

Potential Costs and Benefits of Statewide Smoking Cessation in Pennsylvania

A REPORT PREPARED FOR THE AMERICAN LUNG ASSOCIATION

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Executive Summary

Cigarette smoking is the single leading cause of preventable disease and preventable death in the US -- leading to more than 400,000 deaths annually. It is the most important contributor to many diseases, such as atherosclerotic cardiovascular disease, lung cancer, and chronic obstructive pulmonary disease (COPD), and its annual economic burden in the United States is nearly \$200 billion. To combat the deadly effects of smoking and exposure to secondhand smoke, Pennsylvania recently enacted a statewide ban on smoking in restaurants and non-hospitality workplaces. Although such legislation provides an incentive for smokers to quit, it does not provide the necessary assistance for those who want to quit.

The CDC and the U.S. Department of Health and Human Services have both issued recommended guidelines on smoking cessation to help people to quit smoking that include: access to counseling, access to all FDA-approved over-the-counter and prescription medications; multiple quit attempts; and reduced or eliminated co-pays.

The objective of this study was to determine whether the cost of such smoking cessation programs statewide in Pennsylvania would be justified by the benefits. And, the results show that for most smoking cessation treatments, the benefits of smoking cessation programs statewide in Pennsylvania greatly outweigh the cost to implement them. What does this mean to Pennsylvania's economy? The study specifically found that:

- In Pennsylvania, the annual direct costs to the economy attributable to smoking were in excess of \$16 billion – this includes workplace productivity losses of \$9.6 billion; premature death losses of \$5.5 billion; and direct medical expenditures of \$6.9 billion.
- The retail price of a pack of cigarettes in Pennsylvania is on average \$4.72. The combined medical costs and productivity losses in Pennsylvania attributable to each pack of cigarettes sold are approximately \$23.78 per pack of cigarettes.
- The ratio of benefits to cost varies from \$1.28 to \$2.76 saved per dollar spent on smoking cessation programs, depending upon the type of intervention.
- The average benefits across all potential smoking cessation programs are nearly 60% greater than the average costs.

There are two types of benefits to society from smoking cessation. First, smokers who quit successfully will have fewer medical expenses. And, second, smokers who quit successfully will have higher workplace productivity due to reduced absenteeism and increased productivity during working hours.

The costs to society associated with smoking cessation include the cost of the smoking cessation programs, the lost tax revenue to the public sector and the lost revenue to retailers and distributors since smokers who quit will no longer purchase cigarettes.

Whether the benefits of smoking cessation programs statewide outweigh the costs depends on how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. For this study, smoking cessation programs based on three treatment alternatives were studied: nicotine replacement therapy (NRT), bupropion, and varenicline. Each approach was evaluated with and without individual counseling.

This analysis suggests that with the right combination of smoking cessation programs, the Commonwealth of Pennsylvania could see great results from both a health and economic perspective.

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1 Background

Smoking rates have declined steadily in the U.S. over the last half-century. For example, while 42% of adults regularly smoked cigarettes in the mid-1960s, only 22% of adults smoked cigarettes in 2003 [1-5]. In spite of this decline, cigarette smoking is still the single most important cause of preventable disease in the US, and is responsible for more than 400,000 deaths annually [1, 6] and differences in smoking rates remain across strata of the population. For example, adult men have much higher smoking rates than the average [1, 7]. Furthermore, smoking is the most important contributor to the atherosclerotic cardiovascular disease, lung cancer, and chronic obstructive pulmonary disease (COPD), all of which are associated with premature death [8-12]. It can cause or exacerbate other pulmonary diseases, including asthma [13], and can increase risk for other conditions, such as peptic ulcer disease [14] and osteoporosis [15], in patients with lung disease.

There are significant health benefits to smokers who quit smoking [16]. Benefits include reduced risk of cardiovascular disease and events [17], improved lung function [18-20], reduced risk of lung infection [21-23], and reduced risk of lung cancer [24]. Quitting smoking can also improve risk of other chronic diseases, such as diabetes [25] and osteoporosis [15, 26].

