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Potential Costs and Benefits of Smoking Cessation: An Overview of the Approach to State Specific Analysis

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Introduction

Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

This supplemental report to the Executive Summaries and state specific tables is a generic description of the economic research conducted to determine whether the cost of making smoking cessation programs available at the state level could be justified by the benefits. It provides information on the societal impact of smoking in the Background section, and a description of the research model addressed by the research and an explanation of the methodology employed to conduct the analysis in the Methods section. A general summary on the results, a discussion on the findings of relevant national studies, and the limitations of this analysis are also included in this detailed report. The actual results by state are found in the state-specific Executive Summaries, including the findings and results in Tables 1-8.

Background

Smoking rates have declined steadily in the United States (US) 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. Many states have enacted statewide bans 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 adoption of a smoking cessation program by a state 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 state-level societal 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. This approach is appropriate given the responsibilities at the state level of insurance regulation and coverage decisions.

Methods

The Model

The conceptual model that underlies the cost-benefit analysis is presented in Figure 1. In this model, annual rates of smoking are modified by smoking cessation programs. Specific programs considered are NRT, bupropion, and varenicline with or without face-to-face counseling. Both annualized 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, including reductions in smoking attributable deaths. 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. In summary, estimating the annualized costs and benefits of smoking cessation 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 avoided.

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 smoking cessation programs across the nation 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 avoided) per pack by the number of packs former smokers would no longer consume. Multiple data sources from different time frames were used to identify the benefits and costs that could be realized on an annual basis. Using data on inflation from the U.S. Department of Labor, adjustments were made on all monetary data sources to normalize them to 2009 dollars (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 throughout the United States 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 residential 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 the United States 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). Sample sizes are state specific (42). The study is age constrained to those 18 years and older that completed the survey. Survey responses were appropriately weighted to achieve population estimates (Table 1).

The number of packs of cigarettes consumed was determined by identifying the amount of excise tax reported by the state and then dividing by the state's excise tax rate per pack (43). The number of total packs per smoker per year varied by state and was calculated

by taking the total number of packs consumed and dividing it by the total number of smokers (Table 1).

The next step involved estimating visitors and their impact on cigarette sales in a particular state. It was important to isolate these numbers in order to objectively evaluate the societal impact on smoking cessation programs to residents of the state. We began by estimating the number of visitors to the state. State visitor data came from a variety of state-specific sources and documentation of the actual source can be found in the footnotes to Table 1. In order to determine how many visitors smoked, prevalence data from the United States BRFSS data was used (44). Visitor consumption was then subtracted from the total of cigarette packs consumed to reach a total number of cigarettes consumed by residents of a specific state. Using the total number of cigarette packs sold times the number of resident smokers, and then dividing by the number of total smokers, we calculated the number of packs of cigarettes sold just to residents of the state. This provided a baseline population of current resident smokers and an estimate of the number of cigarettes consumed annually by a resident smoker (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 for those age 35 or older (<http://apps.nccd.cdc.gov/sammec/>). The Adult SAMMEC program derives smoking-attributable mortality (SAM) using an attributable-fraction formula (45, 46). 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 (47). 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 (47). SAMMEC computes the SAFs for each disease by sex using the following formula:

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

where p_i is a prevalence rate and RR_i is a risk ratio. The SAMMEC YPLL calculations as presented by the CDC facilitate the use of state specific data. For each state the most recent smoking prevalence data from the BRFSS was used and risk of death was calculated based on the most recently available mortality statistics (47). The present value of future earnings was calculated using the most recently available earning and net present value calculations for the state (47).

To estimate lost productivity time, data from the May 2007 Current Population Survey were used to determine labor force participation rates for each state and the District (48). See the Puerto Rico specific report for the unique data sources that were used to produce that report. 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. (2006) 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 (49). Their research identified a net productivity loss of \$1,807 per current smoker and \$623 annually per former smoker over a non-smoking worker. These numbers were then adjusted for inflation to 2009.

Medical Costs. The CDC's SAMMEC tool also provides a mechanism for estimating medical costs that result from smoking: smoking-attributable expenditures (SAEs). These expenditures 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 (47). 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) (50). Data for the total dollars of care spent by state in 2004 and by category were taken from reports by the Centers for Medicare and Medicaid Services (51). 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 a state (Table 3).

Secondary neonatal costs avoided were identified using the Medical Economic Outcomes reports generated by the Maternal and Child Health (MCH) SAMMEC application. MCH

SAMMEC uses birth certificate data for state specific analysis on maternal smoking to estimate smoking-attributable outcomes (52). Summaries of the total neonatal costs, costs per pack , and costs per smoker can be found in Table 3.

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 (53). The average national factory price is the representative price to wholesalers and distributors of cigarettes. The distributor and retail mark-up is based on the average mark-up as determined by Orzechowski & Walker, Tax Burden on Tobacco 2006 (53) and adjusted for inflation. These numbers are the foundation for the 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 it has been reported that as many as 75% of smokers may attempt to quit each year, often without the assistance of a smoking cessation program (54).

Cost of Treatment. Retail cost values are presented in Table 5 and includes two key cost components: the cost of the therapy itself, and the cost of therapy with smoking cessation counseling. The cost of the physician office visit to receive the prescription was not included in the costs due to anecdotal evidence that smoking cessation is not the primary

reason for the visit. Cost of counseling for smoking cessation was based on Medicare reimbursement rates. Medicare currently reimburses at most two smoking cessation attempts per year, with as many as four face to face counseling sessions per year per cessation attempt. Each session is reimbursed at a rate of \$32 per session. We assumed all four session would be used per attempt for a total cost of \$128.

Given the societal perspective of this research, it was important to identify the retail pricing of the therapies being evaluated. Drug pricing is highly volatile depending on the source. Characteristics that affect price include purchasing entity, which include retail chains, mail order pharmaceutical benefits managers, or local drug stores; insurance coverage and geographic location. Retail pricing for pharmaceutical therapies were obtained from drugstore.com (41). While it is acknowledged that pricing varies by state, it was not possible to determine state specific pricing, and national averages were used in the calculations.

The cost of NRT was assumed to be the average cost for a 12-week course of Nicoderm CQ. Assuming one patch per day, the average cost for a full course of NRT was \$316. We also assumed a 12-week course of bupropion dosed at 300 mg per day. We obtained prices for both generic and branded bupropion, which were \$518 for a full course of branded bupropion and \$179 for a full course of generic. For varenicline we assumed a 12-week course at a dose of 1 mg twice per day, including the starter pack. Total costs were \$355 for a full course of varenicline (55).

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 6. 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.

Results

The results are summarized in general for each state in the results section of the Executive Summary and in Tables 7-9. A benefit to cost ratio of 1 or greater represents a favorable outcome. In other words, for every dollar in costs one dollar of benefit or greater is received. When the ratio is less than one, more costs are incurred than benefits gained.

