitter. Previous cost-effectiveness analyses ignore this cost component by assuming smokers are already identified.

The second component of equation (4-1) concerning advice can be expressed as

$$\frac{CADV}{\Delta Q_i} = \frac{CADV/POP}{pb[W_i] \cdot \Delta QR_i} \quad (4-5)$$

It differs from screening in excluding the probability that a patient smokes from the denominator. This is

because advice costs are being given only to smokers.

The third component can be expressed as

$$\frac{CMOT}{\Delta Q_i} = \frac{CMOT/POP}{\Delta QR_i} \cdot \frac{pb[NW_i]}{pb[W_i]} \quad (4-6)$$

Per capita costs for motivation apply only to smokers who are unwilling to try the i th intervention on a particular visit. For any given intervention, motivational costs per quitter vary inversely with the odds of being willing to try to quit. For example, if 50 percent of smokers are willing to try to quit using the i th intervention, then motivational costs per quitter are simply equal to per capita costs divided by the marginal quit rate. If only 25 percent are willing to try an intervention, then motivational costs per quitter are three times per capita motivational costs divided by the marginal quit rate. If all patients are assumed to be willing to try to quit without motivation (highly unrealistic), no motivational costs are incurred. Hence, motivational costs are fairly sensitive to the attractiveness of an intervention.

Finally, the cost-effectiveness of the direct intervention alone is

$$\frac{CC_i}{\Delta Q_i} = \frac{CC_i/pb[S] \cdot POP \cdot pb[W_i]}{\Delta QR_i} \quad (4-7)$$

The numerator is the direct intervention costs per smoker participating in the i th intervention while the denominator is simply the marginal quit rate.

Assuming the cost per participant is constant (i.e., all direct intervention costs are variable), then direct costs per quitter fall as marginal quit rates rise.

The overall cost-effectiveness per quitter for a given intervention is simply the sum of per quitter costs for the four components.

Interventions incorporating nicotine replacement and/or intensive counseling by nonphysicians would be analyzed using the same general formula (4-1). Intervention costs per participant and marginal quit rates would vary, as would the assumed willingness of smokers to undergo the specific intervention.

Equations (4-4 through 4-7) focus on the cost-effectiveness of various interventions in encouraging smokers to quit. Each component would also be expressed in terms of life-years saved by multiplying the denominator by average life-years gained per quitter.

Producing a single cost-effectiveness ratio for the entire *Guideline* requires access to decision

probabilities. The population probability (Pb_i) for a patient undertaking the i th intervention is equal to

$$Pb_i = pb[S] \cdot pb[WQ] \cdot pb[W_i] \cdot (1 - pb[Rx]):$$

without nicotine replacement (4-8)

$$= pb[S] \cdot pb[WQ] \cdot pb[W_i] \cdot pb[Rx] \cdot pb[PCH]:$$

with patch (4-9)

$$= pb[S] \cdot pb[WQ] \cdot pb[W_i] \cdot pb[Rx] \cdot pb[GUM]:$$

with gum (4-10)

where $pb[WQ]$ = the likelihood a patient is willing to try and quit, $pb[Rx]$ = the likelihood a willing patient will also be willing to try pharmacotherapy, and $pb[PCH]$, $pb[GUM]$ = the likelihood a pharmacotherapy patient will use the patch or gum.

For example, if 25 percent of patients smoke, if 25 percent are willing to try and quit, if 40 percent of willing smokers prefer intervention i , and 75 percent are also willing to use pharmacotherapy, then the joint probability of a patient being enrolled in the i th intervention without pharmacotherapy is 1.875 percent. That is, slightly less than 2 percent of all of a physician's patient visits would result in enrollment in the i th counseling intervention without pharmacotherapy.

These probabilities are used to weight both the direct costs (DC_i) of various interventions (they exclude screening and up-front costs) as well as determine the number of quitters. That is,

$$CC = \sum_i CC_i = \sum_i POP \cdot Pb_i \cdot DC_i \quad , \quad (4-11)$$

where CC = total direct costs attributable to all interventions in the *Guideline*, and $POP \cdot Pb_i$ = number of smokers undertaking the i th intervention. The expected number of quitters across all interventions is derived in similar fashion:

$$E[\Delta Q_i] = \sum_i E[\Delta Q_i]$$

$$= \sum_i POP \cdot Pb_i \cdot \Delta QR_i \quad , \quad (4-12)$$

where $E[\Delta Q]$ = the expected number of quitters across all interventions. Thus, the number of quitters can be considered a weighted sum of marginal quit rates of the various interventions. If all smokers are assumed willing to try at least one of the interventions, i.e., $pb[WQ] = 1$, then the sum of the weights adds to the total number of smokers in the population. Consequently, interventions with either higher marginal quit rates or a greater willingness of

smokers to try them will contribute more to total quitters.

4.4 Calibration of Key Parameters

The interventions were costed using a spreadsheet that listed the probabilities of persons undergoing certain intervention modules, the unit costs of intervention components, the number of recommended units of service (e.g., counseling minutes), and the cost per unit. Initial screening, for example, is done on everyone at every visit. Hence, this component has a probability of one. It is done by a nonphysician and is assumed to take a minute.

Effectiveness data in the form of quit rates are included in the spreadsheet as well under each intervention. Both the underlying baseline quit rate and the estimated quit rate of patients undergoing a given intervention are included in order to derive the marginal gain in quit rate due specifically to the intervention. Another table converts quit rates into years of life saved at different age groups. The *Guideline* does not differentiate interventions by patient age. Assuming the quit rates apply uniformly to all age groups, it is possible to generate a range of cost-effectiveness ratios depending solely upon the age of the patient. An overall cost-effectiveness ratio for the entire population is based on the distribution of smokers by age group. For example, if the marginal quit rate for an intervention is 10 percentage points and 1 million smokers undertake the intervention, then 100,000 new quitters are generated. If quitting smoking adds 2 years (discounted) to the average smoker's life, then 200,000 life-years becomes the denominator of the C/E ratio.

Estimates of the total number of office and hospital visits and admissions are used to factor up the per contact costs to a national cost estimate.

4.4.1 Decision Probabilities

Table 4-1 gives the probabilities used in constructing cost-effectiveness ratios under different scenarios. The top panel gives the univariate probabilities of each event while the bottom panel gives the joint probability of 10 possible combinations of visit counseling and the use of the patch or gum.

The likelihood of a patient being a smoker (25 percent) comes from National Survey data (NCHS, 1994). For nearly all scenarios, 100 percent of smokers are assumed to be willing to quit versus the more realistic alternative of only 25 percent (based on expert opinion and Goldstein *et al.*, unpublished;

Table 4-1. Decision Probabilities for the *Smoking Cessation Guideline*

| | Probabilities (Percent) | | | |
|--|-------------------------------------|------------|-------------|-------|
| | Baseline | | Sensitivity | |
| Probability of Smoking, <i>pb[S]</i> | 25 | | | |
| Probability of Willing to Quit, <i>pb[WQ]</i> | 100 | | 25 | |
| Willing Smoker Probability of Visit Type, <i>pb[Wij]</i> | | | | |
| Minimal Visit | 25 | | | |
| Brief Visit | 40 | | | |
| Counseling | 30 | | | |
| Intensive Counseling | 5 | | | |
| Probability of Using Any Pharmacotherapy, <i>pb[Rx]</i> | 75 | | | |
| Pharmacotherapy Using Patch, <i>pb[PCH]</i> | 83 | | | |
| Pharmacotherapy Using Gum, <i>pb[GUM]</i> | 17 | | | |
| Relapse Rate (>6 months) | 35 | | 10 | |
| Type of Intervention | Conditional Probabilities (Percent) | | | |
| | Alone | With Patch | With Gum | Total |
| Minimal | 6.25 | - | - | 6.25 |
| Brief | 2.50 | 6.22 | 1.28 | 10.00 |
| Counseling | 1.875 | 4.66 | 0.96 | 7.50 |
| Intensive Counseling | 0.313 | 0.78 | 0.16 | 1.25 |
| Total | 10.94 | 11.66 | 2.40 | 25.00 |

Sources: *pb[S]*: Health U.S. 1994, Table 64. Data from National Health Interview Survey. Other probabilities: Expert panel opinion and literature (see text).

Velicer *et al.*, 1995). A 25 percent willing-to-try rate is somewhat higher than the 16-18 percent found in the literature. The higher rate was based on the expected success of the *Guideline's* motivational intervention in converting some smokers who might have been contemplating quitting in the near future. The likelihood of willing smokers' choosing one of four counseling interventions is also based on expert panel opinion. It is weighted heavily towards a brief or full counseling visit with one or two follow-up visits. Generally, very few patients are willing to undertake intensive counseling with five to seven sessions of 30 minutes (individual) to an hour (group) that involves traveling to another site to see nonphysicians. Liechtenstein and Hollis (1992), for example, report that 11.3 percent of Kaiser Portland smokers actually attended the first meeting of a multi-session smoking cessation program versus the 53.2 percent who said they were initially willing to try the program. Only 8.9 percent actually completed the nine-session program (which claimed to have a 35 percent quit rate). We have assumed only 5 percent of smokers screened and advised by physicians in the office would undertake intensive counseling under the assumption they would have to

pay a \$100 or more (plus transportation and time costs). The Kaiser program was free.

Concerning nicotine replacement, Oster *et al.* (1986) assumed that 25 percent of patients who are offered a prescription for nicotine gum will actually use it. They based this estimate on clinical trials (Jamrozik *et al.*, 1984; Russell *et al.*, 1983) in which 50 percent of all smokers accepted an offer of nicotine gum in a primary care setting when it was offered free of charge. Oster *et al.* assumed that this rate would be lower if patients had to purchase the gum themselves and tested their assumption using sensitivity analysis. By contrast, expert panel opinion estimated that three-quarters of smokers would be willing to try pharmacotherapy. Of these, it was believed they would prefer the patch over the gum by at least a 5-to-1 ratio. These probabilities, instead of earlier estimates from Oster's group, were used given they were based on more current information.

To recognize that not all quitters stay abstinent, a 35 percent relapse rate is applied as well to the marginal quit rates. The *Guideline* meta-analyses were based on an abstinence rate for at least 5 months. Hence, the 35 percent relapse rate is

assumed for patients who resume smoking after being abstinent roughly half a year. The limited literature on relapse rates shows a wide range of assumed relapse rates. Oster *et al.* (1986) assumed no relapse after 1 year in their baseline study of nicotine gum, while Cummings, Rubin, and Oster (1989) assumed a 10 percent relapse rate. The very recent cost-effectiveness analysis of the nicotine patch by Fiscella and Franks (1996) assumed a 35 percent lifetime relapse from smoking cessation. The rate was based on the National Health and Nutrition Examination Surveys I and II (CDC, 1990). Sensitivity at a less conservative 10 percent rate is also used in some variants.

The probabilities are all set equal to 1.0 (except for the likelihood of being a smoker) when evaluating the cost-effectiveness of individual interventions. This approach answers the "what if" question necessary in comparing cost-effectiveness ratios across interventions. The actual joint probabilities are used (in the bottom panel) when determining the expected outlays, number of quitters, and life-years saved for each intervention under a naturally occurring choice set. As one can see, the likelihood of an adult opting for intensive counseling using nicotine gum is very low: 0.16% [= (0.25) (1.0) (0.05) (0.75) (0.17)].

It should be kept in mind, though, that the conditional probabilities apply to the entire adult population. The rates should be multiplied by 4 when considering the likelihood of a smoker choosing a particular intervention. For example, assuming all smokers were willing to try and quit, roughly 19 percent would be expected to choose full counseling with the patch. Another 44 percent would not use nicotine replacement at all.

An alternative set of joint probabilities for the various intervention combinations can be derived by setting the willing-to-quit probability to 25 percent. As explained below, this would be appropriate if one assumed that the marginal quit rates were based on only a willing-to-quit population of smokers.

4.4.2 Quit Rates

The *Guideline* uses smoking quit rates as its effectiveness indicator. Primarily employing a modified intent-to-treat analysis technique, the researchers supporting the *Guideline* panel calculated percentages of individuals who successfully quit smoking under different interventions, drawing from peer-reviewed, published literature that provided at least 5 months of follow-up data. Meta-analyses evaluated basic treatment characteristics such as counseling format, 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* converts the logistic regression coefficients generated from the meta-analyses into odds ratios.

By way of example, one of the *Guideline's* meta-analyses compares quit rates by the extent of person-to-person contact. The estimated odds ratios in the *Guideline* report compare the success of each counseling intervention to no intervention, i.e., no contact. For example, the odds of a person quitting as a result of a minimal (<3 minute) counseling visit relative to no intervention was 1.2. Therefore, someone would be approximately 20 percent more likely to quit smoking if they received one minimal counseling visit versus trying to quit on their own.

For the 56 studies included in the meta-analysis, the baseline no intervention quit rate was 8.8 percent versus 10.7 percent for minimal counseling, 12.1 percent for brief counseling and 18.7 percent for counseling greater than 10 minutes, all excluding pharmacotherapy (see Table 4-2). The baseline and intervention quit rates for the study of intensive counseling (based on four to seven sessions) were 10.4 and 22.6 percent, respectively. Absolute quit rates for each intervention were converted into marginal quit rates by subtracting the underlying baseline quit rate. Marginal quit rates, net of the baseline rate, are the relevant statistics given the marginal increases in practice care costs generated by the various smoking interventions, although they need to be rebased for reasons given below.