Previous studies have shown that decisions to start smoking and attempts to quit smoking are influenced by policies that restrict smoking in public places, restrict access to tobacco products, restrict advertisements for tobacco products, and raise prices on tobacco products (e.g. via increased taxes) [7, 27-29]. Thus, public policy is an important tool to incentivize smoking cessation efforts. Pennsylvania recently enacted a statewide ban on smoking in restaurants and non-hospitality workplaces. Although such legislation provides an incentive for smokers to quit, it does not provide assistance for those who wish to quit.

In spite of incentives created by legislation and by widespread marketing messages, attempts by smokers to quit smoking are often unsuccessful. This is largely because smokers who attempt to quit may experience an array of withdrawal symptoms, including irritability, insomnia, and anxiety, or more serious symptoms such as weight gain [30-34] and depression [35]. Although the less serious symptoms usually take three to four weeks to resolve, because of these symptoms, and because cravings for cigarettes may persist for months, attempts to quit smoking are often unsuccessful. There are, however, both behavioral and pharmacological treatments available that have been demonstrated to increase the ability of smokers to quit [36-38] and to benefit both individuals and society [12]. Behavioral interventions include face-to-face counseling by health care providers, telephone quit lines, and printed materials. Pharmacological interventions include nicotine replacement therapy (NRT) (gum, lozenges, patches), the atypical antidepressant bupropion [39], and varenicline [40]. Programs often combine behavioral and

pharmacological treatments and provide counseling in combination with NRT, bupropion, or varenicline.

The objective of this study is to determine whether the cost of statewide adoption of a smoking cessation program in Pennsylvania could be justified by the benefits. Accordingly, we adopt a cost-benefit analysis framework and estimate the costs and benefits of behavioral and pharmacological programs. Our study is unique in that it adopts a statewide perspective and explicitly takes into consideration the cost to society of smoking cessation, which includes lost tax revenue to the public sector and lost retail revenue in the private sector.

2 Methods

The Model

The conceptual model that underlies the cost-benefit analysis is presented in Figure 1. In this model, rates of smoking are modified by smoking cessation programs. Specific programs we consider are NRT, bupropion, and varenicline with or without face-to-face counseling. Both costs and benefits of smoking cessation are then taken into account. There are two broad classes of benefits that accrue to society from smoking cessation. First, direct and indirect medical expenses will go down as a result of the improved health and risk reduction that follows. Second, there will be improvements in workplace productivity due to reduced absenteeism and increased productivity during working hours.

The model also recognizes that there are costs to society associated with smoking cessation. First, there is lost tax revenue to the public sector since smokers will no longer purchase cigarettes. This tax revenue must either be recovered through increased taxes elsewhere, or else society must do without the benefit of public services previously provided by those funds. Second, there are lost revenues to retailers and distributors because of reduced cigarette sales. Estimating the costs and benefits of smoking cessation then requires an estimate of how many smokers will successfully quit using the interventions, the resulting reduction in cigarette sales, the lost tax revenue and retail revenue, and the medical costs and productivity losses gained.

Cost-Benefit Analysis

Cost-benefit analysis is a method of economic evaluation that asks whether the costs of an intervention can be justified by the value of the benefits it provides. As with other types of economic evaluation it first estimates the total costs of the intervention from a specific decision making perspective. It then determines the benefits of the intervention, and translates those benefits into monetary terms. Since both costs and benefits are expressed in the same units (e.g. dollars), a recommendation can be gleaned from a comparison of the values of the costs and benefits. Usually the comparison is made from the ratio of benefits to costs. If the ratio is greater than one, then benefits outweigh costs and the intervention is recommended. If the ratio is less than one, then the costs outweigh the benefits and the intervention is not recommended.

To estimate the costs and benefits of a statewide smoking cessation program we first estimated total annual costs and benefits, and then translated these into costs and benefits per pack of cigarettes sold. Costs (tax and retail revenue) were then estimated by multiplying the cost per pack by the total packs that former smokers would no longer purchase. Similarly, benefits were estimated by multiplying benefits (expenditures and productivity losses) per pack by the number of packs former smokers would no longer consume. Multiple data sources with different time frames were used to identify the benefits and costs. Using data on inflation from the U.S. Department of Labor, adjustments were made on all monetary data sources to 2008 [41]. Cost-benefit was expressed as the ratio of total benefits to total costs.