Baseline Results

Baseline cost-benefit results are contained in Table 7, which presents the total costs, total benefits, and cost-benefit ratio for nationwide smoking cessation programs. Results are state specific.

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 6. As seen in Table 8, if marginal treatment effectiveness was assumed to be at the low of reported estimates, the benefit-cost ratios responded to the changes in lost tax dollars and revenue. 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.

Discussion

This model considered just one treatment option at a time offered across the state. In reality, implementing smoking cessation programs across a state would likely offer some combination of NRT, bupropion, and varenicline, perhaps with adjunct counseling, similar to the options available under Medicare today. 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.

In addition, this analysis was not designed to make comparisons between counseling versus non-counseling treatment options. That would require a cost effectiveness analysis to take into account the non-monetary costs and benefits of counseling sessions. The study was designed to address the individual costs and benefits of various options for smoking cessation.

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 (55). 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 (56). 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 state-based 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.

Volpp et al. identified favorable returns to employers who offered incentives to employees to stop smoking (57). Using data from the CDC MMWR from 2002 on the economic costs of smoking, they identified \$3,400 per year per employee that results from increased productivity, decreased absenteeism, and the reduced incidence of illness (58). When adjusted for inflation these numbers are consistent with the findings of this work, which used the same CDC sources with more current information.

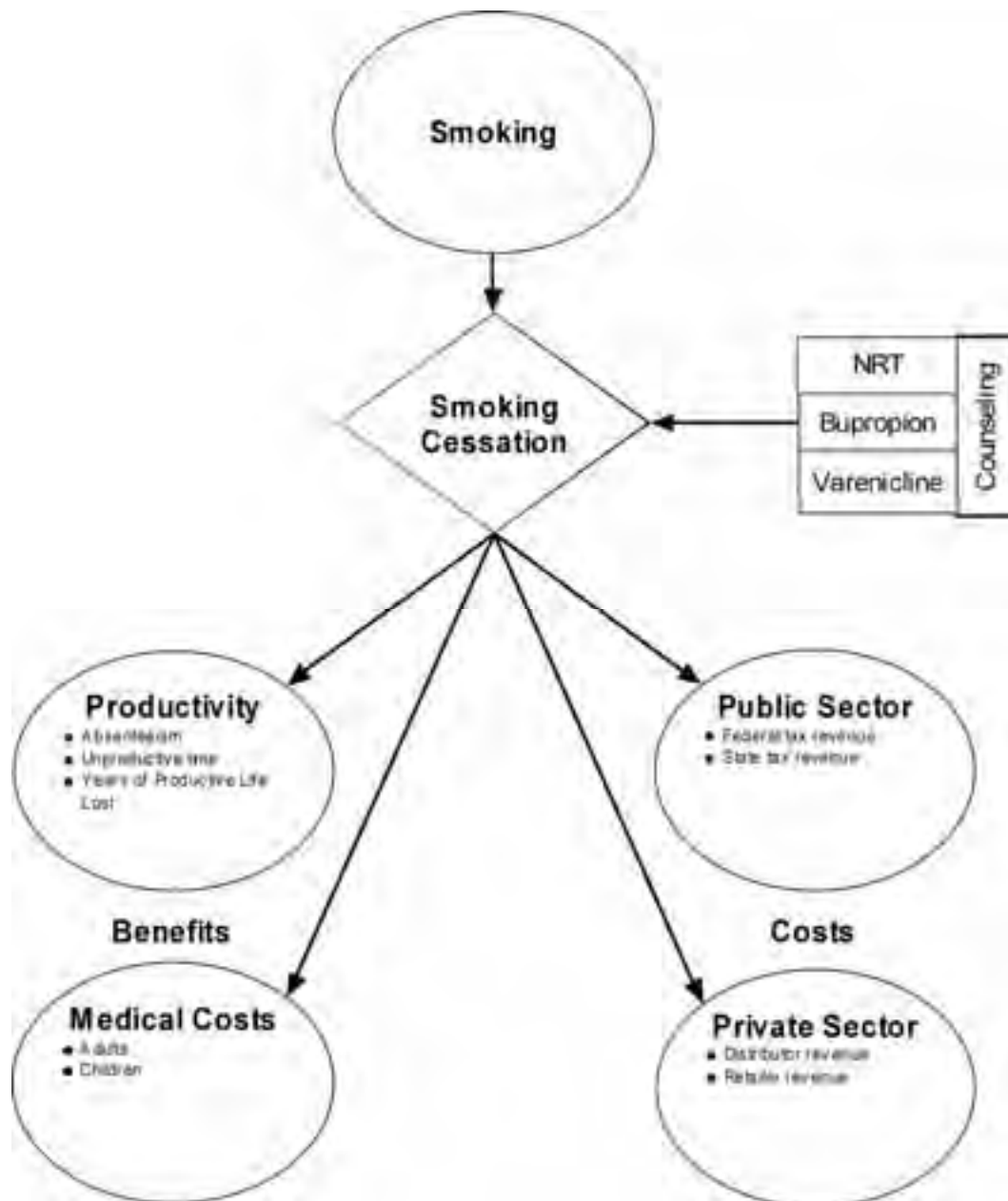
Although there are relatively few cost-benefit analyses of smoking cessation, there are several published cost-effectiveness studies. Most of these studies compare counseling to combination counseling and NRT (59-63). More recent studies estimate the cost-effectiveness of bupropion to counseling or NRT (64-68). 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 (69). We also did not take into account the deleterious effects of smoking on smoking related fires and accidents (70, 71).

The model is comprehensive in terms of costs of the implementation of smoking cessation programs within a specific state. Therefore, these estimates of the cost-benefit of 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.

Figures

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



References

1. (CDC) CfDcAP. Cigarette smoking among adults--United States, 2003. MMWR Morb Mortal Wkly Rep 2005 May 27; 54(20):509-13.
2. (CDC) CfDcAP. Cigarette smoking among adults--United States, 2002. MMWR Morb Mortal Wkly Rep 2004 May 28; 53(20):427-31.
3. (CDC) CfDcAP. Cigarette smoking among adults--United States, 2001. MMWR Morb Mortal Wkly Rep 2003 Oct 10; 52(40):953-6.
4. Giovino GA, Schooley MW, Zhu BP, Chrismon JH, Tomar SL, Peddicord JP, et al. Surveillance for selected tobacco-use behaviors--United States, 1900-1994. MMWR CDC Surveill Summ 1994 Nov 18; 43(3):1-43.
5. McIntosh H. U.S. will not reach tobacco goal for year 2000. J Natl Cancer Inst 1995 Apr 19; 87(8):563-5.
6. (CDC) CfDcAP. Annual smoking-attributable mortality, years of potential life lost, and productivity losses--United States, 1997-2001. MMWR Morb Mortal Wkly Rep 2005 Jul 1; 54(25):625-8.
7. Stellman SD, Garfinkel L. Smoking habits and tar levels in a new American Cancer Society prospective study of 1.2 million men and women. J Natl Cancer Inst 1986 Jun; 76(6):1057-63.
8. Bergen AW, Caporaso N. Cigarette smoking. J Natl Cancer Inst 1999 Aug 18; 91(16):1365-75.
9. Ezzati M, Henley SJ, Thun MJ, Lopez AD. Role of smoking in global and regional cardiovascular mortality. Circulation 2005 Jul 26; 112(4):489-97.
10. HEW. Smoking and Health: Report of the Advisory Committee to the Surgeon General of the Public Health Service. Washington D.C.: U.S. Department of Health, Education, and Welfare, 1964 Contract No.: 1103.
11. HHS. The health consequences of smoking. A report of the Surgeon General. Washington D.C.: U.S. Department of Health and Human Services, 1984 Contract No.: 84-50205.