Other quit rates were developed for adjuvant pharmacotherapy. Because the logistic coefficients from the meta-analyses produced unreasonably high marginal quit rates for nicotine patch and gum, due in part to small clinical trial samples testing these interventions, simple odds ratios from meta-analyses of the patch or gum were used instead. For transdermal replacement, the odds ratios ranged from 2.1 to 2.6 over counseling alone (see Table 16, p. 54, of the *Guideline*). Similarly, odds ratios for gum use ranged from 1.4-1.6. These odds ratios were converted to quit rates under varying lengths of physician contact. For example, the brief visit quit rate was 12.1 percent, implying an odds ratio of 0.138 [= 0.121/(1 - 0.121)]. Multiplying this ratio by the most conservative 2.1 odds ratio gives a brief counseling-with-patch odds ratio of 0.29, which converts back to an overall quit rate of 22.5 percent [= 0.29/(1 + 0.29)]. The marginal quit rate for brief

Table 4-2. Smoking Cessation Quit Rates

| Type of Visit | Baseline (percent) | Odds Ratio | Intervention ^a (percent) | Marginal Quit Rate (percent) | Rebased Marginal Quit Rate ^b (percent) |
|---|--------------------|------------|-------------------------------------|------------------------------|---|
| Minimal (<3 minutes) | 8.8 | 1.2 | 10.7 | 1.9 | 0.94 |
| With Patch | 8.8 | 2.1 | 19.6 | 10.8 | 6.70 |
| With Gum | 8.8 | 1.5 | 14.8 | 6.0 | 3.68 |
| Brief (3-10 minutes) | 8.8 | 1.4 | 12.1 | 3.3 | 1.86 |
| With Patch | 8.8 | 2.1 | 22.5 | 13.7 | 8.40 |
| With Gum | 8.8 | 1.5 | 17.1 | 8.3 | 4.95 |
| Counseling (>10 minutes) | 8.8 | 2.4 | 18.7 | 9.9 | 6.20 |
| With Patch | 8.8 | 2.1 | 32.6 | 23.8 | 16.00 |
| With Gum | 8.8 | 1.5 | 25.7 | 16.9 | 10.90 |
| Intensive Counseling (4-7 visits @ 20-30 minutes) | 10.4 | 2.5 | 22.6 | 12.2 | 6.62 |
| With Patch | 10.4 | 2.1 | 38.0 | 27.6 | 16.64 |
| With Gum | 10.4 | 1.5 | 30.5 | 20.1 | 11.50 |

^aQuit rates using patch and gum derived by applying marginal odds ratios reprinted in guideline to quit rates without nicotine replacement (see Chapter 4 on methods).

^bDerived by adjusting 5% underlying quit rate for at least 3 months in U.S. by odds ratios (see text).

Source: USDHHS, Clinical Practice Guideline Number 18: Smoking Cessation, PHS/AHCPR, No. 96-0692, April 1996.

counseling with patch is 13.7 percentage points (= 22.5 percent - 8.8 percent), as shown in Table 4-2.

The very high baseline quit rates in the meta-analyses are due to (a) some studies including only want-to-quit subjects, and (b) minimal cessation interventions (e.g., self-help materials) offered some control subjects. In order to apply the results of the meta-analyses to the entire U.S. smoking population, the odds ratios derived from the analyses were applied to the underlying 3-month-or-more quit rate in the U.S. (CDC, 1996). This rate was reported (by C. Husten at CDC) to be 5 percent (versus 5.7 percent for smokers quitting for at least 1 month). For example, the rebased marginal quit rate for brief counseling using the patch of 8.4 percent was derived by converting the 5 percent underlying quit rate into an odds ratio (= 0.0526), multiplying by the product of the two odds ratios (1.4 x 2.1 = 2.94), converting the result back into a percentage (= 0.1339 = 0.155/1.155), and subtracting off the original 5 percent. Finally, a 35 percent relapse rate is applied to derive an estimate of expected permanent quitters beyond 5 months. Thus, in determining the estimated number of permanent quitters under this intervention, 5.46 percent was used instead of 8.4 percent (or the 13.7 percentage point difference derived from the meta-analyses based on an 8.8 percentage point baseline).

Average and marginal quit rates are easily converted into an estimate of the total number of quitters by multiplying by the number of smokers involved in a given intervention. Approximately 25 percent of the adult population smokes, or slightly less than 50 million persons. If every smoker were to undergo minimal counseling, then the expected number of quitters would be 470,000 persons (= 50 million times 0.0094). With just brief counseling, about 930,000 persons (= 50 million times 1.86 percent) would be expected to quit versus 4.2 million (= 50 million times 8.4 percent) if they all used the patch as well.

Using quit rates to develop cost-effectiveness ratios allows one to compare alternative smoking cessation interventions, but they cannot be compared with other medical interventions whose cost-effective ratios are based on life-years saved, e.g., treatment of hypertension. In the next section, we describe the data and methods used to convert quit rates into life-years saved.

4.4.3 Life-Years Saved by Demographic Characteristic

Fortunately, the adverse effects of smoking have been well documented allowing researchers to link quit rates to health effects. Smokers have higher death rates than nonsmokers at all ages over 35

(Hodgson, 1992). They also are at higher risk for lung cancer, coronary heart disease, and emphysema, which is almost never observed among nonsmokers (Oster, 1984). The Office of Technology Assessment (1985) estimates that in 1982, 32 percent of all cancer deaths, 13 percent of all cardiovascular deaths, and 88 percent of all chronic lung disease deaths were due to smoking. In addition, smoking is a major agent for many other medical conditions including chronic bronchitis, cerebrovascular disease, and cancers of the oral cavity, larynx, and esophagus.

Hammond (1966) found that men aged 50-69 who were light smokers returned to a nonsmoker's level of risk of lung cancer within 5 years after quitting. He also reported that former light smokers demonstrated a decrease in coronary heart disease mortality within 1 year after quitting with the decline in risk complete after 10 years. Former heavy smokers returned to the nonsmoker risk levels 15 years after they quit smoking.

Table 4-3 shows the years of life gained as a result of smoking cessation for both men and women in different age groups. The data come from

Fiscella and Franks (1996), who performed a cost-effectiveness analysis of nicotine patch and gum as an adjunct to smoking cessation counseling from a physician. The authors translated quit rates into years-of-life-saved using life expectancy data for smokers and never smokers taken from Rogers and Powell-Griner (1991). Fiscella and Franks extrapolated mortality rates for smokers versus 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 25-State Cancer Prevention Study II (CDC, 1990).

The unadjusted life-years saved are highest for young female smokers, averaging over 6.5 years. Young males average roughly 2 years less due to shorter expected lifetimes in general. Discounting by 3 and 5 percent has a pronounced effect on the expected years saved. This is due to the fact that most years are gained near the end of life 20-30 years after quitting smoking. Indeed, undiscounted life-years saved for males, aged 18-19, is nearly 5-fold larger than if discounted at 5 percent.

Table 4-3. Estimates of Years of Life Saved per Smoker by Age and Gender

| Age at Quitting | Years of Life Saved per Smoker | | | Quality-Adjusted Years of Life Saved per Smoker | | |
|-----------------|--------------------------------|-------------|-------------|---|-------------|-------------|
| | Undiscounted | 3% Discount | 5% Discount | Undiscounted | 3% Discount | 5% Discount |
| Men | | | | | | |
| 25-29 | 4.73 | 1.31 | 0.95 | 6.55 | 2.34 | 1.32 |
| 30-34 | 4.47 | 1.39 | 1.03 | 6.09 | 2.38 | 1.40 |
| 35-39 | 4.09 | 1.43 | 1.06 | 5.48 | 2.34 | 1.44 |
| 40-44 | 3.59 | 1.40 | 1.08 | 4.75 | 2.20 | 1.41 |
| 45-49 | 3.03 | 1.30 | 1.00 | 3.96 | 1.98 | 1.32 |
| 50-54 | 2.35 | 1.11 | 0.89 | 3.08 | 1.67 | 1.16 |
| 55-59 | 1.76 | 0.91 | 0.74 | 2.31 | 1.35 | 0.97 |
| 60-64 | 1.23 | 0.70 | 0.59 | 1.62 | 1.01 | 0.77 |
| 65-69 | 0.76 | 0.47 | 0.40 | 1.04 | 0.69 | 0.54 |
| Women | | | | | | |
| 25-29 | 6.71 | 1.43 | 1.01 | 6.60 | 1.94 | 1.01 |
| 30-34 | 6.66 | 1.63 | 1.13 | 6.34 | 2.04 | 1.10 |
| 35-39 | 6.44 | 1.80 | 1.29 | 5.93 | 2.08 | 1.17 |
| 40-44 | 6.00 | 1.90 | 1.32 | 5.38 | 2.06 | 1.19 |
| 45-49 | 5.56 | 1.95 | 1.39 | 4.77 | 1.97 | 1.19 |
| 50-54 | 4.94 | 1.92 | 1.38 | 4.08 | 1.81 | 1.13 |
| 55-59 | 4.28 | 1.85 | 1.33 | 3.39 | 1.62 | 1.05 |
| 60-64 | 3.53 | 1.69 | 1.24 | 2.67 | 1.39 | 0.94 |
| 65-69 | 2.67 | 1.41 | 1.07 | 1.93 | 1.08 | 0.77 |

Sources: Fiscella, K. and P. Franks, Cost-Effectiveness of the Transdermal Nicotine Patch as an Adjunct to Physicians' Smoking Cessation Counseling, *Journal of the American Medical Association*, 275(16), April 24, 1996, and unpublished data by Fiscella and Franks. Estimates were derived from the American Cancer Society's Cancer Prevention Study II and adjusted for quality of life using the Healthy People 2000 Years of Healthy Life (YHL) measure.

Fiscella and Franks made a quality-of-life adjustment to the raw years-of-life saved figures. They used a years-of-healthy-life index constructed from questions on the annual National Health Interview Survey (CDC, 1995). Self-reported health status assesses health on a 0-1 continuum using two health domains: self-rated health and role limitations.

Adjusting for quality of life, like discounting, has pronounced effects on the gains to quitting smoking, especially for males. Not only can young males expect to gain over 4.5 years of life generally, they can add another 38 percent in terms of better health functioning by avoiding chronic lung and heart problems, etc. Morbidity gains to women are much less, in part because their early health gains are less from quitting. As with the undiscounted life-years saved, the value of quality-adjusted life-years is quite sensitive to the discount used. In their work, Fiscella and Franks (1996) discount their estimates of QALY's saved by 3 percent, a rate recently recommended by the Panel on Cost-Effectiveness in Health and Medicine (Gold *et al.*, 1996).

By multiplying the number of quitters by the discounted life-years saved per quitter, one can calculate total life-years saved and convert cost per quitter to cost per life-year saved. Cost-effectiveness ratios can then be compared among alternative smoking cessation interventions and other medical interventions derived from the literature.

4.4.4 Resource Utilization and Costs

The amount of counseling that smokers willing to make a quit attempt receive depends largely on patient and/or physician preference. We modeled five possible intervention scenarios that a patient may follow after receiving advice from a physician. They include 1) minimal counseling, 2) brief counseling, 3) full counseling, 4) individual intensive counseling, and 5) group intensive counseling. The level of provider time and number of sessions vary among these five options. The first three interventions involve primary care clinicians, who we assume are physicians, while intensive counseling, both individual and group, is performed by smoking cessation specialists.

Time Inputs. The assumptions that we made concerning the providers and length of time required for each intervention scenario are outlined in Table 4-4. They were provided by the *Guideline* panel chairman, Dr. Fiore. The *Guideline* recommends that health professionals screen all patients for smoking status during office visits or hospitalization. We assumed that this task is performed by a registered

nurse, and that it requires 1 minute of provider time. Furthermore, we assumed that adults 18 years and older are screened for their smoking status at each office visit, an average of approximately three visits per patient each year.

Following the identification of a smoker, initial smoking cessation advice is provided by physicians in either an office or hospital setting. This task involves delivering a clear, strong, and personalized message urging every smoker to quit. We assumed that this would take 1 minute of physician advice time and that all smokers would be advised to quit at each of their office visits or during the course of 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 that 75 percent of all smokers would require a motivational intervention at each of their annual office visits or during the course of hospitalization.

Minimal, brief, and full counseling interventions are provided to smokers willing to make a cessation attempt. These are delivered by primary care clinicians and involve increasing amounts of physician time. Among these three scenarios, full counseling involves the greatest amount of physician time, 15 minutes during an initial visit and two 10-minute follow-up visits. An extra 3 minutes was allocated to the minimal, brief, and full counseling interventions when nicotine replacement is used.