Model Parameters

Given the complexities of this analysis, multiple data sources were needed to estimate the parameters in the model. These data sources provided information on the population of smokers in Pennsylvania in a typical year, the productivity losses experienced by the working population, the medical costs associated with smoking, tax and revenue losses, the potential participation rate of smokers in cessation programs, and the cost and treatment effectiveness of the cessation programs. Care was taken to address only cigarette smoking prevalence, utilization, and projected outcomes. The analysis did not include the implications of non-smoking tobacco products.

Population. In order to identify the relevant population of smokers, former smokers and non-smokers in Pennsylvania we used data from the Center for Disease Control and prevention's (CDC) Behavioral Risk Factors Surveillance System (BRFSS). BRFSS is the world's largest, on-going telephone health survey system, tracking health conditions and risk behaviors in the United States yearly since 1984 [42]. The Pennsylvania sample for 2005 included 13,378 surveys [43]. Survey responses were appropriately weighted to achieve population estimates (Table 1).

The number of packs of cigarettes consumed was determined by how many total packs of cigarettes were consumed in the Commonwealth and then subtracting out cigarettes consumed by visitors. The calculation for the total number of cigarette packs consumed was done by taking the Commonwealth's total tax revenue reported by the Pennsylvania

Department of Revenue for 2006, and dividing it by the excise tax rate per pack of cigarettes [44].

The next step involved estimating visitors and their impact on cigarette sales in the Commonwealth. It was important to isolate these numbers in order to objectively evaluate the impact on smoking cessation programs to residents of the Commonwealth. We began by calculating the number of visitors to the Commonwealth, determining how many smoked, and subtracting their cigarette consumption from the total of cigarette packs consumed to reach a total number of cigarettes consumed by residents. The number of visitors to the Commonwealth (140 million) came from the 2007 annual report compiled by the state [45]. Smoking prevalence among visitors was calculated using the national average of 20.4% from the 2005 BRFSS data that sampled over 350,000 people in the United States [46]. It was then necessary to translate visitors, who spend an average of 3 nights in Pennsylvania into an annual number for comparison to residents [45]. Using the total number of annualized visitors, 180,961, and the average number of packs of cigarettes consumed per person per year, we computed the consumption by visitor and subtracted that consumption from the total to get the number of packs consumed by residents. This provided us with a baseline population of current smokers and an estimate of the number of cigarettes consumed annually (Table 1).

Productivity Losses. There are two different kinds of productivity losses that were considered in this model. The first is potential years of potential life lost (YPLL) due to pre-mature deaths in the population that can be linked to smoking. The second is lost

workday productivity, which is time lost on the job due to smoking cigarettes. Estimates for both of these are presented in Table 2. In order to compute the quantities in Table 2, we utilized the CDC’s Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC) tool to estimate the potential years of life lost (<http://apps.nccd.cdc.gov/sammecc/>). The Adult SAMMEC program derives smoking-attributable mortality (SAM) using an attributable-fraction formula [47, 48]. The smoking-attributable fractions (SAFs) of deaths for 19 diseases where cigarette smoking is a cause are calculated using sex-specific smoking prevalence and relative risk (RR) of death data for current and former smokers aged 35 and older [49]. Infant mortality is included in the calculation. SAFs are calculated using estimates of maternal smoking prevalence and RR of death for four perinatal conditions caused by smoking [49]. SAMMEC computes the SAFs for each disease by sex using the following formula:

$$\text{SAF} = \frac{(p_0 + p_1RR_1 + p_2RR_2) - 1}{p_0 + p_1RR_1 + p_2RR_2}$$

where p_i is a prevalence rate and RR_i is a risk ratio. The SAMMEC YPLL calculations facilitate the use of state specific data. For Pennsylvania the 2005 smoking prevalence data from the BRFSS was used and risk of death was calculated based on the Pennsylvania 2001 Mortality statistics [49]. The present value of future earnings was calculated using the United States 2001 averages earning and net present value calculations [49].