12. HHS. The Health Consequences of Smoking: A Report of the Surgeon General. . Washington D.C.: Centers for Disease Control, 2004 Contract No.: 7829.
13. Grassi M, Bugiani M, de Marco R. Investigating indicators and determinants of asthma in young adults. *Eur J Epidemiol* 2006; 21(11):831-42.
14. Kurata JH, Nogawa AN. Meta-analysis of risk factors for peptic ulcer. Nonsteroidal antiinflammatory drugs, *Helicobacter pylori*, and smoking. *J Clin Gastroentero* 1997 Jan; 24(1):2-17.
15. Cornuz J, Feskanich D, Willett WC, Colditz GA. Smoking, smoking cessation, and risk of hip fracture in women. *Am J Med* 1999 Mar; 106(3):311-4.
16. Vollset SE, Tverdal A, Gjessing HK. Smoking and deaths between 40 and 70 years of age in women and men. *Ann Intern Med* 2006 Mar 21; 144(6):381-9.
17. Goldenberg I, Jonas M, Tenenbaum A, Boyko V, Matetzky S, Shotan A, et al. Current smoking, smoking cessation, and the risk of sudden cardiac death in patients with coronary artery disease. *Arch Intern Med* 2003 Oct 27; 163(19):2301-5.
18. Anthonisen NR, Connett JE, Kiley JP, Altose MD, Bailey WC, Buist AS, et al. Effects of smoking intervention and the use of an inhaled anticholinergic bronchodilator on the rate of decline of FEV1. The Lung Health Study. *Jama* 1994 Nov 16; 272(19):1497-505.
19. Buist AS, Sexton GJ, Nagy JM, Ross BB. The effect of smoking cessation and modification on lung function. *Am Rev Respir Dis* 1976 Jul; 114(1):115-22.
20. Kanner RE, Connett JE, Williams DE, Buist AS. Effects of randomized assignment to a smoking cessation intervention and changes in smoking habits on respiratory symptoms in smokers with early chronic obstructive pulmonary disease: the Lung Health Study. *Am J Med* 1999 Apr; 106(4):410-6.
21. Arcavi L, Benowitz NL. Cigarette smoking and infection. *Arch Intern Med* 2004 Nov 8; 164(20):2206-16.
22. den Boon S, van Lill SW, Borgdorff MW, Verver S, Bateman ED, Lombard CJ, et al. Association between smoking and tuberculosis infection: a population survey in a high tuberculosis incidence area. *Thorax* 2005 Jul; 60(7):555-7.

23. Nuorti JP, Butler JC, Farley MM, Harrison LH, McGeer A, Kolczak MS, et al. Cigarette smoking and invasive pneumococcal disease. Active Bacterial Core Surveillance Team. *N Engl J Med* 2000 Mar 9; 342(10):681-9.
24. Vineis P, Alavanja M, Buffler P, Fontham E, Franceschi S, Gao YT, et al. Tobacco and cancer: recent epidemiological evidence. *J Natl Cancer Inst* 2004 Jan 21; 96(2):99-106.
25. Willi C, Bodenmann P, Ghali WA, Faris PD, Cornuz J. Active smoking and the risk of type 2 diabetes: a systematic review and meta-analysis. *Jama* 2007 Dec 12; 298(22):2654-64.
26. Ortego-Centeno N, Munoz-Torres M, Jodar E, Hernandez-Quero J, Jurado-Duce A, de la Higuera Torres-Puchol J. Effect of tobacco consumption on bone mineral density in healthy young males. *Calcif Tissue Int* 1997 Jun; 60(6):496-500.
27. Parrott S, Godfrey C. Economics of smoking cessation. *Bmj* 2004 Apr 17; 328(7445):947-9.
28. Evans N, Farkas A, Gilpin E, Berry C, Pierce JP. Influence of tobacco marketing and exposure to smokers on adolescent susceptibility to smoking. *J Natl Cancer Inst* 1995 Oct 18; 87(20):1538-45.
29. Snider GL. Emphysema: the first two centuries--and beyond. A historical overview, with suggestions for future research: Part 2. *Am Rev Respir Dis* 1992 Dec; 146(6):1615-22.
30. Chinn S, Jarvis D, Melotti R, Luczynska C, Ackermann-Liebrich U, Anto JM, et al. Smoking cessation, lung function, and weight gain: a follow-up study. *Lancet* 2005 May 7-13; 365(9471):1629-35; discussion 00-1.
31. Filozof C, Fernandez Pinilla MC, Fernandez-Cruz A. Smoking cessation and weight gain. *Obes Rev* 2004 May; 5(2):95-103.
32. Flegal KM, Troiano RP, Pamuk ER, Kuczmarski RJ, Campbell SM. The influence of smoking cessation on the prevalence of overweight in the United States. *N Engl J Med* 1995 Nov 2; 333(18):1165-70.

33. O'Hara P, Connett JE, Lee WW, Nides M, Murray R, Wise R. Early and late weight gain following smoking cessation in the Lung Health Study. *Am J Epidemiol* 1998 Nov 1; 148(9):821-30.
34. Williamson DF, Madans J, Anda RF, Kleinman JC, Giovino GA, Byers T. Smoking cessation and severity of weight gain in a national cohort. *N Engl J Med* 1991 Mar 14; 324(11):739-45.
35. Glassman AH, Covey LS, Stetner F, Rivelli S. Smoking cessation and the course of major depression: a follow-up study. *Lancet* 2001 Jun 16; 357(9272):1929-32.
36. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. *Cochrane Database Syst Rev* 2007(1):CD006103.
37. Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. *Cochrane Database Syst Rev* 2007(1):CD000031.
38. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. *Cochrane Database Syst Rev* 2004(3):CD000146.
39. Wilkes S. The use of bupropion SR in cigarette smoking cessation. *Int J Chron Obstruct Pulmon Dis* 2008; 3(1):45-53.
40. Fagerstrom K, Hughes J. Varenicline in the treatment of tobacco dependence. *Neuropsychiatr Dis Treat* 2008 Apr; 4(2):353-63.
41. Databases, Tables & Calculators by Subject, Bureau of Labor Statistics (2009) Consumer Price Inflation Calculator. Washington, D.C.: Department of Labor, Bureau of Labor Statistics, 2008. Retrived on September 14, 2009 at http://www.bls.gov/data/inflation_calculator.htm.
42. CDC. Behavioral Risk Factor Surveillance System Survey Data. . Atlanta, Georgia: Centers for Disease Control and Prevention, 2008.
43. Campaign for Tobaccor Free Kids (2009) State cigarette tax rates & rank, Date of last increase, annual pack sales & revenues, and related data. Washington, D.C. Retrived on September 14, 2009 at <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>