The individual intensive and group intensive 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 five counseling sessions that are each 30 minutes long. The first session involves 10 minutes of physician time for the purpose of assessing the patient and prescribing pharmacotherapy and an additional 20 minutes of R.N. time. The remaining time is divided between a registered nurse with health education experience and a psychologist (three 30-minute visits for the former and two 30-minute visits for the latter). Across the five sessions, there is a total of 10 minutes of physician time, 80 minutes of R.N. time, and 60 minutes of psychologist time. We assumed that group intensive counseling is delivered to groups of 10 patients and that the patients undergo seven 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 of the first). The remaining time for the first group session and sessions 2 through 7 involves a

Table 4-4. Resource Utilization Assumptions

| Type of Intervention | Intervention Time (Minutes) | | |
|--|--|------------------------------|------------|
| | Minimal | Brief | Counseling |
| Interventions for Primary Care Clinicians | | | |
| Screening | | | |
| Registered Nurse | 1 | 1 | 1 |
| Advice | | | |
| Physician Alone | 1 | 1 | 1 |
| Initial Counseling | | | |
| Physician Alone | 3 | 7 | 15 |
| Physician with Patch/Gum | 6 | 10 | 15 |
| Follow-up Counseling | | | |
| First Follow-up MD Visit | 3-6 | 10 | 10 |
| Second Follow-up MD Visit | | | 10 |
| Type of Intervention | Intervention Time (Minutes) ^a | | |
| | Individual Intensive ^b | Group Intensive ^c | |
| Intensive Interventions for Smoking Cessation Specialists | | | |
| Screening | | | |
| Registered Nurse | 1 | 1 | |
| Advice | | | |
| Physician Alone | 1 | 1 | |
| Counseling Sessions | | | |
| Physician | 10 | 20 | |
| Registered Nurse | 80 | 400 | |
| Psychologist | 60 | 400 | |

^aPatients referred to a smoking cessation specialist are first screened in an office or hospital setting and advised to quit by a primary care clinician.

^bCounseling time for Individual Intensive patients is distributed over five 30-minute sessions.

^cCounseling time for Group Intensive patients is distributed over seven 1-hour sessions.

registered nurse, who provides health education, and a psychologist. These two 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 among primary care clinicians. Their costs include not only a return to their own time input but any overhead costs associated with maintaining their practice. We used Medicare claims data to estimate the cost of physician time in both the office and hospital settings (see top panel of Table 4-5). Other studies (Cummings, 1989) have used physician charges, but very few patients or insurers pay full charges today. Medicare rates were used assuming they more accurately reflect the physician's true marginal price of providing an office visit. Assuming that patients are provided with a smoking cessation intervention during a routine office visit or during the course of hospitalization, we searched Medicare data for Current Procedural Terminology (CPT) codes identifying total costs incurred and

total patient encounters for relevant visit codes. To determine the per minute cost of physician time for the initial intervention, we used Evaluation and Management codes for new patients receiving services in an office or other outpatient setting. Per patient Medicare payments for 10, 20, 30, 45, and 60 minute visits were calculated and adjusted for medical services inflation through 1995. Then a per minute payment was calculated for each office code, and a weighted average taken across all time intervals to account for differences in patients with respect to length of office visits. We estimated that the Medicare effective physician payment per minute for an initial visit is \$1.97. Using the same methodology, we estimated that the average per minute cost of physician time for follow-up office visits is \$2.20.

We used Evaluation and Management CPT codes for subsequent hospital care to estimate initial physician advice and counseling costs in a hospital setting, i.e., \$1.92 per minute. We assumed that

Table 4-5. Cost Estimates of Physician Time

| CPT Code | Medicare Payments | Patient Encounters | Minutes per Visit | 1994 Cost per Visit | 1994 Cost per Minute | 1995 Cost per Minute |
|---|-------------------|--------------------|-------------------|---------------------|----------------------|----------------------|
| New Patient: Evaluation and Management, Office or Other Outpatient | | | | | | |
| 99201 | \$22,356,671 | 853,648 | 10 | \$26.19 | \$2.62 | \$2.75 |
| 99202 | 120,603,240 | 3,011,825 | 20 | 40.04 | 2.00 | 2.10 |
| 99203 | 198,088,091 | 3,717,946 | 30 | 53.28 | 1.78 | 1.87 |
| 99204 | 194,207,390 | 2,445,577 | 45 | 79.41 | 1.76 | 1.85 |
| 99205 | 154,541,514 | 1,583,820 | 60 | 97.58 | 1.63 | 1.71 |
| 1995 Weighted Average Physician Cost per Minute: | | | | | | \$1.97 |
| Established Patient: Evaluation and Management, Follow-up and/or Periodic Reevaluation | | | | | | |
| 99211 | \$111,513,773 | 8,392,042 | 5 | \$13.29 | \$2.66 | \$2.80 |
| 99212 | 695,309,442 | 31,592,741 | 10 | 22.01 | 2.20 | 2.31 |
| 99213 | 2,605,981,622 | 83,419,519 | 15 | 31.24 | 2.08 | 2.19 |
| 99214 | 1,470,776,427 | 30,568,970 | 25 | 48.11 | 1.92 | 2.02 |
| 99215 | 501,549,210 | 6,769,614 | 40 | 74.09 | 1.85 | 1.94 |
| 1995 Weighted Average Physician Cost per Minute: | | | | | | \$2.20 |
| Established Patient: Subsequent Hospital Care | | | | | | |
| 99231 | \$929,300,584 | 30,942,535 | 15 | \$30.03 | \$2.00 | \$2.10 |
| 99232 | 1,545,432,134 | 35,888,843 | 25 | 43.06 | 1.72 | 1.81 |
| 99233 | 719,801,417 | 11,998,762 | 35 | 59.99 | 1.71 | 1.80 |
| 1995 Weighted Average Physician Cost per Minute: | | | | | | \$1.92 |

Note: 1995 costs were derived using the Consumer Price Index (CPI) for all urban consumers, medical care services, to adjust 1994 costs.

Source: 1994 Medicare Claims data.

hospitalized patients would receive follow-up after discharge in an office setting or on an outpatient basis. Therefore, we used the same \$2.20 per minute average follow-up rate that was used for patients whose initial visit was in a physician's office setting.

We used Bureau of Labor Statistics (BLS) estimates of mean weekly earnings to calculate the per minute cost of R.N. and psychologist time (see Table 4-6). In 1995, the average weekly earnings of registered nurses and psychologists were \$729 and \$698, respectively. Assuming that these professionals work an average of 40 hours each week, the per minute labor cost of R.N.s is \$0.30, and for psychologists, the per minute labor cost is \$0.29.

Recognizing that there are also overhead costs associated with services that these professionals provide, we increased their salaries by a factor of two. Note that our physician cost estimate did not require this sort of adjustment because the Medicare claims that we used are based on office/hospital visit payments rather than physicians' salaries.

Educational Materials. 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 anti-smoking 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 two educational pamphlets during their counseling session at a total cost of \$2.00 per patient undergoing the intervention.

Nicotine Replacement. The *Guideline* recommends that every smoker be offered nicotine replacement therapy except in special circumstances, e.g., pregnant women. All of the smoking cessation scenarios were analyzed considering the cost-effectiveness of including the patch and/or gum as part of the intervention. We used the *Guideline* recommendations to determine the amount and dosages that each patient should receive.

Both the patch and nicotine gum are prescription drugs, although recently they have been made

Table 4-6. Cost Estimates of Nonphysician Time

| Occupation | 1995 Mean Weekly Earnings | Mean Hourly Earnings | Earnings per Minute | Total Cost per Minute |
|--------------------------|---------------------------|----------------------|---------------------|-----------------------|
| Registered Nurses | \$729 | \$18.23 | \$0.30 | \$0.60 |
| Licensed Practice Nurses | 463 | 11.58 | 0.19 | 0.38 |
| Nurses' Aids | 335 | 8.38 | 0.14 | 0.28 |
| Psychologists | 698 | 17.45 | 0.29 | 0.58 |
| Physician Assistants | 741 | 18.53 | 0.31 | 0.62 |

Note: Total cost per minute for nonphysician time was doubled to account for overhead and support costs.
Source: Bureau of Labor Statistics (BLS) Current Population Survey, 1995 estimates of weekly earnings.

available over the counter.³ Transdermal nicotine is sold under four different brand names: Nicoderm, Habitrol, Prostep, and Nicotrol. A complete smoking cessation intervention using the patch requires that patients use different dosages over a period of 8 weeks. We used the Average Wholesale Price (AWP) as an estimate of the cost of nicotine replacement (Mosby, 1995).

It is difficult to determine the exact price of any pharmacotherapy because prices vary with geographic region and by pharmacy. AWP's are benchmark prices that reflect what a retailer might pay without any special discounts. However, most pharmacies receive discounts off the AWP between 10 and 18 percent (HCFA, 1992). The price that consumers pay for drugs includes the discounted AWP cost to retailers plus any dispensing costs and net profits. Coincidentally, the AWP's for nicotine replacement are reflective of actual prices that consumers pay. This was determined by a random survey of Boston-area pharmacies. The retail prices for nicotine replacement varied from AWP's by less than 3 percent among chain drug stores and between 6 and 18 percent among more expensive independent pharmacies.

Table 4-7 gives the 1995 AWP for transdermal nicotine applied to the nicotine replacement recommendations detailed in the *Guideline* for each brand name. The average cost of an 8-week supply of the patch is \$219.23.

Nicotine gum is available under one brand name, Nicorette, in 2mg or 4mg doses. Both doses come in boxes of 96, and the AWP per box is \$38.85 and \$63.29, respectively. We assumed that patients use nicotine gum for the first 3 months of their quit

attempt and that they chew an average of 10 pieces per day. This intervention requires a single patient to purchase 10 boxes of gum. Therefore, the cost of a complete treatment of 2mg gum is \$388.50 and 4mg gum is \$632.90.

Only a portion of patients willing to undergo an intervention successfully quit. Unsuccessful quitters would not purchase an 8-week supply of nicotine replacement therapy or a full 90-day supply of gum. Instead, we assumed that they would only purchase a 4-week supply of the patch or gum. For transdermal nicotine, the average cost for the first month of patches is \$114.38. And a 4-week supply of nicotine gum requires approximately three boxes of gum, which costs \$116.55 for 2mg gum or \$189.87 for 4 mg gum.

4.5 Resources by Intervention Activity

Table 4-8 outlines smoking cessation interventions for primary care clinicians employing our resource utilization and cost assumptions. Minimal, brief, and full counseling interventions all have the same cost per participant for screening (\$0.60), advice (\$1.97), and motivation (\$1.97). However, the per participant intervention cost of each scenario increases with the intensity of counseling provided. The estimated cost of a single minimal intervention without pharmacotherapy is \$14.51. The brief intervention assumes longer initial physician visit and follow-up time, with a per participant cost of \$37.79. The full counseling intervention, requiring 15 minutes during the initial visit plus two 10-minute follow-up visits, costs \$75.55.

In calculating direct intervention costs for scenarios that employ pharmacotherapies, we assumed the 75 percent of smokers willing to quit would also be willing to use either the patch or nicotine gum. The total cost of pharmacotherapy was estimated as the sum of the cost of successful

³Transdermal nicotine and nicotine gum are now available over the counter at presumably lower cost. Because all of the meta-analyses of effectiveness are based on the gum available only by prescription, no price reduction was made.

Table 4-7. Nicotine Replacement Therapy Costs

| Brand | Duration of Treatment | Dosage | Average Wholesale Price per Box | Number per Box | Boxes per Treatment | Cost of Treatment |
|---|-----------------------|----------------|---------------------------------|----------------|---------------------|-------------------|
| Transdermal Nicotine | | | | | | |
| Nicoderm | 4 weeks | 21 mg/24 hours | \$57.18 | 14 | 2 | 114.36 |
| | then 2 weeks | 14 mg/24 hours | 52.50 | 14 | 1 | 52.50 |
| | then 2 weeks | 7 mg/24 hours | 48.60 | 14 | 1 | 48.60 |
| Total | | | | | | \$215.46 |
| Habitrol | 4 weeks | 21 mg/24 hours | 115.96 | 30 | 1 | 115.96 |
| | then 2 weeks | 14 mg/24 hours | 110.17 | 30 | 0.5 | 55.09 |
| | then 2 weeks | 7 mg/24 hours | 104.37 | 30 | 0.5 | 52.19 |
| Total | | | | | | \$223.23 |
| Prostep | 4 weeks | 22 mg/24 hours | 30.76 | 7 | 4 | 123.04 |
| | then 4 weeks | 11 mg/24 hours | 28.35 | 7 | 4 | 113.40 |
| Total | | | | | | \$236.44 |
| Nicotrol | 4 weeks | 15 mg/16 hours | 52.08 | 14 | 2 | 104.16 |
| | then 2 weeks | 10 mg/16 hours | 49.56 | 14 | 1 | 49.56 |
| | then 2 weeks | 6 mg/16 hours | 48.05 | 14 | 1 | 48.05 |
| Total | | | | | | \$201.77 |
| Average Cost of Complete Treatment | | | | | | \$219.23 |
| Average Cost of Partial Treatment (First Month) | | | | | | \$114.38 |
| Nicotine Gum | | | | | | |
| Nicorette | 90 days | 2 mg | \$38.85 | 96 | 10 | \$388.50 |
| Nicorette | 90 days | 4 mg | 63.29 | 96 | 10 | \$632.90 |
| Cost of Partial Treatment, 2 mg | | | | | | \$116.55 |
| Cost of Partial Treatment, 4 mg | | | | | | \$189.87 |

Sources: Physicians GenRx (Mosby Publishing, 1995); Guideline Recommendations on Usage.

and failed treatments. The average total cost of successful pharmacotherapy was calculated as the cost of a single successful treatment (using the full recommended dosage) times the number of successful quitters (assuming a 30 percent relapse). The cost of pharmacotherapy among failed quitters was equal to the cost of just a 1-month supply of pharmacotherapy times the total number of smokers who attempted to quit but failed. Adding pharmacotherapy greatly increases intervention costs. For brief counseling, the per participant cost rises to \$262.93 with the addition of a complete treatment of transdermal nicotine and to \$432.20 with nicotine gum. Full counseling with a complete transdermal nicotine treatment costs \$300.69, and full counseling with nicotine gum costs \$469.96. These costs, however, are much lower for patients who fail to quit because they do not require a complete treatment nicotine replacement.