To estimate lost productivity time, data from the May 2007 Current Population Survey were used to determine labor force participation rates for Pennsylvania. Labor force

participation rates were then combined with the BRFSS population statistics on smokers, former smokers, and non-smokers to arrive at the population estimates for smokers and former smokers in the work force. Bunn et al. studied labor productivity loss across a large cross-section of US employers and estimated current and former smoker net productivity losses that result from lost work days and unproductive time at work [50]. Their research identified a net productivity loss of \$1,807 per current smoker and \$623 annually per former smoker over a non-smoking worker.

Medical Costs. The CDC's SAMMEC tool also provides a mechanism for estimating medical costs that result from smoking: smoking-attributable expenditures (SAEs). These fall into two categories: 1) adult personal health smoking-attributable expenditures avoided, and 2) secondary neonatal costs avoided. SAEs are the excess personal health care expenditures attributed to diseases to which cigarette smoking can be related as a cause [49]. The Adult SAMMEC provides smoking attributable percentage weighted approximations for each of the five major health care industry expenditure categories: ambulatory care (out-patient), hospital care, prescription drugs, nursing home care, and other care (which include home health, non-prescription drugs and non-durable medical products) [51]. Data for the total dollars of care spent in Pennsylvania in 2004 and by category were taken from reports by the Centers for Medicare and Medicaid Services [52]. The SAMMEC percentages were then applied to the health expenditures dollars by category to estimate direct expenditures on medical care attributable to smoking and smoking related events in Pennsylvania (Table 3).

Secondary neonatal costs avoided were identified using the Medical Economic Outcomes reports generated by the Maternal and Child Health SAMMEC application. MCH SAMMEC uses birth certificate data for state specific analysis on maternal smoking to estimate smoking-attributable outcomes [53]. Combining neonatal medical costs, adult medical costs, and productivity losses, smoking costs Pennsylvania approximately \$23.77 for each pack of cigarettes sold to residents.

Tax and Retail Income Losses. Data on taxes and retail income provided in Table 4 were from the Campaign for Tobacco Free Kids, Economic Research Service at the Department of Agriculture [54]. The average national factory price is the representative price to wholesalers and distributors of cigarettes. The tax of \$2.01 includes both federal and Pennsylvania specific taxes. The distributor and retail mark-up is also Pennsylvania specific and is computed by subtracting taxes and known factory price from the average retail price within the state. These numbers reflect estimates of state and federal revenues that will be lost as a result of a decline in the number of cigarette packs sold due to successful smoking cessation.

Participation Rate. Participation rate data were not available in the literature. We therefore assumed that 10% of smokers who were offered a cessation program would take advantage of it. This is a conservative estimate since as many as 75% of smokers may attempt to quit each year, often without the assistance of a smoking cessation program [55].

Cost of Treatment. Cost values are presented in Table 5. Cost of counseling for smoking cessation was based on Medicare reimbursement rates. Medicare currently reimburses for at most two smoking cessation attempts per year, with as many as four counseling sessions per attempt. Each session is reimbursed at a rate of \$32 per session. We assumed five sessions for a total cost of \$160. The cost of NRT was assumed to be the average cost for patch, gum and lozenge. We assumed a cost for patch of \$4 per day and a course of 12 weeks. Cost for gum was \$4.50 per day for and 8-week course. Costs for lozenges were assumed to be \$6 per day for a 6-week course. The average for a full course of NRT was \$252. Cost of treatment for bupropion and varenicline were taken from Red Book (Red Book™ for Windows, Thomson Micromedex, Greenwood Village, Colorado, July 2008). We assumed a 12-week course of bupropion dosed at 1mg per day. Prices were for a starter month plus two additional months, giving a total cost of \$447.94 for a full course of bupropion. For varenicline we assumed a 12-week course at a dose of 300mg per day. Total costs were \$428.85 for a full course of varenicline.