44. BRFSS. Prevalence and trend data: Adults who are current smokers. Atlanta, GA: National Center for Chronic Disease Prevention & Health Promotion, 2005.
45. Levin ML. The occurrence of lung cancer in man. *Acta Unio Internationalis Contra Cancrum* 1953; 9:531-41.
46. Lilienfeld AM, Lilienfeld DE. *Foundations of epidemiology*. 2nd ed. New York: Oxford University Press; 1980.
47. SAMMEC M. MCH SAMMEC - Medical Economics Report. Washington, D.C.: CDC; 2008.
48. U.S. Census Bureau. Current Population Survey (CPS): May 2007 Supplemental. A joint effort between the Bureau of Labor Statistics and the Census Bureau. Washington, D.C.
49. Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R, 2006. Effect of smoking status on productivity loss. *J Occup Environ Med* 2006 Oct; 48(10):1099-108.
50. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC. 2008.
51. Actuary Oot. Health Expenditure Data, Health Expenditures by State of Residence, Centers for Medicare and Medicaid Services. Baltimore, MD: Centers for Medicare and Medicaid Services, National Health Statistics Group, 2007.
52. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator [database on the Internet]. CDC. 2008. Available from: http://apps.nccd.cdc.gov/sammec/exp_comp.asp.
53. Boonn A. 2007. STATE CIGARETTE PRICES, TAXES, AND COSTS PER PACK. Economic Research Service, Department of Agriculture, November 27, 2007. Report No.
54. CDC. Tobacco use among adults--United States, 2005. *MMWR Morb Mortal Wkly Rep* 2006 Oct 27; 55(42):1145-8.

55. Weiss SJ, Jurs S, Lesage JP, Iverson DC. A cost-benefit analysis of a smoking cessation program. *Eval Program Plann* 1984; 7(4):337-46.
56. WEG. The net benefits and economic impacts of investing in employee-smoking cessation programs in the public and private sectors in Florida. Coral Gables: The Washington Economics Group, 2008 January 4, 2008. Report No.
57. Volpp KG, Troxel AB, Pauly MV, Glick HA, Puig A, Asch DA, et al. A randomized, controlled trial of financial incentives for smoking cessation. *N Engl J Med* 2009 Feb 12; 360(7):699-709.
58. CDC. Annual smoking-attributable mortality, years of potential life lost, and economic costs--United States, 1995-1999. *MMWR Morb Mortal Wkly Rep* 2002 Apr 12; 51(14):300-3.
59. Chirikos TN, Herzog TA, Meade CD, Webb MS, Brandon TH. Cost-effectiveness analysis of a complementary health intervention: the case of smoking relapse prevention. *Int J Technol Assess Health Care* 2004 Fall; 20(4):475-80.
60. Cromwell J, Bartosch WJ, Fiore MC, Hasselblad V, Baker T. Cost-effectiveness of the clinical practice recommendations in the AHCPR guideline for smoking cessation. Agency for Health Care Policy and Research. *Jama* 1997 Dec 3; 278(21):1759-66.
61. Fiscella K, Franks P. Cost-effectiveness of the transdermal nicotine patch as an adjunct to physicians' smoking cessation counseling. *Jama* 1996 Apr 24; 275(16):1247-51.
62. Stapleton JA, Lowin A, Russell MA. Prescription of transdermal nicotine patches for smoking cessation in general practice: evaluation of cost-effectiveness. *Lancet* 1999 Jul 17; 354(9174):210-5.
63. Wasley MA, McNagny SE, Phillips VL, Ahluwalia JS. The cost-effectiveness of the nicotine transdermal patch for smoking cessation. *Prev Med* 1997 Mar-Apr; 26(2):264-70.
64. Feenstra TL, Hamberg-van Reenen HH, Hoogenveen RT, Rutten-van Molken MP. Cost-effectiveness of face-to-face smoking cessation interventions: a dynamic modeling study. *Value Health* 2005 May-Jun; 8(3):178-90.

65. Gilbert AR, Pinget C, Bovet P, Cornuz J, Shamlaye C, Paccaud F. The cost effectiveness of pharmacological smoking cessation therapies in developing countries: a case study in the Seychelles. *Tob Control* 2004 Jun; 13(2):190-5.
66. Javitz HS, Swan GE, Zbikowski SM, Curry SJ, McAfee TA, Decker DL, et al. Cost-effectiveness of different combinations of bupropion SR dose and behavioral treatment for smoking cessation: a societal perspective. *Am J Manag Care* 2004 Mar; 10(3):217-26.
67. Song F, Raftery J, Aveyard P, Hyde C, Barton P, Woolacott N. Cost-effectiveness of pharmacological interventions for smoking cessation: a literature review and a decision analytic analysis. *Med Decis Making* 2002 Sep-Oct; 22(5 Suppl):S26-37.
68. Tran MT, Holdford DA, Kennedy DT, Small RE. Modeling the cost-effectiveness of a smoking-cessation program in a community pharmacy practice. *Pharmacotherapy* 2002 Dec; 22(12):1623-31.
69. USDOHHS. Healthy People 2010: Understanding and Improving Health. Washington, DC: U.S. Government Printing Office, 2000 November 2000. Report No.
70. Wen CP, Tsai SP, Cheng TY, Chan HT, Chung WS, Chen CJ. Excess injury mortality among smokers: a neglected tobacco hazard. *Tob Control* 2005 Jun; 14 Suppl 1:i28-32.
71. Ahrens M. Smoking and fire. *Am J Public Health* 2004 Jul; 94(7):1076-7.

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation in the United States

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Abstract

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level and aggregated nationwide could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a state based societal perspective. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The annualized cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in the United States the annual direct costs to the economy attributable to smoking were in excess of \$298 billion, including workplace productivity losses of approximately \$67.5 billion, premature death losses of \$117 billion, and direct medical expenditures of \$116 billion. While the retail price of a pack of cigarettes in the US is on average \$5.51, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$18.05 per pack of cigarettes. The ratio of benefits to cost varies from \$0.86 to \$2.52 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. All therapies had a positive break even to costs at the mid-point of the range of treatment effectiveness. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range.