The participant costs of intensive interventions provided by smoking cessation specialists are

outlined in Table 4-9. Screening, advising, and motivation are provided by primary care clinicians in an office or hospital setting before the patient is referred to a specialist. Therefore, these costs are the same as those described in Table 4-8. The cost of educational materials and pharmacotherapy are the same under these scenarios as well. Intensive interventions are divided into five sessions for individual counseling and seven sessions for group counseling. While the group counseling sessions are longer than individual counseling sessions (1 hour as opposed to 30 minutes), its per participant costs are much lower because the cost for each group session is distributed across 10 patients. The participant cost of an individual intensive counseling intervention without pharmacotherapy is \$104.50 per patient while it is only \$53.14 per patient for a group intervention. Adding a complete treatment of transdermal nicotine increases patient costs to \$323.73 and \$272.37, respectively. A complete, successful intensive intervention with gum costs

\$493 when provided through individual counseling and \$441.64 when provided in a group context. Again, among the scenarios that employ pharmacotherapy, costs are substantially less among

patients who fail than among successful quitters because of the differential costs of nicotine replacement.

Table 4-8. Smoking Cessation Costs: Interventions for Primary Care Clinicians

| Treatment | Minimal | | | Brief | | | Counseling | | |
|--------------------------------------|---------|------------|----------|-------|------------|----------|------------|------------|----------|
| | Alone | With Patch | With Gum | Alone | With Patch | With Gum | Alone | With Patch | With Gum |
| Screening | | | | | | | | | |
| Number of Minutes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Cost per Minute | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Cost of Screening Visit | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Advice | | | | | | | | | |
| Number of Minutes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Cost per Minute | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 |
| Cost of Advice Visit | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 |
| Motivation | | | | | | | | | |
| Number of Minutes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Cost per Minute | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 |
| Cost of Motivational Visit | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 |
| Intervention | | | | | | | | | |
| Initial Physician Counseling | | | | | | | | | |
| Number of Minutes | 3.00 | 6.00 | 6.00 | 7.00 | 10.00 | 10.00 | 15.00 | 18.00 | 18.00 |
| Cost per Minute | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 |
| Cost of Initial Physician Counseling | 5.91 | 13.82 | 13.82 | 13.79 | 19.70 | 19.70 | 29.55 | 35.46 | 35.46 |
| Physician Follow-up | | | | | | | | | |
| Number of Minutes | 3.00 | 6.00 | 6.00 | 10.00 | 10.00 | 10.00 | 20.00 | 20.00 | 20.00 |
| Cost per Minute | 2.20 | 2.20 | 2.20 | 2.20 | 2.20 | 2.20 | 2.20 | 2.20 | 2.20 |
| Cost of Physician Follow-up | 6.60 | 13.20 | 13.20 | 22.00 | 22.00 | 22.00 | 44.00 | 44.00 | 44.00 |
| Educational Materials | | | | | | | | | |
| Complete Pharmacotherapy | 0.00 | 219.23 | 388.50 | 0.00 | 219.23 | 388.50 | 0.00 | 219.23 | 388.50 |
| Partial Pharmacotherapy | 0.00 | 114.38 | 116.55 | 0.00 | 114.38 | 116.55 | 0.00 | 114.38 | 116.55 |
| Cost of Successful Intervention | 14.51 | 246.25 | 415.52 | 37.79 | 262.93 | 432.20 | 75.55 | 300.69 | 469.96 |
| Cost of Failed Intervention | 14.51 | 141.40 | 193.57 | 37.79 | 158.08 | 160.25 | 75.55 | 195.84 | 198.01 |

Table 4-9. Smoking Cessation Costs: Interventions for Specialists

| Treatment | Individual Intensive Counseling | | | Group (10 Patients) Intensive Counseling | | |
|---------------------------------|---------------------------------|------------|----------|--|------------|----------|
| | Alone | With Patch | With Gum | Alone | With Patch | With Gum |
| Screening | | | | | | |
| Number of Minutes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Cost per Minute | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Cost of Screening Visit | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Advice | | | | | | |
| Number of Minutes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Cost per Minute | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 |
| Cost of Advice Visit | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 |
| Motivation | | | | | | |
| Number of Minutes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Cost per Minute | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 |
| Cost of Motivational Visit | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 | 1.97 |
| Intervention | | | | | | |
| Session 1 | 31.70 | 31.70 | 31.70 | 8.66 | 8.66 | 8.66 |
| Session 2 | 18.00 | 18.00 | 18.00 | 7.08 | 7.08 | 7.08 |
| Session 3 | 18.00 | 18.00 | 18.00 | 7.08 | 7.08 | 7.08 |
| Session 4 | 17.40 | 17.40 | 17.40 | 7.08 | 7.08 | 7.08 |
| Session 5 | 17.40 | 17.40 | 17.40 | 7.08 | 7.08 | 7.08 |
| Session 6 | 0.00 | 0.00 | 0.00 | 7.08 | 7.08 | 7.08 |
| Session 7 | 0.00 | 0.00 | 0.00 | 7.08 | 7.08 | 7.08 |
| Educational Materials | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Complete Pharmacotherapy | 0.00 | 219.23 | 388.50 | 0.00 | 219.23 | 388.50 |
| Partial Pharmacotherapy | 0.00 | 114.38 | 116.55 | 0.00 | 114.38 | 116.55 |
| Cost of Successful Intervention | 104.50 | 323.73 | 493.00 | 53.14 | 272.37 | 441.64 |
| Cost of Failed Intervention | 104.50 | 218.88 | 221.05 | 53.14 | 167.52 | 169.69 |

5.0 Cost-effectiveness of the *Smoking Cessation Guideline*

5.1 Introduction

This chapter presents the findings regarding the costs and effectiveness of several smoking cessation interventions recommended in the *AHCPR Guideline*. Section 5.2 provides a summary of the basic parameters used in simulating costs and constructing cost-effectiveness ratios. The parameters include the number of adult smokers, total physician office visits, total hospital admissions, the likelihood of a patient being a smoker, etc. Section 5.3 then summarizes the estimates of the expected number of quitters under 12 intervention strategies by extent of patient-physician contact and the use of nicotine replacement. Section 5.4 provides the cost-effectiveness results for the same interventions. Each intervention scenario assumes the marginal quit rates apply to all comers (i.e., all smokers). We examine interventions provided to smokers who visit a physician's office and smokers who are hospitalized. Section 5.5 presents overall cost-effectiveness results for the *Guideline* as a whole. This section weights the cost-effectiveness ratios of the individual interventions by the likelihood that a patient will undertake the intervention. These models examine interventions initiated in a physician's office, intervention provided to hospitalized patients, and a combination of the physician visits and inpatient hospital interventions. Finally, Section 5.6 summarizes results of sensitivity analyses including willingness to quit, patient opportunity costs, relapse rate, format preference, and screening volume.

5.2 Summary of Basic Parameters

Each of the smoking cessation scenarios that we modeled is based on a common set of basic parameters that are listed in Table 5-1. The U.S. resident population over the age of 18 is estimated by the U.S. Bureau of the Census for January 1, 1996. The probability of smoking is based on the findings of the CDC's National Health Interview Survey, which found that, in 1993, 25 percent of the U.S. 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 CDC's National Ambulatory Medical Care Survey. This study found that there was a total of 606,877,000 office visits in the U.S. in 1992 among the population aged 15 years and older. We assumed the same number of office visits for our study. We estimated that adults in the U.S. experience an average of 3.11 physician office visits per year.

Hospital admissions were based on the American Hospital Association's (AHA) 1993 survey of hospitals. We used the estimate for short-term hospital admissions, which includes all patients except newborns. Psychiatric admissions were deducted from the total assuming that smoking cessation interventions would not be provided to these patients. We estimated that the total number of hospital admissions was 32,315,795.

Table 5-1. Summary of Basic Parameters

| | |
|--|-------------|
| Population | |
| Population (18 years and older) ^a | 194,980,000 |
| Probability of Smoking ^b | 25% |
| Number of Smokers | 48,745,000 |
| Utilization | |
| Total Office Visits per Year ^c | 606,877,000 |
| Office Visits per Capita | 3.11 |
| Office Visits to Smokers | 158,580,925 |
| Short-Term Hospital Admissions ^d | 32,315,795 |
| Short-Term Hospital Admissions to Smokers | 8,653,757 |
| Unique Smoker Admissions | 6,966,275 |

Notes: Hospital admissions exclude newborns and admissions to psychiatric facilities.

Sources:

^aU.S. Bureau of the Census, U.S. Resident Population estimates. January 1, 1996.

^bHealth, United States, 1994. Table 64, Cigarette Smoking by Persons 18 Years of Age and Older, 1993. Based on data from the CDC's *National Health Interview Survey*.

^cHealth, United States, 1994. Table 79, Office Visits to Physicians, 1992. Based on data from the CDC's *National Ambulatory Medical Care Survey*.

^dAHA Hospital Statistics, 1994-1995. Table 2A, Utilization, Personnel and Finances in Short-Term Hospitals. Based on 1993 AHA Hospital Survey.

Smokers have higher physician office and hospital utilization than people who have never smoked. Rice *et al.* (1986) found that, on average, smokers experienced about 6 percent more physician office visits and spent 27 percent more days in the hospital than never smokers. To determine the number of physician office visits among smokers, we estimated the average number of physician visits per smoker versus nonsmoker. If the ratio of the average number of physician visits among smokers versus nonsmokers is 1.06, and the number of visits per capita is 3.11, then the average smoker would experience 3.25 visits. Nonsmokers would have an average of 3.06 visits. We estimated that 606,877,000 physician office visits were made by smokers.

Using National Health Interview Survey (NHIS) estimates of the number of short-term hospital episodes by age and gender, we calculated that there were 29,051,900 admissions among the adult population ages 18 years or older. Therefore, there were approximately 0.149 admissions per adult resident. We assumed that because smokers experience 27 percent more hospital days per year than nonsmokers, they would also be 27 percent more likely to be admitted to the hospital. We calculated that 18.8 percent of smokers would experience an inpatient stay, while only 13.9 percent of nonsmokers would be admitted. These estimates generated 8,653,757 smoker admissions. However, according to NHIS estimates, among the general population, only 80.5 percent of admissions are unique hospital admissions; the remaining 19.5 percent are readmissions. We calculated that the total number of unique smoker admissions that would be eligible for an intervention is 6,966,275.

5.3 Number of Expected Quitters and Life-Years Saved by Intervention

Table 5-2 provides a summary of the expected number of quitters and quality-adjusted life-years saved from following the *Guideline*. The first two columns give the results for the overall *Guideline* while the second two columns report numbers only for hospitalized smokers. The number of quitters in each row was derived by multiplying the marginal quit rates, adjusted for a 35 percent relapse rate, times the roughly 48 million smokers in the United States, under the assumption that all smokers would go through a given intervention once during the year. For example, if all smokers were to undertake minimal counseling alone, 298,000 would be

expected to quit over-and-above the baseline expected number of quitters (1.56 million = $0.05 \times 48 \text{ million} \times 0.65$). A second set of figures is presented for the hospital-specific component of the *Guideline*. The number of quitters is derived by applying the same marginal quit rates from the literature to the estimated number of smokers that were hospitalized in 1995.

The number of quitters is converted into two measures of life-years saved: one discounted by 5 percent, and a second adjusted for quality-of-life years saved and discounted by 5 percent. The estimated years of life saved per quitter is given in the notes at the bottom of the table. For example, quitters can expect to save 1.18 quality-adjusted years of life, discounted at 5 percent annually. Not adjusting for quality-of-life improvements and discounting by 5 percent annually reduces the gain to 1.07 life-years.

Finally, a set of figures is provided at the bottom of the table that combines the results from each of the interventions. It does so by applying choice probabilities to each of the interventions. Hence, the number of quitters is based on a weighted average of the number of quitters in each intervention, the weights being the likelihood a patient would undergo a particular intervention.

According to Table 5-2, if all smokers were to undertake the minimal counseling intervention (assumed to be 3 minutes with the physician) with a 3-minute follow-up telephone call within 2 weeks, 298,000 smokers could be expected to be permanent quitters. If they were successful in quitting, a total of 351,400 quality-adjusted life-years would be saved (discounted at 5 percent). The total number of quitters and life-years saved rise with the intensity and duration of the cessation intervention. Intensive counseling with behavioral specialists and using the nicotine patch would generate the most quitters, 5.27 million, for a total of over 6.2 million quality-adjusted life-years saved.