Treatment Effectiveness. Treatment effectiveness was based on Cochrane reviews for all three treatments. Silagy et al. reported an overall odds ratio of quitting of 1.77 for NRT [38], Hughes et al. reported an odds ratio of 1.94 for bupropion [37], and Cahill et al. reported an odds ratio of quitting of 3.22 for varenicline [36]. Assuming a baseline quit rate of 8.8% and a marginal improvement for counseling of 15%, the estimated quit rates for NRT, bupropion, and varenicline alone and in combination with counseling are presented in Table 5. Also included are relatively low and relatively high values for

successful quit rates, which are based on confidence intervals in the Cochrane reviews and were used in sensitivity analyses.

Sensitivity Analyses. Sensitivity analyses were performed for marginal treatment effectiveness of the various treatment options. No sensitivity analysis was done on participation rates because the ratio of benefits to costs remains constant with changes in participation rates. As mentioned earlier, Table 6 provides a summary of the variable ranges used for the sensitivity analysis. The marginal treatment effectiveness rates were based on Silagy et al. [38] for NRT, Hughes et al. [37] for bupropion, and Cahill et al. [36] for varenicline.

3 Results

Baseline Results

Baseline cost-benefit results are contained in Table 7, which presents the total costs, total benefits, and cost-benefit ratio for statewide smoking cessation programs in Pennsylvania. As seen in Table 7, statewide smoking cessation based on NRT and varenicline had favorable benefit-cost ratios and statewide smoking cessation based on bupropion has benefits similar to costs. NRT without counseling had a benefit-cost ratio of 1.28, which means that benefits are 28% greater than costs. When NRT was combined with counseling, the additional effectiveness was somewhat offset by the additional cost, yielding a benefit-cost ratio of 1.16, which means that benefits were 16% greater than costs. Bupropion without counseling had a benefit-cost ratio of 0.97 and with counseling had a benefit-cost ratio of 0.98, which suggests costs and benefit were nearly equal. Finally, varenicline without counseling had a benefit-cost ratio of 2.76, which suggests that the benefits of smoking cessation under this treatment are more the two and a half times their costs. Treatment with varenicline in combination with counseling has a somewhat lower benefit-cost ratio of 2.35. Across all treatments, the ratio of benefits to costs was 1.58, suggesting benefits outweigh costs by nearly 60%.

Sensitivity Analyses

We present results of sensitivity analyses in Table 8 and Table 9. Table 8 presents results assuming marginal treatment effectiveness equal to the low values shown in Table 5. As seen in Table 8, if marginal treatment effectiveness was assumed to be at the low of reported estimates, benefit-cost ratios were somewhat smaller. For statewide smoking

cessation based on NRT, the cost benefit ratio was 1.13 without counseling and 1.04 with counseling. For statewide smoking cessation based on bupropion, the cost benefit ratio was 0.77 without counseling and 0.81 with counseling, suggesting that the costs outweigh the benefits. For statewide smoking cessation based on varenicline, the cost benefit ratio was 2.04 without counseling and 1.76 with counseling. Across all treatments assuming the lower values of treatment effectiveness, the ratio of benefits to costs was 1.26, suggesting benefits outweigh costs by nearly 26%.

The final sensitivity analysis estimated costs and benefits assuming marginal treatment effectiveness in the higher ranges of values reported in the literature (Table 9). As expected, the benefit-cost ratios are much more favorable in this scenario. The benefit-cost ratio for statewide smoking cessation based on NRT was 1.43 without counseling, and 1.28 with counseling. For bupropion the benefits again outweighed costs, with benefit-cost ratios of 1.18 with no counseling and 1.16 with counseling. The benefit-cost ratios for a smoking cessation program based on varenicline were 3.47 if offered alone and 2.95 if offered in combination with counseling. Across all treatments assuming the higher values of treatment effectiveness, the ratio of benefits to costs was 1.91, suggesting benefits are almost double the costs of the program.