Conclusions. Three of the four smoking cessation products studied resulted in breakeven or positive benefits to costs ratios at the most conservative estimates of treatment effectiveness. Smoking cessation programs offered across the country hold the potential of a favorable cost-benefit ratio from a state-based societal perspective.

1 Background

Smoking rates have declined steadily in the United States (US) 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. Many states have enacted statewide bans 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 adoption of a smoking cessation program in the US 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 nationwide perspective that results from the aggregation of state-level data 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. This approach is appropriate given the responsibilities at the state level for insurance regulation and coverage decisions.

2 Methods

The Model

The conceptual model that underlies the cost-benefit analysis is presented in Figure 1. In this model, annual rates of smoking are modified by smoking cessation programs. Specific programs considered are NRT, bupropion, and varenicline with or without face-to-face counseling. Both annualized 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, including reductions in smoking attributable deaths. 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. In summary, estimating the annualized costs and benefits of smoking cessation 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 avoided.

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 smoking cessation programs across the nation 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 avoided) per pack by the number of packs former smokers would no longer consume. Multiple data sources from different time frames were used to identify the benefits and costs that could be realized on an annual basis. Using data on inflation from the U.S. Department of Labor, adjustments were made on all monetary data sources to normalize them to 2009 dollars (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 throughout the United States 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 residential 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 the United States 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 United States sample for 2005 included 354,582 surveys (42) completed by those 18 years and older that were used for this analysis. Survey responses were appropriately weighted to achieve population estimates (Table 1).

The number of packs of cigarettes consumed was determined by identifying how many total packs of cigarettes were reported as Federal tax sales, including sales from Indian tribes, military bases, and other US territories (43). The number of total packs per

smoker per year of 366 was calculated by taking the total number of packs consumed and dividing it by the total number of smokers.

The next step involved estimating visitors and their impact on cigarette sales in the United States. It was important to isolate these numbers in order to objectively evaluate the societal impact on smoking cessation programs to residents of the country. We began by estimating the number of visitors to the country, determining how many smoked using prevalence data from the World Health Organization (44), and subtracting their cigarette consumption from the total of cigarette packs consumed to reach a total number of cigarettes consumed by residents of the United States. The number of visitors to the United States (39,984,810) came from the 2008 annual report compiled by the U.S. Department of Commerce, International Trade Administration (45). The number of visitors was further refined to reflect the number of individuals age 18 years or older using population distribution estimates from the Department of Economic and Social Affairs of the United Nations (46). Smoking prevalence among visitors was calculated using the international average of 20% from the Tobacco Free Initiative, Department of Gender and Women's Health, World Health Organization (44). It was then necessary to translate international visitors, who spend an average of 8 nights in the country into an annual number for comparison to residents (45). Using the total number of cigarette packs sold times the number of resident smokers, and then dividing by the number of total smokers, we calculated the number of packs of cigarettes sold just to residents of the US. This provided a baseline population of current resident smokers and an estimate of the number of cigarettes consumed annually by a resident smoker (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 for those age 35 and older (<http://apps.nccd.cdc.gov/sammec/>). 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 national data. For the United States the 2004 smoking prevalence data from the BRFSS was used and risk of death was calculated based on the nation’s

2004 Mortality statistics (49). The present value of future earnings was calculated using the United States 2004 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 the United States (50). 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. (2006) 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 (51). Their research identified a net productivity loss of \$1,807 per current smoker and \$623 annually per former smoker over a non-smoking worker. These numbers were then adjusted for inflation to 2009.

Medical Costs. The CDC's SAMMEC tool also provides a mechanism for estimating medical costs that result from smoking: smoking-attributable expenditures (SAEs). These expenditures 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) (52). Data for the total dollars of care spent in the United States in

2004 and by category were taken from reports by the Centers for Medicare and Medicaid Services (53). 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 the US (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 (54). Combining neonatal medical costs, adult medical costs, and productivity losses, smoking costs the United States approximately \$18.05 for each pack of cigarettes sold to residents in 2009 dollars.

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 (55). The average national factory price is the representative price to wholesalers and distributors of cigarettes. The tax of \$2.48 includes both federal and a weighted average of state specific taxes based on number of packs of cigarettes sold by state. The distributor and retail mark-up is based on the average mark-up as determined by Orzechowski & Walker, Tax Burden on Tobacco 2006 (55) and adjusted for inflation. 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 it has been reported that as many as 75% of smokers may attempt to quit each year, often without the assistance of a smoking cessation program (56).

Cost of Treatment. Retail cost values are presented in Table 5 and includes two key cost components: the cost of the therapy itself, and the cost of therapy with smoking cessation counseling. The cost of the physician office visit to receive the prescription was not included in the costs due to anecdotal evidence that smoking cessation is not the primary reason for the visit. Cost of counseling for smoking cessation was based on Medicare reimbursement rates. Medicare currently reimburses at most two smoking cessation attempts per year, with as many as four face to face counseling sessions per year per cessation attempt. Each session is reimbursed at a rate of \$35 per session. We assumed all four session would be used per attempt for a total cost of \$140.

Given the societal perspective of this research, it was important to identify the retail pricing of the therapies being evaluated. Drug pricing is highly volatile depending on the source. Characteristics that affect price include purchasing entity, which include retail chains, mail order pharmaceutical benefits managers, or local drug stores; insurance coverage and geographic location. Retail pricing for pharmaceutical therapies were obtained from drugstore.com in 2009 dollars (41). The cost of NRT was assumed to be the average cost for a 12-week course of Nicoderm CQ. Assuming one patch per day, the

average cost for a full course of NRT was \$316. We also assumed a 12-week course of bupropion dosed at 300 mg per day. We obtained prices for both generic and branded bupropion, which were \$518 for a full course of branded bupropion and \$179 for a full course of generic. For varenicline we assumed a 12-week course at a dose of 1 mg twice per day, including the starter pack. Total costs were \$355 for a full course of varenicline (57).

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 nationwide smoking cessation programs aggregated from each state. As seen in Table 7, the smoking cessation programs using any one of the four identified therapies had favorable benefit-cost ratios.

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 yield a positive benefit-cost ratio of 1.14, which means that benefits were 14% more than costs. Brand name Bupropion (Wellbutrin, Wellbutrin XL, Wellbutrin SR, Zyban) without counseling had a benefit-cost ratio of 1.06 and with counseling had a benefit-cost ratio of 10.2, close to the breakeven point. However, the generic Bupropion had very favorable benefits to costs ratios – 1.63 without counseling and 1.37 with counseling, which suggests there exists a cost effective alternative for this treatment modality. Finally, varenicline without counseling had a benefit-cost ratio of 2.09, which suggests that the benefits of smoking cessation under this treatment are two times their costs. Treatment with varenicline in combination with counseling had a somewhat lower benefit-cost ratio of 1.87 but still exceedingly favorable.