Clearly, the use of nicotine replacement adds considerably to the effectiveness of any counseling intervention. With minimal counseling, the increase in the number of quitters is over 7-fold. Combined with intensive counseling, the impact of the patch is a 2.5-fold gain in quitters over the number expected from just intensive counseling alone. The large difference in the marginal effectiveness of the patch is due to the difference in marginal gain over the underlying 5 percent quit rate. For any counseling intervention, the nicotine patch slightly more than doubles the quit rate. Once the constant 5 percent underlying quit rate is subtracted, however, the

Table 5-2. Expected Annual Number of Quitters and Life-Years Saved by Smoking Cessation Intervention, Assuming All Smokers Attempt To Quit Once During the Year

| Treatment | Overall Guideline: Office and Hospital | | | Hospital Only | | |
|--|--|---------------------------------------|-------------------------------|---------------------------------|---------------------------------------|-------------------------------|
| | Number of Quitters ^a | Quality Life-Years Saved ^b | Life-Years Saved ^c | Number of Quitters ^a | Quality Life-Years Saved ^b | Life-Years Saved ^c |
| Minimal Counseling | 298 | 351.4 | 318.7 | 43 | 50.2 | 45.5 |
| With Patch | 2,123 | 2,504.0 | 2,271.4 | 303 | 358.0 | 324.6 |
| With Gum | 1,156 | 1,364.6 | 1,237.4 | 165 | 195.0 | 176.8 |
| Brief Counseling | 589 | 659.4 | 630.6 | 84 | 99.4 | 90.1 |
| With Patch | 2,662 | 3,140.5 | 2,847.8 | 380 | 448.8 | 407.0 |
| With Gum | 1,568 | 1,850.7 | 1,678.2 | 224 | 264.5 | 239.8 |
| Full Counseling | 1,964 | 2,318.0 | 2,101.9 | 281 | 331.3 | 300.4 |
| With Patch | 5,069 | 5,982.0 | 5,424.3 | 724 | 854.9 | 775.2 |
| With Gum | 3,454 | 4,075.2 | 3,695.3 | 494 | 582.4 | 528.1 |
| Intensive Counseling | 2,097 | 2,475.0 | 2,244.3 | 300 | 353.7 | 320.7 |
| With Patch | 5,272 | 6,221.3 | 5,614.3 | 753 | 889.1 | 806.2 |
| With Gum | 3,644 | 4,299.6 | 3,898.7 | 521 | 614.5 | 557.2 |
| Combined Intervention^d | 2,630 | 3,103.7 | 2,814.4 | 376 | 443.6 | 402.2 |

^aNumber of quitters (in thousands).

^bQuality-adjusted life-years saved (discounted 5%), in thousands, derived using 1.18 adjustment factor to number of quitters.

^cLife-years (discounted 5%), in thousands, derived using 1.07 adjustment factor to the number of quitters.

^dDerived by weighting the individual interventions by the likelihood of smokers choosing each intervention.

Source: Marginal quit rates: AHCPR Guideline. Life-years saved per quitter: Fiscella and Franks (1996).

relative impacts become far larger for the shorter counseling sessions.

Quality-adjusted life-years saved ranges from a low of 351,400 under the overall *Guideline* to over 6.2 million for full and intensive counseling using the patch. Life-years saved also discounted at 5 percent and not adjusted for quality improvements are slightly less than the number based on quality adjustments.

Summing across all the interventions suggests that roughly 2.63 million new quitters could be expected under the *Guideline*, assuming patients choose the various interventions in proportions expected by the panel experts and the literature. If realized, these new quitters could expect to enjoy 3.1 million more quality-adjusted life-years, discounted at 5 percent. The new quitters would slightly more than double the underlying 5 percent quit rate in the United States.

5.4 Cost-Effectiveness Results: Individual Interventions

Cost-effectiveness ratios were developed for each intervention scenario assuming that the entire population of smokers over the age of 18 would be willing to quit. We performed three separate analyses. First, we examined patients visiting their primary care clinician. Second, we analyzed the cost-effectiveness of providing smoking cessation interventions to hospitalized patients. Finally, we combined office visit patients and hospitalized patients into a single analysis.

5.4.1 Cost-Effectiveness Ratios for Office Visit Patients

Table 5-3 presents the cost-effectiveness results of each of the intervention scenarios. We assumed that

Table 5-3. Cost-Effectiveness of Smoking Cessation Provided in Physicians' Offices by Intervention, All Comers

| Treatment | Minimal | | | Brief | | | Counseling | | | Individual Intensive Counseling | | | Group (10 Patients) Intensive Counseling | | |
|--|-----------------------------------|------------|-----------|-----------|------------|-----------|------------|------------|------------|---------------------------------|------------|------------|--|------------|------------|
| | Alone | With Patch | With Gum | Alone | With Patch | With Gum | Alone | With Patch | With Gum | Alone | With Patch | With Gum | Alone | With Patch | With Gum |
| | Total Screening Cost ^a | 364,126 | 364,126 | 364,126 | 364,126 | 364,126 | 364,126 | 364,126 | 364,126 | 364,126 | 364,126 | 364,126 | 364,126 | 364,126 | 364,126 |
| Total Advising Cost ^a | 312,404 | 312,404 | 312,404 | 312,404 | 312,404 | 312,404 | 312,404 | 312,404 | 312,404 | 312,404 | 312,404 | 312,404 | 312,404 | 312,404 | 312,404 |
| Total Motivation Cost ^a | 234,303 | 234,303 | 234,303 | 234,303 | 234,303 | 234,303 | 234,303 | 234,303 | 234,303 | 234,303 | 234,303 | 234,303 | 234,303 | 234,303 | 234,303 |
| Direct Intervention | | | | | | | | | | | | | | | |
| Total Direct Cost ^a | 707,290 | 7,234,974 | 7,482,171 | 1,842,074 | 8,134,926 | 8,467,568 | 3,682,685 | 10,363,967 | 11,096,924 | 5,093,853 | 11,519,762 | 12,299,546 | 2,590,309 | 9,016,218 | 9,796,002 |
| Cost per Capita | 3.63 | 37.11 | 38.37 | 9.45 | 41.72 | 43.43 | 18.89 | 53.15 | 56.91 | 26.13 | 59.08 | 63.08 | 13.29 | 46.24 | 50.24 |
| Cost per Smoker | 14.51 | 148.42 | 153.50 | 37.79 | 166.89 | 173.71 | 75.55 | 212.62 | 227.65 | 104.50 | 236.33 | 252.32 | 53.14 | 184.97 | 200.96 |
| Cost per Quitter | 2,374.80 | 3,408.15 | 6,469.81 | 3,125.72 | 3,056.55 | 5,398.96 | 1,874.69 | 2,044.38 | 3,213.16 | 2,428.54 | 2,184.98 | 3,375.58 | 1,234.95 | 1,710.12 | 2,688.48 |
| Aggregate Statistics | | | | | | | | | | | | | | | |
| Total Intervention Cost ^a | 1,618,124 | 8,145,808 | 8,993,005 | 2,752,907 | 9,045,760 | 9,378,402 | 4,593,519 | 11,274,801 | 12,007,757 | 6,004,686 | 12,430,596 | 13,210,380 | 3,501,143 | 9,927,052 | 10,706,836 |
| Marginal Quit Rate | 0.0094 | 0.067 | 0.0365 | 0.0186 | 0.084 | 0.0495 | 0.062 | 0.16 | 0.109 | 0.0662 | 0.1664 | 0.115 | 0.0662 | 0.1664 | 0.115 |
| Total Quitters | 297,892 | 2,122,845 | 1,156,475 | 589,327 | 2,661,477 | 1,568,370 | 1,964,424 | 5,069,480 | 4,453,583 | 2,097,497 | 5,272,259 | 3,643,689 | 2,097,497 | 5,272,259 | 3,643,689 |
| Total Cost per Quitter | 5,433.01 | 3,837.21 | 7,257.40 | 4,671.27 | 3,398.77 | 5,979.71 | 2,338.35 | 2,224.05 | 3,476.90 | 2,862.79 | 2,357.74 | 3,625.55 | 1,669.20 | 1,982.88 | 2,938.46 |
| Total Cost per Capita | 8.30 | 41.78 | 43.05 | 14.12 | 46.39 | 48.10 | 23.56 | 57.83 | 61.58 | 30.80 | 63.75 | 67.75 | 17.96 | 50.91 | 54.91 |
| Total Cost per Smoker | 33.20 | 167.11 | 172.18 | 56.48 | 185.57 | 192.40 | 94.24 | 231.30 | 246.34 | 123.19 | 255.01 | 271.01 | 71.83 | 203.65 | 219.65 |
| Cost per Life-Year Saved | | | | | | | | | | | | | | | |
| Undiscounted | 1,168.66 | 825.40 | 1,561.09 | 1,004.81 | 791.09 | 1,286.25 | 502.99 | 478.40 | 747.89 | 615.79 | 507.16 | 779.87 | 359.05 | 405.01 | 632.07 |
| 3% Discount | 3,716.64 | 2,624.98 | 4,964.68 | 3,195.55 | 2,325.05 | 4,090.63 | 1,599.63 | 1,521.44 | 2,378.49 | 1,958.39 | 1,612.89 | 2,480.19 | 1,141.88 | 1,288.05 | 2,010.16 |
| 5% Discount | 5,083.10 | 3,590.08 | 6,789.99 | 4,370.42 | 3,179.88 | 5,594.59 | 2,187.75 | 2,080.82 | 3,252.97 | 2,678.41 | 2,205.89 | 3,392.05 | 1,561.70 | 1,761.62 | 2,749.21 |
| Cost per Quality-Adjusted Life-Year Saved | | | | | | | | | | | | | | | |
| Undiscounted | 1,065.45 | 752.50 | 1,423.23 | 916.07 | 666.52 | 1,172.66 | 458.57 | 436.15 | 681.84 | 561.41 | 462.37 | 711.00 | 327.34 | 369.25 | 576.25 |
| 3% Discount | 2,791.75 | 1,929.38 | 3,649.07 | 2,348.75 | 1,708.93 | 3,006.64 | 1,175.74 | 1,118.27 | 1,748.21 | 1,439.43 | 1,185.49 | 1,822.95 | 839.28 | 946.73 | 1,477.48 |
| 5% Discount | 4,568.38 | 3,226.54 | 6,102.43 | 3,927.87 | 2,857.88 | 5,028.07 | 1,966.22 | 1,870.11 | 2,923.57 | 2,407.19 | 1,982.52 | 3,048.57 | 1,403.56 | 1,583.23 | 2,470.82 |

^aCosts are reported in thousands.
 Note: Quitters were discounted at 35 percent to account for relapse.

all smokers visiting a physician's office during a period of 1 year would attempt to quit. The costs associated with screening all patients and advising and motivating all smokers to quit remain constant across all of the intervention scenarios. Only the intervention-specific direct costs and their corresponding quit rates vary.

The estimated total cost of providing the minimal intervention alone to all smokers is \$1,618,124,000. Given a marginal quit rate of 0.9 percent and assuming that 35 percent of the quitters will relapse, the scenario generates a cost of \$5,433.01 per quitter. Spread across the entire U.S. adult population, the minimal intervention scenario costs \$8.30 per capita, or \$33.20 per adult smoker. The direct intervention costs, which exclude the cost of screening, advising, and motivating patients, is \$707,290,000. The cost per quitter of this portion of the minimal scenario is \$2,374.80. This intervention costs \$5,083.10 per year of life saved (discounted at 5 percent). When we adjust for quality of life, the cost drops to \$4,568.38.

The remaining intervention scenarios include brief, full counseling, individual intensive counseling, and group intensive counseling. With the exception of group counseling, which provides counseling sessions to groups of 10 patients, as the amount of provider time required for an intervention increases, its costs do as well. The addition of nicotine replacement therapy increases intervention costs even further. The most costly intervention is individual intensive counseling with nicotine gum. It would cost over \$13 billion to provide this intervention to all smokers, assuming they were willing. The cost of this intervention about 8 times greater than the total cost of the minimal intervention alone.

However, costs alone are of limited use in making economic decisions. Just as intervention costs increase with intensity, the marginal number of quitters increases, too. So while individual intensive counseling with gum costs over \$13 billion, it is expected to generate over 3.6 million new quitters, assuming all smokers were willing to try this intervention.

The total costs per quitter ranged from a low of \$1,669.20 for group intensive counseling without pharmacotherapy to \$7,257.40 for minimal counseling with nicotine gum. When the cost of advising, screening, and motivating are excluded from the total costs, the direct intervention cost-effectiveness estimates range from a low of \$1,234.95 per quitter for group intensive counseling

alone to a high of \$6,469.81 for minimal counseling with nicotine gum. Cost per life-year saved, discounted at 5 percent, ranged from \$1,561.70 for group intensive counseling alone to \$6,789.99 for minimal counseling with nicotine gum.

5.4.2 Cost-Effectiveness Ratios for Hospitalized Patients

The *Guideline* recommends that hospitalized patients receive smoking cessation interventions. We performed a separate analysis examining this population assuming that all smokers admitted to a short-term hospital would be willing to undergo an intervention. Our results are summarized in Table 5-4. The number of smokers who would receive an intervention in the hospital is much smaller than the population that would encounter a physician in an office setting, 6.9 million versus 48 million, so aggregate costs are lower.

When we assume that all patients receive an intervention, costs per life-year saved are slightly higher for the nonhospitalized patients versus hospitalized patients, reflecting the large number of patients who are repeatedly screened, advised, and motivated in the office setting. Among the hospitalized patients, the total intervention costs ranged from \$142,390,000 for minimal counseling alone to \$1,796,631,000 for individual intensive counseling with nicotine gum. However, group counseling alone generated the lowest cost per quitter, \$1,373.92. Minimal intensive counseling with gum is the most costly intervention per quitter at \$6,713.43. This translates to a cost of \$1,298.01 per life-year saved (discounted at 5 percent) for group counseling alone and \$6,342.49 for minimal counseling with gum.