4 Discussion

These results suggest that benefits of statewide provision of smoking cessation programs outweigh the costs for most treatment options available for smoking cessation. In baseline analyses, benefits were 28% greater than costs for NRT, approximately at the breakeven point for bupropion, and 176% greater for varenicline if counseling was not offered on combination. These ratios were somewhat lower when used in combination with behavioral therapy because the marginal cost of the add-on was relatively high compared to the marginal benefit.

This model considered just one treatment option at a time offered across the state. In reality, a statewide smoking cessation would likely offer some combination of NRT, bupropion, and varenicline, perhaps with adjunct counseling. The realized benefit-cost ratio of such an approach would then be a weighted average of the benefit-cost ratios of the individual treatments, where weight would be determined by the choices of participants. Given that most individual treatment options have favorable benefit-cost ratios, combinations of options are likely to have favorable benefit-cost ratios.

Previous studies have also suggested a favorable benefit-cost ratio for smoking cessation programs. Weiss and Jurs, writing at a time when only behavioral interventions were available, found that a support group and group counseling intervention had a favorable benefit-cost ratio, even if the marginal treatment effectiveness was relatively small [56]. Their study was a single program at a single institution with very few patients, however, and not a statewide analysis. There is one statewide cost-benefit analysis of smoking

cessation. The Washington Economics Group produced an unpublished cost-benefit analysis of statewide smoking cessation in Florida [57]. This study only included costs incurred by insurers for smoking cessation programs and found that smoking cessation saved between \$1.90 and \$5.75 for each dollar spent on smoking cessation. Costs and benefits were asymmetric in that benefits were estimated from a societal perspective and costs were estimated from a payer perspective. Still, the case for a favorable benefit-cost ratio for a statewide smoking cessation program in Florida is compelling.

Although there are relatively few cost-benefit analyses of smoking cessation, there are several published cost-effectiveness studies. Most of these studies compare counseling to combination counseling and NRT [58-62]. More recent studies estimate the cost-effectiveness of bupropion to counseling or NRT [63-67]. In all of these studies the incremental cost-effectiveness ratios fall well within the accepted range for cost-effective interventions, which implies that smoking cessation programs offer good value for money for health care budgets.

There are several limitations to our model. First, it assumes that all medical benefits accrue during the first year after quitting smoking. In reality, it may take years before society would reap the benefits that come from quitting smoking. A dynamic model that quantifies all of the intertemporal effects and relationships would be necessary to adequately model these phenomena. Second, we did not include all of the benefits and costs to society of smoking cessation. For example, our model did not take into account

the effects of second hand smoke exposure [68]. We also did not take into account the deleterious effects of smoking on smoking related fires and accidents [69, 70].

The model is comprehensive in terms of costs of statewide smoking cessation. Therefore, these estimates of the cost-benefit of statewide smoking cessation should be viewed as relatively conservative. If it were possible to include other effects, such as second hand smoke exposure, fires, and accidents, the cost-benefit would likely be even more favorable.

Tables

Table 1: Baseline data on smokers and smoking in Pennsylvania.

Variable	Total
Resident Smokers in PA ¹	2,264,544
Visiting Smokers in PA ²	180,961
Total Smokers	2,445,505
Total Packs Sold to Residents	700,577,211
Total Packs Sold to Visitors	55,983,530
Total Packs Sold	756,560,741
Average Packs Per Resident Per Year	309

¹ Data from the Behavioral Risk factor Surveillance System, Pennsylvania Calculated Variable Data Report, 2005. Retrieved on August 30, 2008 from:

http://apps.nccd.cdc.gov/s_broker/htmsql.exe/weat/freq_analysis.hspl?survey_year=2005

² Data from VisitPA.com, media room, annual report 2007.

Table 2: Total productivity losses attributable to smoking. Includes productivity losses due to premature death, and workplace productivity losses due to absenteeism and the net loss of productive work time.