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 responded to the changes in lost tax dollars and revenue, negatively impacting all therapies but resulting in unfavorable benefits to cost ratio for branded bupropion. For nationwide smoking cessation based on NRT, the cost benefit ratio was 1.14 without counseling and 1.03 with counseling. For nationwide smoking cessation based on brand name bupropion, the cost benefit ratio was 0.86 without counseling and 0.86 with counseling, suggesting that the costs outweigh the benefits. For the generic bupropion, positive benefits to cost ratios were 1.35 without counseling and 1.16 with counseling. For nationwide smoking cessation based on varenicline, the cost benefit ratio was 1.61 without counseling and 1.46 with counseling.

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 nationwide smoking cessation based on NRT was 1.41 without counseling, and 1.24 with counseling. For brand name bupropion a breakeven position is substantially exceeded, with benefit-cost ratios of 1.26 with no counseling and 1.19 with counseling. For generic bupropion, the benefits-cost ration is 1.89 without counseling and 1.57 with counseling. The benefit-cost ratios for a smoking cessation program based on varenicline were 2.52 if offered alone and 2.25 if offered in combination with counseling.

4 Discussion

These results suggest that benefits across the nation of state-based provision of smoking cessation programs outweigh the costs for most treatment options available for smoking cessation. In baseline analyses, benefits were approximately at the breakeven point for the brand name version of Bupropion, 28% better for NRT therapy, 63% greater for prescriptions for the generic bupropion, and 109% 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. However, this analysis was not designed to make comparisons between counseling versus non-counseling treatment options. That would require a cost effectiveness analysis to take into account the non-monetary costs and benefits of counseling sessions. The study was designed to address the individual cost benefits of various options for smoking cessation.

This model considered just one treatment option at a time offered across the nation. In reality, implementing smoking cessation programs across the country would likely offer some combination of NRT, bupropion, and varenicline, perhaps with adjunct counseling, similar to the options available under Medicare today. 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 (57). 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 (58). 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 state-based 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.

Volpp et al. identified favorable returns to employers who offered incentives to employees to stop smoking (59). Using data from the CDC MMWR from 2002 on the economic costs of smoking, they identified \$3,400 per year per employee that results from increased productivity, decreased absenteeism, and the reduced incidence of illness (60). When adjusted for inflation these numbers are consistent with the findings of this work, which used the same CDC sources with more current information.

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 (61-65). More recent studies estimate the cost-effectiveness of bupropion to counseling or NRT (66-70). 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 (71). We also did not take into account the deleterious effects of smoking on smoking related fires and accidents (72, 73).

The model is comprehensive in terms of costs of the implementation of smoking cessation programs throughout the United States aggregated for a national perspective. Therefore, these estimates of the cost-benefit of nationwide 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 the United States.

Variable	Total
Resident Smokers in US ¹	45,622,271
Visiting Smokers in US ²	175,156
Total Smokers	45,797,427
Total Packs Sold to Residents	16,675,976,536
Total Packs Sold to Visitors	64,023,464
Total Packs Sold	16,740,000,000
Average Packs Per Resident Smoker Per Year	366

¹ Data from the Behavioral Risk Factor Surveillance System, All States/Territories Calculated Variable Data Report, 2005. Retrieved on August 20, 2009 from:

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

² Data from the US Department of Commerce, International Trade Commission, Manufacturing and Services, Office of Travel and Tourism Industries. International visitation to the United States: A Statistical Summary of the US arrivals. Retrieved on September 2, 2009 at

http://tinnet.ita.doc.gov/outreachpages/download_data_table/2008_Visitation_Report.pdf and the Tobacco Free Initiative, Department of Gender and Women's Health, World Health Organization (2003). Gender, health and tobacco. Geneva, Switzerland. Retrieved on September 3, 2009 at http://www.who.int/entity/gender/documents/Gender_Tobacco_2.pdf

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

Component	Total	Per Pack	Per Smoker
Premature Death¹			
Men	\$77,088,162,835	\$8.62	\$3,149.85
Women	\$40,050,612,134	\$5.18	\$1,893.76
Combined	\$117,138,774,968	\$7.02	\$2,567.58
Workplace Productivity²			
Current Smokers ³	\$45,895,087,851	\$2.75	\$1,005.98
Former Smokers ⁴	\$21,594,905,621	\$1.29	\$473.34
Combined	\$67,489,993,472	\$4.05	\$1,479.32
Total Productivity Losses	\$184,628,768,441	\$11.07	\$4,046.90

Adjusted for inflation to 2009

¹. Data from SAMMEC M. MCH SAMMEC - Medical Economics Report. Washington, D.C.: CDC; 2008

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 the United States. Total expenditures per pack for both medical care and productivity losses are \$18.05 per pack.

Cost Component	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$18,854,537,111	\$1.13	\$413.27
Hospital Care	\$58,981,294,492	\$3.54	\$1,292.82
Rx	\$18,750,368,397	\$1.12	\$410.99
Nursing Home	\$10,286,054,808	\$0.62	\$225.46
Other Care ²	\$9,343,691,332	\$0.56	\$204.81
Total	\$116,217,157,404	\$6.97	\$2,547.38
Neonatal Expenditures	\$179,936,858	\$0.01	\$3.94
Total Expenditures	\$116,397,094,262	\$6.98	\$2,551.32

Adjusted for inflation to 2009

¹. Columns may not add up due to rounding.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups. An average representation for the United States.

Component	Price
Factory Price	\$2.36
Total Taxes	\$2.48
Federal Tax	\$1.01
State Tax	\$1.18
State Sales Tax	\$0.29
Distributor & Retailer Mark-ups	\$0.67
Final Retail Price	\$5.51

Adjusted for inflation to
2009

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).

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

Treatment	Alone	With Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Drugstore.com (2009). Prices are inflation adjusted to 2009.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis. Calculated from treatment rates in Silagy et al. (38) for NRT, Hughes et al. (37) for bupropion, and Cahill et al. (36) for varenicline.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT	5.8%	5.0%	6.6%
Bupropion (Brand)	7.0%	5.4%	8.6%
Generic Bupropion	7.0%	5.4%	8.6%
Varenicline	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic 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 in thousands).

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$1,742,201,558	\$2,097,456,751	\$2,097,456,751	\$4,486,788,267
Costs of Cessation Program	\$1,053,874,460	\$1,616,442,684	\$924,352,833	\$1,366,583,192
Lost State Tax Revenue	\$141,625,063	\$170,504,064	\$170,504,064	\$364,734,878
Lost Federal Tax Revenue	\$97,478,141	\$117,355,069	\$117,355,069	\$251,040,861
Lost Business Revenue	\$64,910,378	\$78,146,361	\$78,146,361	\$167,167,296
Benefit/Cost Ratio	1.28	1.06	1.63	2.09

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$2,400,885,931	\$2,809,429,403	\$2,809,429,403	\$5,557,160,646
Costs of Cessation Program	\$1,692,586,254	\$2,255,154,478	\$1,563,064,627	\$2,005,294,986
Lost State Tax Revenue	\$195,170,083	\$228,380,933	\$228,380,933	\$451,746,370
Lost Federal Tax Revenue	\$134,332,274	\$157,190,742	\$157,190,742	\$310,929,402
Lost Business Revenue	\$89,451,426	\$104,672,806	\$104,672,806	\$207,046,882
Benefit/Cost Ratio	1.14	1.02	1.37	1.87

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness (dollars given in thousands).