5.4.3 Cost-Effectiveness Ratios for Office Visit and Hospitalized Patients Combined

Table 5-5 combines the interventions provided to office visit patients and hospitalized patients, analyzing each intervention individually. One of the challenges to studying the cost-effectiveness of the recommendations outlined in the *Guideline* is determining any overlap between the population of hospitalized smokers and the population of smokers who visit the office of a primary care clinician. If we simply combine the costs and effects of our hospital and physician office scenarios, we would be

Table 5-4. Cost-Effectiveness of Smoking Cessation Provided to Hospitalized Patients by Intervention, All Comers

| Treatment | Minimal | | | Brief | | | Counseling | | | Individual Intensive Counseling | | | Group (10 Patients) Intensive Counseling | | |
|--|----------|------------|-----------|----------|------------|-----------|------------|------------|-----------|---------------------------------|------------|-----------|--|------------|-----------|
| | Alone | With Patch | With Gum | Alone | With Patch | With Gum | Alone | With Patch | With Gum | Alone | With Patch | With Gum | Alone | With Patch | With Gum |
| | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 |
| Total Screening Cost ^a | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 | 17,431 |
| Total Advising Cost ^a | 16,615 | 16,615 | 16,615 | 16,615 | 16,615 | 16,615 | 16,615 | 16,615 | 16,615 | 16,615 | 16,615 | 16,615 | 16,615 | 16,615 | 16,615 |
| Total Motivation Cost ^a | 8,308 | 8,308 | 8,308 | 8,308 | 8,308 | 8,308 | 8,308 | 8,308 | 8,308 | 8,308 | 8,308 | 8,308 | 8,308 | 8,308 | 8,308 |
| Direct Intervention | | | | | | | | | | | | | | | |
| Total Direct Cost ^a | 100,036 | 1,031,879 | 1,067,207 | 260,817 | 1,159,100 | 1,206,639 | 521,077 | 1,474,872 | 1,579,621 | 724,493 | 1,642,836 | 1,754,277 | 369,491 | 1,287,835 | 1,399,276 |
| Cost per Capita | 0.51 | 5.29 | 5.47 | 1.34 | 5.94 | 6.19 | 2.67 | 7.56 | 8.10 | 3.72 | 8.43 | 9.00 | 1.90 | 6.60 | 7.18 |
| Cost per Smoker | 2.05 | 21.17 | 21.89 | 5.35 | 23.78 | 24.75 | 10.69 | 30.26 | 32.41 | 14.86 | 33.70 | 35.99 | 7.58 | 26.42 | 28.71 |
| Cost per Quitter | 2,350.25 | 3,401.26 | 6,457.16 | 3,096.77 | 3,047.39 | 5,383.42 | 1,856.08 | 2,035.73 | 3,200.46 | 2,416.92 | 2,180.35 | 3,368.89 | 1,232.63 | 1,709.20 | 2,687.15 |
| Aggregate Statistics | | | | | | | | | | | | | | | |
| Total Intervention Cost ^a | 142,390 | 1,074,233 | 1,109,561 | 303,171 | 1,201,454 | 1,248,993 | 563,431 | 1,517,226 | 1,621,975 | 766,847 | 1,685,190 | 1,796,631 | 411,845 | 1,330,189 | 1,441,630 |
| Marginal Quit Rate | 0.0094 | 0.067 | 0.0365 | 0.0186 | 0.084 | 0.0495 | 0.062 | 0.16 | 0.109 | 0.0662 | 0.1664 | 0.115 | 0.0662 | 0.1664 | 0.115 |
| Total Quitters | 42,564 | 303,381 | 165,275 | 84,222 | 380,359 | 224,140 | 280,741 | 724,493 | 493,561 | 299,759 | 753,472 | 520,729 | 299,759 | 753,472 | 520,729 |
| Total Cost per Quitter | 3,345.31 | 3,540.87 | 6,713.43 | 3,599.66 | 3,158.74 | 5,572.38 | 2,006.94 | 2,094.19 | 3,286.27 | 2,558.21 | 2,236.57 | 3,450.22 | 1,373.92 | 1,765.41 | 2,768.48 |
| Total Cost per Capita | 0.73 | 5.51 | 5.69 | 1.55 | 6.16 | 6.41 | 2.89 | 7.78 | 8.32 | 3.93 | 8.64 | 9.21 | 2.11 | 6.82 | 7.39 |
| Total Cost per Smoker | 2.92 | 22.04 | 22.76 | 6.22 | 24.65 | 25.62 | 11.56 | 31.13 | 33.27 | 15.73 | 34.57 | 36.86 | 8.45 | 27.29 | 29.57 |
| Cost per Life-Year Saved | | | | | | | | | | | | | | | |
| Undiscounted | 700.95 | 741.93 | 1,406.69 | 754.25 | 661.86 | 1,167.60 | 420.52 | 438.80 | 686.58 | 536.03 | 468.64 | 722.94 | 287.88 | 369.91 | 580.09 |
| 3% Discount | 2,300.27 | 2,434.74 | 4,616.23 | 2,475.17 | 2,171.99 | 3,831.63 | 1,380.00 | 1,439.99 | 2,259.68 | 1,759.06 | 1,537.89 | 2,372.41 | 944.72 | 1,213.92 | 1,903.64 |
| 5% Discount | 3,160.48 | 3,345.23 | 6,342.49 | 3,400.77 | 2,984.21 | 5,264.49 | 1,896.06 | 1,978.48 | 3,104.70 | 2,416.86 | 2,112.99 | 3,259.59 | 1,298.01 | 1,667.87 | 2,615.52 |
| Cost per Quality-Adjusted Life-Year Saved | | | | | | | | | | | | | | | |
| Undiscounted | 681.64 | 721.48 | 1,367.92 | 733.46 | 643.62 | 1,135.42 | 408.93 | 426.71 | 669.61 | 521.26 | 455.72 | 703.01 | 279.95 | 359.72 | 564.10 |
| 3% Discount | 1,794.71 | 1,899.62 | 3,601.65 | 1,931.16 | 1,694.61 | 2,989.49 | 1,076.69 | 1,123.50 | 1,763.03 | 1,372.44 | 1,199.88 | 1,850.99 | 737.09 | 947.12 | 1,485.25 |
| 5% Discount | 3,020.00 | 3,196.54 | 6,060.58 | 3,249.61 | 2,851.57 | 5,030.50 | 1,811.78 | 1,890.54 | 2,966.70 | 2,309.44 | 2,019.07 | 3,114.71 | 1,240.32 | 1,593.74 | 2,499.26 |

^aCosts are reported in thousands.
 Note: Quitters were discounted at 35 percent to account for relapse.

Table 5-5. Cost-Effectiveness of Smoking Cessation, Physician's Office and Hospital Combined, by Intervention, All Comers

| Treatment | Minimal | | | Brief | | | Counseling | | | Individual Intensive Counseling | | | Group (10 Patients) Intensive Counseling | | |
|--|-----------------------------------|------------|-----------|-----------|------------|-----------|------------|------------|------------|---------------------------------|------------|------------|--|------------|------------|
| | Alone | With Patch | With Gum | Alone | With Patch | With Gum | Alone | With Patch | With Gum | Alone | With Patch | With Gum | Alone | With Patch | With Gum |
| | Total Screening Cost ^a | 381,557 | 381,557 | 381,557 | 381,557 | 381,557 | 381,557 | 381,557 | 381,557 | 381,557 | 381,557 | 381,557 | 381,557 | 381,557 | 381,557 |
| Total Advising Cost ^a | 329,020 | 329,020 | 329,020 | 329,020 | 329,020 | 329,020 | 329,020 | 329,020 | 329,020 | 329,020 | 329,020 | 329,020 | 329,020 | 329,020 | 329,020 |
| Total Motivation Cost ^a | 242,611 | 242,611 | 242,611 | 242,611 | 242,611 | 242,611 | 242,611 | 242,611 | 242,611 | 242,611 | 242,611 | 242,611 | 242,611 | 242,611 | 242,611 |
| Direct Intervention | | | | | | | | | | | | | | | |
| Total Direct Cost ^a | 706,245 | 7,232,884 | 7,480,081 | 1,839,635 | 8,131,443 | 8,464,085 | 3,677,460 | 10,357,697 | 11,090,654 | 5,090,369 | 11,516,278 | 12,296,062 | 2,589,613 | 9,015,522 | 9,795,306 |
| Cost per Capita | 3.62 | 37.10 | 38.36 | 9.43 | 41.70 | 43.41 | 18.86 | 53.12 | 56.88 | 26.11 | 59.06 | 63.06 | 13.28 | 46.24 | 50.24 |
| Cost per Smoker | 14.49 | 148.38 | 153.45 | 37.74 | 166.82 | 173.64 | 75.44 | 212.49 | 227.52 | 104.43 | 236.26 | 252.25 | 53.13 | 184.95 | 200.95 |
| Cost per Quitter | 2,371.29 | 3,407.17 | 6,468.00 | 3,121.59 | 3,055.24 | 5,396.74 | 1,872.03 | 2,043.15 | 3,211.35 | 2,426.88 | 2,184.32 | 3,374.62 | 1,234.62 | 1,709.99 | 2,688.29 |
| Aggregate Statistics | | | | | | | | | | | | | | | |
| Total Intervention Cost ^a | 1,659,433 | 8,166,072 | 8,433,269 | 2,792,823 | 9,084,631 | 9,417,273 | 4,630,648 | 11,310,885 | 12,043,842 | 6,043,557 | 12,469,466 | 13,249,250 | 3,542,801 | 9,968,710 | 10,748,494 |
| Marginal Quit Rate | 0.0094 | 0.067 | 0.0365 | 0.0186 | 0.084 | 0.0495 | 0.062 | 0.16 | 0.109 | 0.0662 | 0.1664 | 0.115 | 0.0662 | 0.1664 | 0.115 |
| Total Quitters | 297,832 | 2,122,845 | 1,156,475 | 589,327 | 2,661,477 | 1,568,370 | 1,964,424 | 5,069,480 | 3,453,583 | 2,097,497 | 5,272,259 | 3,643,689 | 2,097,497 | 5,272,259 | 3,643,689 |
| Total Cost per Quitter | 5,571.71 | 3,856.18 | 7,292.22 | 4,739.00 | 3,413.38 | 6,004.50 | 2,357.26 | 2,231.17 | 3,487.35 | 2,881.32 | 2,365.11 | 3,636.22 | 1,689.06 | 1,890.79 | 2,949.89 |
| Total Cost per Capita | 8.51 | 41.98 | 43.25 | 14.32 | 46.59 | 48.30 | 23.75 | 58.01 | 61.77 | 31.00 | 63.95 | 67.95 | 18.17 | 51.13 | 55.13 |
| Total Cost per Smoker | 34.04 | 167.94 | 173.01 | 57.29 | 186.37 | 193.19 | 95.00 | 232.04 | 247.08 | 123.98 | 255.81 | 271.81 | 72.68 | 204.51 | 220.50 |
| Cost per Life-Year Saved | | | | | | | | | | | | | | | |
| Undiscounted | 1,194.52 | 826.73 | 1,563.38 | 1,016.00 | 731.80 | 1,287.31 | 505.37 | 478.34 | 747.65 | 617.73 | 507.06 | 779.57 | 362.12 | 405.37 | 632.43 |
| 3% Discount | 3,813.97 | 2,639.65 | 4,991.70 | 3,243.96 | 2,336.54 | 4,110.22 | 1,613.60 | 1,527.29 | 2,387.17 | 1,972.33 | 1,618.97 | 2,489.08 | 1,156.20 | 1,294.29 | 2,019.27 |
| 5% Discount | 5,219.19 | 3,612.20 | 6,830.84 | 4,439.17 | 3,197.42 | 5,624.59 | 2,208.11 | 2,090.01 | 3,266.70 | 2,699.02 | 2,215.47 | 3,406.16 | 1,582.19 | 1,771.16 | 2,763.25 |
| Cost per Quality-Adjusted Life-Year Saved | | | | | | | | | | | | | | | |
| Undiscounted | 1,097.81 | 759.79 | 1,436.80 | 933.74 | 672.55 | 1,183.08 | 464.46 | 439.61 | 687.12 | 567.71 | 466.00 | 716.45 | 332.80 | 372.55 | 581.22 |
| 3% Discount | 2,823.66 | 1,954.25 | 3,695.58 | 2,401.65 | 1,729.85 | 3,042.99 | 1,194.62 | 1,130.72 | 1,767.33 | 1,460.21 | 1,198.60 | 1,842.78 | 855.99 | 958.22 | 1,494.96 |
| 5% Discount | 4,725.52 | 3,270.53 | 6,184.73 | 4,019.28 | 2,894.98 | 5,092.58 | 1,999.25 | 1,892.32 | 2,957.71 | 2,443.73 | 2,005.91 | 3,083.98 | 1,432.54 | 1,603.63 | 2,501.89 |

^aCosts are reported in thousands.
 Note: Quitters were discounted at 35 percent to account for relapse.

costing multiple interventions provided individual smokers and attributing more than one successful quit attempt to them.

According to the *Guideline*, all patients are screened during office visits and during hospitalization. Therefore, a patient may be screened more than once either because he/she visited a physician's office multiple times or visited a physician's office and was hospitalized. The *Guideline* indicates that continual screening is not necessary for adults who have never smoked or not smoked for many years, and for whom this information is clearly documented in their medical record. Our analysis makes the conservative assumption that all patients would require continual screening. Similarly, we assumed that individual smokers would be advised to quit in both office and hospital settings with health care clinicians repeatedly urging them to quit. Seventy-five percent of patients visiting a physician's office and 50 percent of hospitalized patients were assumed, initially, to be unwilling to quit and would receive a motivational message. We then assumed all smokers would undertake one intervention annually.