Component	Total (in thousands)	Per pack
Premature Death		
Men	\$3,696,371	\$5.28
Women	\$1,894,429	\$2.70
Combined	\$5,590,800	\$7.98
Workplace Productivity		
Current smokers ¹	\$3,382,603	\$4.83
Former smokers ²	\$684,894	\$0.98
Combined	\$4,067,497	\$5.81
Total Productivity Losses	\$9,658,297	\$13.79

¹ Total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

² Total cost per former smoker in the labor force is \$2623, with a net effect of \$623.

Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in Pennsylvania. Total expenditures per pack for both medical care and productivity losses are \$23.78 per pack.

Cost Component	Total (in thousands)	Per Pack
Adult Expenditures		
Ambulatory care	\$2,206,871	\$3.15
Hospital care	\$1,387,257	\$1.98
Rx	\$913,928	\$1.30
Nursing home	\$1,926,425	\$2.75
Other care	\$481,682	\$0.69
Total	\$6,916,163	\$9.87
Neonatal Expenditures	\$79,837	\$0.11
Total Expenditures	\$6,995,999	\$9.99

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups. Source: Economic Research Service, U.S. Department of Agriculture, Tobacco Briefing Room, "Most Frequently Used Tables," Number 9, <http://www.ers.usda.gov/Briefing/tobacco>, downloaded January 23, 2007 (adjusted to reflect Philip Morris price cuts to four of its major brands).

Component	Price
Factory Price	\$2.28
Total Taxes	\$2.01
Federal Tax	\$0.39
State Tax	\$1.35
State Sales Tax	\$0.27
Distributor & Retailer Markups	\$0.43
Final Retail Price	\$4.72

Table 5: Costs for smoking cessation treatments. Costs are for a full course of treatment, which varies by treatments.

Treatment	Alone	With Counseling
NRT	\$262	\$402
Bupropion	\$429	\$569
Varenicline	\$270	\$410

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis. Calculated from treatment rates in [36-38]

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT	5.8%	5.0%	6.6%
Bupropion	7.0%	5.4%	8.6%
Varenicline	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness (Dollars given are in thousands).

Costs/Benefits	No Counseling			Counseling		
	<i>NRT</i>	<i>Bupropion</i>	<i>Varenicline</i>	<i>NRT</i>	<i>Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$84,750	\$102,031	\$218,261	\$116,792	\$135,665	\$270,330
Costs of Cessation Program	\$58,857	\$96,289	\$60,623	\$90,366	\$127,799	\$92,133
Lost Tax Revenue	\$5,944	\$7,156	\$15,308	\$8,191	\$9,585	\$18,960
Lost Business Revenue	\$1,272	\$1,531	\$3,275	\$1,752	\$2,051	\$4,056
Benefit/Cost Ratio	1.28	0.97	2.76	1.16	0.98	2.35

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness (Dollars are given as thousands).