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$1,506,977,438	\$1,635,812,404	\$1,635,812,404	\$3,068,602,842
Costs of Cessation Program	\$1,053,874,460	\$1,616,442,684	\$924,352,833	\$1,366,583,192
Lost State Tax Revenue	\$122,503,492	\$132,976,598	\$132,976,598	\$249,449,365
Lost Federal Tax Revenue	\$84,317,086	\$91,525,548	\$91,525,548	\$171,691,788
Lost Business Revenue	\$56,146,475	\$60,946,566	\$60,946,566	\$114,329,005
Benefit/Cost Ratio	1.14	0.86	1.35	1.61

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$2,130,378,193	\$2,278,538,403	\$2,278,538,403	\$3,926,247,408
Costs of Cessation Program	\$1,692,586,254	\$2,255,154,478	\$1,563,064,627	\$2,005,294,986
Lost State Tax Revenue	\$173,180,276	\$185,224,347	\$185,224,347	\$319,168,029
Lost Federal Tax Revenue	\$119,197,061	\$127,486,792	\$127,486,792	\$219,677,968
Lost Business Revenue	\$79,372,937	\$84,893,042	\$84,893,042	\$146,282,847
Benefit/Cost Ratio	1.03	0.86	1.16	1.46

Adjusted for inflation to 2009

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

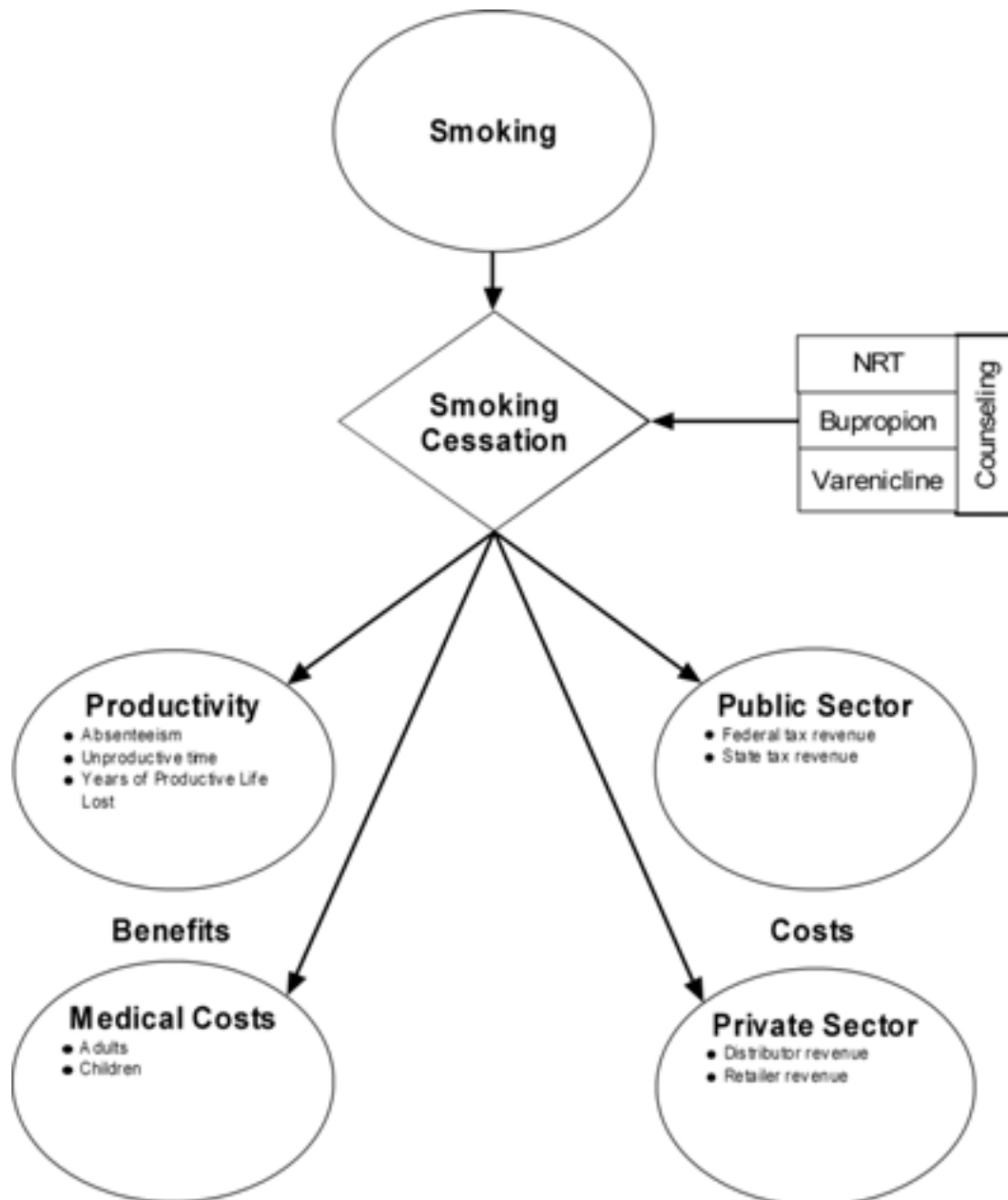
Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$1,973,199,050	\$2,602,412,073	\$2,602,412,073	\$6,134,711,472
Costs of Cessation Program	\$1,053,874,460	\$1,616,442,684	\$924,352,833	\$1,366,583,192
Lost State Tax Revenue	\$160,403,048	\$211,552,316	\$211,552,316	\$498,695,973
Lost Federal Tax Revenue	\$110,402,711	\$145,607,889	\$145,607,889	\$343,244,021
Lost Business Revenue	\$73,516,808	\$96,959,821	\$96,959,821	\$228,565,082
Benefit/Cost Ratio	1.41	1.26	1.89	2.52

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$2,666,533,046	\$3,390,128,022	\$3,390,128,022	\$7,452,272,332
Costs of Cessation Program	\$1,692,586,254	\$2,255,154,478	\$1,563,064,627	\$2,005,294,986
Lost State Tax Revenue	\$216,764,765	\$275,586,423	\$275,586,423	\$605,801,629
Lost Federal Tax Revenue	\$149,195,529	\$189,681,484	\$189,681,484	\$416,963,036
Lost Business Revenue	\$99,348,820	\$126,308,286	\$126,308,286	\$277,654,336
Benefit/Cost Ratio	1.24	1.19	1.57	2.25