To calculate the combined cost of direct intervention provided to patients encountered in the physician's office and those encountered in an inpatient hospital setting, we subtracted the number of unique smoker admissions from the total population of smokers. We assumed that all hospitalized smokers would receive an initial intervention during their admission and would receive follow-up in a physician's office or be referred to a smoking cessation specialist. All other smokers would receive their initial intervention during the course of an office visit to their primary care clinician. Therefore, 6,966,275 smoking cessation interventions begin in the hospital, and 41,778,725 interventions begin in a physician's office.

Table 5-5 summarizes our analysis of the individual interventions, which combines ambulatory and hospitalized patients. Note that the total costs of screening, advising, and motivation include services provided in both physicians' offices and hospitals. Therefore, the costs are slightly higher than those in Table 5-3. Total intervention costs ranged from \$1.7 billion for minimal counseling alone to 13.2 billion for individual intensive counseling with nicotine gum. The total direct intervention costs ranged from \$706 million for minimal counseling alone to over \$12 billion for individual intensive counseling with nicotine gum. Again, group intensive counseling alone generated the lowest cost per quitter,

\$1,689.06, and would cost \$1,582.19 per life-year saved (discounted at 5 percent). Minimal counseling with gum costs \$7,292.22 per quitter, more than any other intervention. This translates to a cost of \$6,830.84 per life-year saved.

5.5 Overall *Guideline* Cost-Effectiveness Ratios

While analyzing the cost-effectiveness of each intervention scenario individually allows one to identify the relative economic value of each approach, these hypothetical constructs are unlikely to ever occur in actual medical practice. In reality, smokers vary in their willingness to undergo intensive interventions and use pharmacotherapies, and one would not expect the entire population of smokers (or willing-to-quit smokers) to select or be offered the same intervention option. Furthermore, the *Guideline* recognizes that a variety of smoking cessation approaches are effective and allows for patient willingness and, to a certain degree, provider discretion to influence intervention selection.

Table 5-6 combines all of the interventions into just three models. We assumed that all smokers would be willing to quit, but that this population would be distributed across all of the intervention scenarios based on smoker preferences. Intervention probabilities were used to determine the likelihood that a smoker would choose a particular scenario (see Section 4.4.1 in Chapter 4). We assumed that only 5 percent of smokers would select an intensive intervention, whereas 25 percent would choose a minimal intervention. Another 40 percent would be willing to receive a brief intervention, and the remaining 30 percent of willing smokers opt for counseling. In addition, we assumed that 75 percent of smokers making a quit attempt would be willing to use pharmacotherapy, and among these smokers, 5 times as many patients would choose the nicotine patch as nicotine gum. These probabilities were applied to the population of adult smokers to determine the number of smokers that would go through each intervention. Then, the cost of each intervention scenario was calculated as a weighted sum, as well as the number of new quitters that each would generate.

The total cost of providing all patients who visit a physician's office with the smoking cessation intervention of their choice is \$8.1 billion. Most of this cost, \$7.2 billion, is attributable to the direct intervention, while the remaining cost is associated with screening, advising, and motivation efforts. We estimate that this model would result in 2,630,288

Table 5-6. Cost-Effectiveness of Smoking Cessation, Combined Interventions

| | Office Visit Patients | Hospitalized Patients | Combined Patients |
|--|-----------------------|-----------------------|-------------------|
| Total Cost | 8,034,047 | 1,056,715 | 8,072,870 |
| Total Screening Cost | 364,126 | 17,431 | 381,557 |
| Total Advising Cost | 312,404 | 16,615 | 329,020 |
| Total Motivation Cost | 234,303 | 8,308 | 242,611 |
| Total Direct Intervention Cost | 7,123,213 | 1,014,361 | 7,119,682 |
| Total Quitters (18+) | 2,630,288 | 375,901 | 2,630,288 |
| Cost per Quitter | 3,054.44 | 2,811.15 | 3,069.20 |
| Cost per Capita | 41.20 | 5.42 | 41.40 |
| Cost per Smoker | 164.82 | 21.68 | 165.61 |
| Cost per Life-Year Saved | | | |
| Undiscounted | 657.02 | 589.03 | 658.01 |
| Discounted (3%) | 2,089.49 | 1,932.98 | 2,100.94 |
| Discounted (5%) | 2,857.72 | 2,655.83 | 2,875.01 |
| Cost per Quality-Adjusted Life-Year Saved | | | |
| Undiscounted | 599.00 | 572.80 | 604.73 |
| Discounted (3%) | 1,535.79 | 1,508.14 | 1,555.42 |
| Discounted (5%) | 2,568.34 | 2,537.78 | 2,603.07 |

Notes: Costs are reported in thousands. Quitters were discounted by 35 percent to account for relapse. The Combined Patients model adjusts office visit interventions to avoid double counting. Life-years exclude adult quitters over 69 years old.

new quitters at a cost of \$3,054.44 per quitter. The average cost per years of life-year saved ranged from \$657.02 (undiscounted) to \$2,857.72 (discounted at 5 percent). Adjusted for quality of the life, cost per life-year saved ranged from \$599.00 (undiscounted) to \$2,568.34.

Because there are far fewer smoker hospital admissions per year than smoker office visits, the total cost of providing an intervention to all hospitalized smokers is also less. It would cost slightly more than \$1 billion to reach all smokers who experience an inpatient stay during a period of 1 year. Under this scenario, we estimate that there would be 375,901 new quitters, and the cost per quitter would be \$2,811.15. The cost per years of life saved ranges from \$589.03 (undiscounted) to \$2,655.83 (discounted at 5 percent). And the cost per quality-adjusted life-year saved is \$572.80 (undiscounted) and \$2,537.78 (discounted at 5 percent).

The third intervention scenario estimates the total cost of providing patients who visit a physician's office and patients who are hospitalized with an intervention of their choice. The costs associated with screening, advising, and motivating patients are simply added. Total direct intervention costs assume

that all hospitalized patients receive an intervention, but they are not provided with additional direct interventions in the office setting. The total direct cost of reaching all adult smokers is \$8.1 billion, while the total direct intervention cost is \$7.1 billion. Since the total number of quitters is based on the adult smoking population, this model would generate 2,630,288 new quitters, just as the office visit model did. However, the cost per quitter is slightly more under the physician-hospital combined model, \$3,069.20, because smokers receive continual screening, advice, and motivation in both the office and hospital settings. The costs per life-year saved range from \$658.01 (undiscounted) to \$2,875.01 (discounted at 5 percent). Adjusted for quality, the costs per life-year saved range from \$604.73 to \$2,603.07.

5.6 Sensitivity Analysis

A series of one-way sensitivity analyses was performed to test several of our major assumptions. Recall that the results shown in Tables 5-3 through 5-6 test the sensitivity of our results to changes in the discount rate. Both measures of effectiveness, life-years saved and QALYs saved, were calculated

at the 0, 3, and 5 percent levels. The cost per life-year saved or QALY discounted at 5 percent was over 4 times greater than the undiscounted result. In addition to testing our results at different discount rates, we varied our assumptions concerning patients' willingness to quit, patient opportunity costs, the relapse rate, format preference, and screening.

5.6.1 Willingness to Quit

Our baseline analysis assumes that all smokers are willing to make a quit attempt. However, it is highly unlikely that all smokers would actually be willing to quit even after receiving an added motivational message. Therefore, estimates were calculated assuming that only 25 percent of ambulatory patients and 50 percent of hospitalized patients would be willing to try an intervention. First, each intervention was analyzed individually assuming that it would be provided to all smokers willing to quit. Cost per quitter ranged from \$2,677 for group intensive counseling with the nicotine patch to \$15,509 for minimal counseling alone. Cost per year of life saved (discounted at 5 percent) ranged from \$2,508 to \$14,528 for same interventions. Decisions probabilities were then used to combine the interventions into a single willing-to-quit scenario. The cost per quitter was \$3,844, an increase of 25 percent over the all-comers scenario, and cost per life-year saved (discounted at 5 percent) increased to \$3,601.

5.6.2 Patient Opportunity Costs

Our baseline analysis excluded patient opportunity costs. For certain smoking cessation interventions, the amount of patient time involved is small. For example, minimal counseling is offered during the course of a routine office visit with follow-up provided over the telephone. Therefore, travel time and intervention time associated with smoking cessation is trivial. However, treatments that involve more direct intervention time and one or more follow-up visits can have substantial patient costs. The most extreme example is group intensive counseling, which involves seven 1-hour sessions.

We performed an analysis to test the sensitivity of our results to the inclusion of patient opportunity costs. 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 work week was 40 hours long and

calculated an average per minute patient opportunity cost of \$0.20. For each intervention, we estimated patient travel and cessation counseling time. Travel time for initial visits was excluded because patients would have incurred its costs in the absence of the smoking cessation intervention. Patient time associated with the direct intervention and travel to follow-up or intensive counseling sessions was calculated assuming that patients would travel an average of 20 minutes (round-trip) for each visit. We estimated that minimal counseling would involve no patient opportunity costs, but that group intensive counseling, which involves the greatest amount of travel and direct intervention time, would cost each participant \$112 in lost time that could be spent on other activities.

As the intensity of the interventions increase, they become more sensitive to patient opportunity costs. Group intensive counseling alone experienced the greatest change in cost per quitter rising from \$1,689 when patient costs were ignored to \$4,292 when they were included in the analysis, a \$2,603 difference. Still, minimal counseling with nicotine gum, which involves no patient opportunity costs, remained the least cost-effective intervention. While interventions that involve large amounts of patient time become less cost-effective when patient opportunity costs are incorporated, they remain more cost-effective than minimal or brief counseling, which involve little patient time. Patient opportunity costs increase the cost per quitter of the overall *Guideline* by approximately 6 percent. Adding these costs into the analysis of combined interventions changed the cost per quitter from \$3,093 to \$3,278, a 6 percent increase.

5.6.3 Relapse

Our baseline analysis incorporated a relatively high relapse rate of 35 percent. This was applied to all smokers who remained abstinent after the 5-month follow-up period. To test the sensitivity of our original results, we calculated cost-effectiveness ratios assuming that only 10 percent of quitters would relapse. Cost per quitter ranged from \$1,220 for group intensive counseling along to \$5,266 for minimal counseling with nicotine gum. This translates to \$1,143 and \$4,933 per life-year saved. Combining the interventions using patient preferences generated a cost of \$2,217 per quitter and \$2,076 per life-year saved. These costs are 28 percent less than their baseline estimates.

5.6.4 Format

The baseline analysis assumes that only 5 percent of smokers would select intensive counseling if given an intervention choice. We tested the sensitivity of this assumption using revised decisions probabilities. We assumed that 10 percent of smokers would be willing to try an intensive intervention and, like the baseline scenario, we assumed that intensive counseling was equally distributed between individual intensive and group intensive counseling. We also assumed that 2.5 percent fewer patients would choose to undergo brief counseling and 2.5 percent fewer patients would select full counseling. We did not alter our assumption concerning preference for minimal counseling. The resulting cost per quitter was \$3,019, only 1.6 percent less than our baseline estimate. Cost per life-year saved (discounted at 5 percent) decreased from \$2,875 to \$2,828.

5.6.5 Screening

A major cost of providing smoking cessation to the entire population is the cost of screening patients

to determine their smoking status. Our baseline analysis assumed that all hospitalized and ambulatory patients over the age of 18 are screened for smoking status. And patients may be screened multiple times either because they both visit their physician's office and are hospitalized in a single year or because they visit their physician more than once during the year. So while the cost of a single screening is less than \$1.00, the cost of screening the entire population each time they interact with the medical system is quite large, over \$381 million. We altered our screening costs assuming that smokers would be screened multiple times in a single year and that nonsmoking adults would only be screened once during a physician office visit and once if they were hospitalized. This generated a total screening cost of \$197,934,112. Analyzing the interventions individually resulted in costs per quitter that ranged from \$1,602 to \$7,133. Costs per year of life saved ranged from \$1,500 to \$6,682. Incorporating our baseline decision probabilities, the combined interventions generated a cost per quitter of \$2,999 and a cost per life-year saved of \$2,810, each 2 percent less than our baseline estimates.

6.0 Comparison of *Guideline* Cost-Effectiveness with Alternative Medical Interventions

6.1 Goals of Comparisons

The cost-effectiveness ratios presented in the last chapter are useful in evaluating the efficiency of certain smoking cessation interventions. While valuable, they are limited without external benchmark cost-effectiveness ratios. Relative to other medical interventions, all of the cessation interventions may be cost-effective and should be promoted. Another reason for comparing cessation intervention cost-effectiveness ratios with other medical interventions is the dependence of the cessation interventionist on patient preferences. Some patients will prefer the less cost-effective cessation intervention. This raises the question of whether such an intervention should be promoted by public policymakers.

This chapter provides several preventive and acute intervention cost-effectiveness ratios for benchmarking purposes. Section 6.2 discusses the methodological challenges to making such comparisons. Section 6.3 provides tables of comparisons. The last section summarizes the implications of the comparisons for the cost-effectiveness of the AHCPR *Smoking Cessation Guideline*.

6.2 Methodological Challenges

Literally thousands of cost-effectiveness analyses of health-related interventions exist in the literature. Making comparisons, however, is complicated because of differences in study methods.