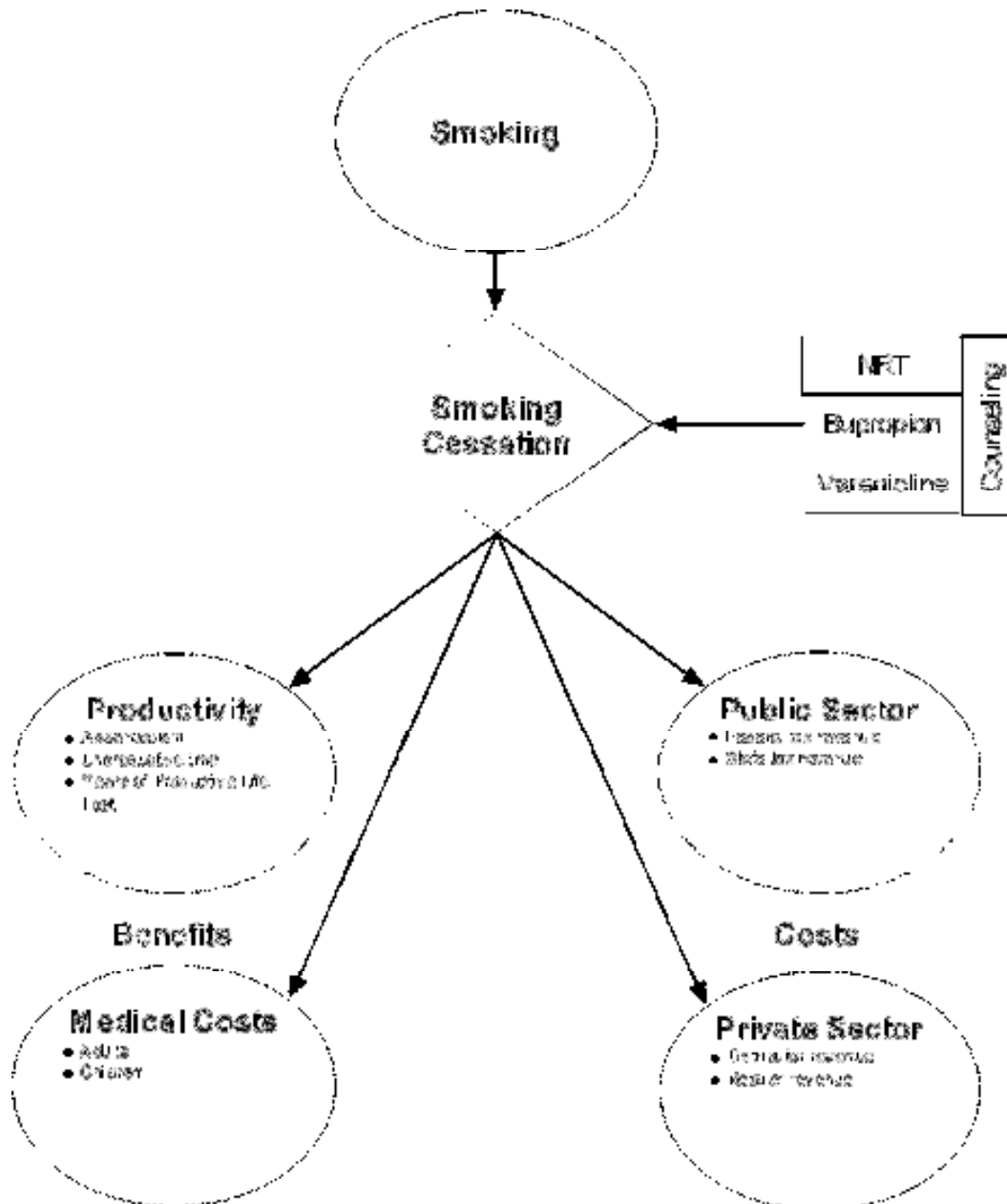
Costs/Benefits	No Counseling			Counseling		
	<i>NRT</i>	<i>Bupropion</i>	<i>Varenicline</i>	<i>NRT</i>	<i>Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$73,307	\$79,575	\$149,273	\$103,633	\$110,890	\$190,993
Costs of Cessation Program	\$58,857	\$96,289	\$60,623	\$90,366	\$127,799	\$92,133
Lost Tax Revenue	\$5,141	\$5,581	\$10,469	\$7,268	\$7,774	\$13,396
Lost Business Revenue	\$1,100	\$1,194	\$2,240	\$1,555	\$1,663	\$2,866
Benefit/Cost Ratio	1.13	0.77	2.04	1.04	0.81	1.76

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness (Dollars are given as thousands).

Costs/Benefits	No Counseling			Counseling		
	<i>NRT</i>	<i>Bupropion</i>	<i>Varenicline</i>	<i>NRT</i>	<i>Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$95,987	\$126,595	\$298,425	\$129,714	\$164,914	\$362,518
Costs of Cessation Program	\$58,857	\$96,289	\$60,623	\$90,366	\$127,799	\$92,133
Lost Tax Revenue	\$6,732	\$8,879	\$20,930	\$9,9098	\$11,566	\$25,426
Lost Business Revenue	\$1,440	\$1,899	\$4,478	\$1,946	\$2,474	\$5,439
Benefit/Cost Ratio	1.43	1.18	3.47	1.28	1.16	2.95

Figures

Figure 1: Conceptual model of the impact of smoking cessation on costs and benefits.



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