Differences in Perspective. Studies differ in their perspective, whether the perspective is that of society, payer, provider, or patient. This has direct impacts on the kinds of costs and benefits that are included. The *Guideline* cost-effectiveness analysis takes a generally societal perspective in the sense that resource costs are usually imputed rather than based on insurer claims. Claims-based analyses will often exclude uncovered services.

Inconsistent Measurement of Costs. Studies differ in how they value resources used in an intervention. These variations have already been demonstrated in Chapter 2 of this report. At the most fundamental level, studies differ in the time period used for valuing inputs. Smoking cessation studies go back to the 1970s, hence requiring adjustments for inflation. At least for physician

services, we have used Medicare payment levels. These are considerably lower than charges, which are often used in other studies. We believe Medicare rates are more accurate measures of what the physician actually is willing to receive in order to provide the service.

Whether the extra costs of medical care in future years should be included is controversial. Some argue that medical costs avoided should be used to offset intervention costs early, while the extra medical costs associated with a longer life should be considered an add-on to costs. Others argue that such a definition of costs is too narrow and biases the results against life-extending interventions.

Varying Discount Rates. Results in this report and other studies indicate that the choice of discount rate is one of the most important variables in conducting a cost-effectiveness analysis of any preventive intervention that generates most of its benefits well into the future. Indeed, discounting at 5 percent vs. no discounting can reduce expected gains by a factor of 5 for younger age groups who quit smoking.

Differing Populations Affected. Smoking cessation interventions affect the entire population of smokers, who are distributed somewhat randomly across the U.S. population (although some differences exist in the characteristics of smokers, e.g., gender, education). Other interventions (e.g., mammography) affect only women, children (e.g., polio immunization), or some special group. Generally, the more targeted the group with a specific illness or high incidence of disease, the more cost effective an intervention will be. Targeting hypertension screening to younger men, for example, is less cost effective than targeting older men.

Preventive Versus Acute Interventions. Preventive interventions, including smoking cessation programs, may not be cost effective because so many persons receiving the intervention are healthy with low likelihood of contracting the illness in question. Performing cardiac angioplasty on men with severe angina, by contrast, may be cost effective simply because the intervention is targeted only to the symptomatic group. If smoking cessation could be targeted to only those who would eventually contract one of the smoking-related diseases, it would show a lower (and better) cost-effectiveness ratio.

No benchmark cost-effectiveness comparisons of different interventions can ever overcome all of these differences. Tengs, *et al.* (1994) have reviewed and made adjustments to 500 life-saving interventions for inflation (all costs are expressed in 1993 dollars), discount rate (all findings converted to 5 percent discount rate), exclusion of indirect costs, and consistent effectiveness measure (years of life saved). The studies shown below have been taken from Tengs with these adjustments, making them more comparable to the ratios derived from the *Guideline*. The one point of difference concerns the treatment of net medical costs, which Tengs' group generally tries to include. Costs avoided or incurred in future years due to smoking cessation have not been included in our cost-effectiveness analysis of the *Guideline* because they tend to be more speculative and are biased against life-extending interventions. We agree with Warner (1982) that if net social costs are to be included, they should include more than simply medical costs. The impact of excluding these costs in the cessation cost-effectiveness ratios is to bias them upwards versus other studies that include them. This is because smoking cessation is a net saver of future medical expenditures (see the discussion of Hodgson's recent study in Chapter 2). Were net medical costs to be included, the cost-effectiveness ratios for smoking cessation would be even lower.

6.3 Comparison of Cost-Effectiveness Ratios

Table 6-1 presents comparative cost-effectiveness ratios for 10 preventive and acute medical interventions along with the overall global cost-effectiveness ratios for the AHCPR *Smoking Cessation Guideline*. The interventions have been selected to show a range of cost-effectiveness across a wide variety of different medical interventions. They range from less than \$0 to over \$100,000. Polio immunization is a case where the net medical costs in the future dominate short-run vaccination costs. Conversely, using antihyperlipemic drug therapy in reducing the risk of coronary heart disease cost \$102,033 per discounted year of life saved for men aged 35-39 with significantly elevated cholesterol levels. This high cost is due primarily to the fact that the lifelong treatment would only result in 0.60 extra years of life (Oster and Epstein, 1987).

Several well-targeted prevention strategies show very low cost-effectiveness ratios, including a one-time screening for cervical cancer for women over

age 64 (\$2,053), and a pneumonia vaccination for people over age 64 (\$1,769). Other screening strategies targeted at younger age groups cost considerably more, including an annual mammography for women aged 40-49 (\$61,744) and hypertension screening for men age 40 (\$23,335). By contrast, coronary bypass surgery or angioplasty appear more cost effective, again because they are targeted to the subset of at-risk patients who actually develop ischemic heart disease.

Two cost-effectiveness ratios for the *Smoking Cessation Guideline* are given at the bottom of Table 6-1. They are based on the expected preference of smokers for one of the many cessation interventions, assuming all smokers undertake an intervention once during the year. Life-years saved have been discounted 5 percent and presented unadjusted and adjusted for quality-of-life gains. The resulting cost-effectiveness ratios are highly favorable relative to most other medical interventions. They also confirm Eddy's (1992) treatment of smoking cessation as the gold standard by which all other screening tests can be compared. They are all the more remarkable in that the *Guideline* is not targeted to any one population group. Were the *Guideline* applied only to smokers under age 30, for example, the costs per life-year saved would be much lower.

Also shown below the two average cost-effectiveness ratios is the range of cost-effectiveness across the various cessation interventions. On a discounted life-year basis, intensive group counseling would cost only \$1,582 without using nicotine replacement as adjunct therapy. At the other extreme, minimal physician counseling using nicotine gum as adjunct therapy would cost \$6,831 per discounted life-year saved. Although more than 5 times more costly per life-year than intensive group counseling, minimal counseling with gum is still more cost-effective than most preventive interventions except those well-targeted to high-risk groups (Tengs, 1994).

6.4 Conclusions

Summarizing the results from the last two chapters, full implementation of the *Guideline* could cost as much as \$8 billion annually, including \$1 billion in screening, advising, and treating hospitalized smokers. For this investment, society could expect to gain 2,630,288 new quitters over-and-above the baseline 5 percent quit rate. These quitters could expect to enjoy 5.2 million extra quality-adjusted life-years, even after discounting

Table 6-1. Comparison of Smoking Cessation Cost-Effectiveness Ratios with Other Medical Interventions

| Intervention | Source | Cost-Effectiveness Ratio |
|---|--------------------------------|------------------------------|
| Selected Interventions | | |
| Beta-blockers for low-risk myocardial infarction survivors | Goldman, et al. (1988) | \$16,897 |
| Annual mammography & breast exam for women 40-49 | Eddy, et al. (1988) | \$61,744 |
| One-time cervical cancer screening for women age 65+ | Fahs, et al. (1992) | \$2,053 |
| Polio immunization for children age 0-4 | Sisk, et al. (1983) | <0 |
| Cholestyramine/low cholesterol diet (versus diet) for men aged 35-39 & 290/dL | Oster, et al. (1987) | \$102,033 |
| 3-vessel coronary artery bypass graft surgery (versus medical management) | Weinstein, et al. (1980) | \$12,350 |
| Hypertension screening for asymptomatic men age 40 | Littenberg, et al. (1990) | \$23,335 |
| PTCA (versus medical management) for men age 55 with severe angina | Wong, et al. (1990) | \$7,395 |
| Pneumonia vaccination for people age 65+ | Sisk, et al. (1983) | \$1,769 |
| Intervention | Effectiveness Measure | Cost-Effectiveness Ratio |
| AHCPR Smoking Cessation Guideline | | |
| Combined Cessation Interventions | 5% Discounted Life-Years | \$2,875 (\$1,582-\$6,831) |
| | 5% Quality-Adjusted Life-Years | \$2,603 (\$1,433-\$6,185) |

by 3 percent. No analysis was done of how these years would fall within smokers' productive lifetimes, but certainly many quitters would enjoy more productive years on the job.

For approximately \$2,600, society could generate an extra year of quality-adjusted life if it could entice smokers, and their health practitioners, to follow the *Guideline*. This cost could be as low as \$1,555 if a 3 percent discount rate were used.

Finally, the more intensive the cessation intervention, the lower the cost per year of life saved, suggesting that greater spending on interventions yields more net benefit. While all 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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Appendix

Smoking Cost/Cost-Effectiveness

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Clinical Practice Guideline

Number 18

Smoking Cessation

Clinical Practice Guideline

Smoking Cessation

U.S. Department of Health and Human Services
Public Health Service
Agency for Health Care Policy and Research
Centers for Disease Control and Prevention

The Agency for Health Care Policy and Research (AHCPR) was established in December 1989 under Public Law 101-239 (Omnibus Budget Reconciliation Act of 1989) to enhance the quality, appropriateness, and effectiveness of health care services and access to these services. AHCPR carries out its mission by conducting and supporting general health services research, including medical effectiveness research, facilitating development of clinical practice guidelines, and disseminating research findings and guidelines to health care providers, policymakers, and the public.

The legislation also established within AHCPR the Office of the Forum for Quality and Effectiveness in Health Care (the Forum). The Forum has primary responsibility for facilitating the development, periodic review, and updating of clinical practice guidelines. The guidelines will assist practitioners in the prevention, diagnosis, treatment, and management of clinical conditions.

The Centers for Disease Control and Prevention (CDC) promotes health and quality of life by preventing and controlling disease, injury, and disability. In acknowledgment of the important role clinical practice guidelines can play in reduction of tobacco use, CDC has collaborated with AHCPR as a partner in the development of this *Clinical Practice Guideline*.

Guidelines are available in formats suitable for health care practitioners, the scientific community, educators, and consumers. AHCPR invites comments and suggestions from users for consideration in development and updating of future guidelines. Please send written comments to Director, Office of the Forum for Quality and Effectiveness in Health Care, AHCPR, Wilco Building, Suite 310, 6000 Executive Boulevard, Rockville, MD 20852.

Clinical Practice Guideline

Number 18

Smoking Cessation

Smoking Cessation Guideline Panel

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U.S. Department of Health and Human Services
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Guideline Development and Use

Guidelines are systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical conditions. This guideline was developed by a private-sector panel convened by the Agency for Health Care Policy and Research (AHCPR) and the Centers for Disease Control and Prevention (CDC). The panel employed an explicit science-based methodology and expert clinical judgment to develop specific statements on smoking cessation.

Extensive literature searches were conducted, and critical reviews and syntheses were used to evaluate empirical evidence and significant outcomes. Peer review was undertaken to evaluate the reliability and utility of the guideline in clinical practice. The panel's recommendations are primarily based on the published scientific literature. When the scientific literature was incomplete or inconsistent in a particular area, the recommendations reflect the professional judgment of panel members and consultants.

The guideline reflects the state of knowledge, current at the time of publication, on effective and appropriate care. Given the inevitable changes in the state of scientific information and technology, periodic review, updating, and revision will be done.

We believe that this AHCPR and CDC-assisted clinical practice guideline will make positive contributions to the quality of care in the United States. We encourage practitioners and patients to use the information provided in the guideline. The recommendations may not be appropriate for use in all circumstances. Decisions to adopt any particular recommendation must be made by the practitioner in light of available resources and circumstances presented by individual patients.

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Publication of this guideline does not necessarily represent endorsement by the U.S. Department of Health and Human Services.

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Abstract

This guideline contains strategies and recommendations designed to assist clinicians, smoking cessation specialists, and health care administrators/insurers/purchasers in identifying tobacco users and supporting and delivering effective smoking cessation interventions. These recommendations were made as a result of an exhaustive and systematic review and analysis of the scientific literature. The primary analytic technique used was meta-analysis. The strength of evidence that served as the basis for each recommendation is clearly indicated in the guideline. Public testimony and a peer review were also part of the guideline's development process, as well as a notice in the *Federal Register* inviting review. The guideline's principal findings are:

- Every person who smokes should be offered smoking cessation treatment at every office visit.
- Clinicians should ask and record the tobacco-use status of every patient.
- Cessation treatments even as brief as 3 minutes a visit are effective.
- More intense treatment is more effective in producing long-term abstinence from tobacco.
- Nicotine replacement therapy (nicotine patches or gum), clinician-delivered social support, and skills training are particularly effective components of smoking cessation treatment.^a
- Health care systems should make institutional changes that result in the systematic identification of, and intervention with, all tobacco users at every visit.

The guideline proposes strategies for carrying out each of its specific recommendations. For clinicians, these recommendations are (1) systematically identify tobacco users and document their status; (2) strongly urge all smokers to quit; (3) identify smokers willing to make a quit attempt; (4) aid the patient in quitting by helping with a quit plan, offering nicotine replacement therapy, giving advice, and providing supplementary information; and (5) schedule followup contact. Recommendations for smoking cessation specialists are (1) assess the smoker who has entered an intervention program; (2) use a variety of clinical specialists; (3) ensure that the program is sufficiently intensive; (4) use a variety of program formats; (5) include effective counseling techniques; (6) target the smoker's motivation to quit; (7) provide relapse prevention intervention; (8) offer nicotine replacement therapy; and (9) arrange followup contact. Recommendations for health insurance purchasers and health care

^a As this guideline went to press, nicotine nasal spray was approved for use in the United States by the Food and Drug Administration, joining the nicotine patch and gum as effective available interventions.