Adjusted for inflation to 2009

Figures

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



References

1. (CDC) CfDcAP. Cigarette smoking among adults--United States, 2003. MMWR Morb Mortal Wkly Rep 2005 May 27; 54(20):509-13.
2. (CDC) CfDcAP. Cigarette smoking among adults--United States, 2002. MMWR Morb Mortal Wkly Rep 2004 May 28; 53(20):427-31.
3. (CDC) CfDcAP. Cigarette smoking among adults--United States, 2001. MMWR Morb Mortal Wkly Rep 2003 Oct 10; 52(40):953-6.
4. Giovino GA, Schooley MW, Zhu BP, Chrismon JH, Tomar SL, Peddicord JP, et al. Surveillance for selected tobacco-use behaviors--United States, 1900-1994. MMWR CDC Surveill Summ 1994 Nov 18; 43(3):1-43.
5. McIntosh H. U.S. will not reach tobacco goal for year 2000. J Natl Cancer Inst 1995 Apr 19; 87(8):563-5.
6. (CDC) CfDcAP. Annual smoking-attributable mortality, years of potential life lost, and productivity losses--United States, 1997-2001. MMWR Morb Mortal Wkly Rep 2005 Jul 1; 54(25):625-8.
7. Stellman SD, Garfinkel L. Smoking habits and tar levels in a new American Cancer Society prospective study of 1.2 million men and women. J Natl Cancer Inst 1986 Jun; 76(6):1057-63.
8. Bergen AW, Caporaso N. Cigarette smoking. J Natl Cancer Inst 1999 Aug 18; 91(16):1365-75.
9. Ezzati M, Henley SJ, Thun MJ, Lopez AD. Role of smoking in global and regional cardiovascular mortality. Circulation 2005 Jul 26; 112(4):489-97.
10. HEW. Smoking and Health: Report of the Advisory Committee to the Surgeon General of the Public Health Service. Washington D.C.: U.S. Department of Health, Education, and Welfare, 1964 Contract No.: 1103.
11. HHS. The health consequences of smoking. A report of the Surgeon General. Washington D.C.: U.S. Department of Health and Human Services, 1984 Contract No.: 84-50205.

12. HHS. The Health Consequences of Smoking: A Report of the Surgeon General. . Washington D.C.: Centers for Disease Control, 2004 Contract No.: 7829.
13. Grassi M, Bugiani M, de Marco R. Investigating indicators and determinants of asthma in young adults. *Eur J Epidemiol* 2006; 21(11):831-42.
14. Kurata JH, Nogawa AN. Meta-analysis of risk factors for peptic ulcer. Nonsteroidal antiinflammatory drugs, *Helicobacter pylori*, and smoking. *J Clin Gastroentero* 1997 Jan; 24(1):2-17.
15. Cornuz J, Feskanich D, Willett WC, Colditz GA. Smoking, smoking cessation, and risk of hip fracture in women. *Am J Med* 1999 Mar; 106(3):311-4.
16. Vollset SE, Tverdal A, Gjessing HK. Smoking and deaths between 40 and 70 years of age in women and men. *Ann Intern Med* 2006 Mar 21; 144(6):381-9.
17. Goldenberg I, Jonas M, Tenenbaum A, Boyko V, Matetzky S, Shotan A, et al. Current smoking, smoking cessation, and the risk of sudden cardiac death in patients with coronary artery disease. *Arch Intern Med* 2003 Oct 27; 163(19):2301-5.
18. Anthonisen NR, Connett JE, Kiley JP, Altose MD, Bailey WC, Buist AS, et al. Effects of smoking intervention and the use of an inhaled anticholinergic bronchodilator on the rate of decline of FEV1. The Lung Health Study. *Jama* 1994 Nov 16; 272(19):1497-505.
19. Buist AS, Sexton GJ, Nagy JM, Ross BB. The effect of smoking cessation and modification on lung function. *Am Rev Respir Dis* 1976 Jul; 114(1):115-22.
20. Kanner RE, Connett JE, Williams DE, Buist AS. Effects of randomized assignment to a smoking cessation intervention and changes in smoking habits on respiratory symptoms in smokers with early chronic obstructive pulmonary disease: the Lung Health Study. *Am J Med* 1999 Apr; 106(4):410-6.
21. Arcavi L, Benowitz NL. Cigarette smoking and infection. *Arch Intern Med* 2004 Nov 8; 164(20):2206-16.
22. den Boon S, van Lill SW, Borgdorff MW, Verver S, Bateman ED, Lombard CJ, et al. Association between smoking and tuberculosis infection: a population survey in a high tuberculosis incidence area. *Thorax* 2005 Jul; 60(7):555-7.

23. Nuorti JP, Butler JC, Farley MM, Harrison LH, McGeer A, Kolczak MS, et al. Cigarette smoking and invasive pneumococcal disease. Active Bacterial Core Surveillance Team. *N Engl J Med* 2000 Mar 9; 342(10):681-9.
24. Vineis P, Alavanja M, Buffler P, Fontham E, Franceschi S, Gao YT, et al. Tobacco and cancer: recent epidemiological evidence. *J Natl Cancer Inst* 2004 Jan 21; 96(2):99-106.
25. Willi C, Bodenmann P, Ghali WA, Faris PD, Cornuz J. Active smoking and the risk of type 2 diabetes: a systematic review and meta-analysis. *Jama* 2007 Dec 12; 298(22):2654-64.
26. Ortego-Centeno N, Munoz-Torres M, Jodar E, Hernandez-Quero J, Jurado-Duce A, de la Higuera Torres-Puchol J. Effect of tobacco consumption on bone mineral density in healthy young males. *Calcif Tissue Int* 1997 Jun; 60(6):496-500.
27. Parrott S, Godfrey C. Economics of smoking cessation. *Bmj* 2004 Apr 17; 328(7445):947-9.
28. Evans N, Farkas A, Gilpin E, Berry C, Pierce JP. Influence of tobacco marketing and exposure to smokers on adolescent susceptibility to smoking. *J Natl Cancer Inst* 1995 Oct 18; 87(20):1538-45.
29. Snider GL. Emphysema: the first two centuries--and beyond. A historical overview, with suggestions for future research: Part 2. *Am Rev Respir Dis* 1992 Dec; 146(6):1615-22.
30. Chinn S, Jarvis D, Melotti R, Luczynska C, Ackermann-Liebrich U, Anto JM, et al. Smoking cessation, lung function, and weight gain: a follow-up study. *Lancet* 2005 May 7-13; 365(9471):1629-35; discussion 00-1.
31. Filozof C, Fernandez Pinilla MC, Fernandez-Cruz A. Smoking cessation and weight gain. *Obes Rev* 2004 May; 5(2):95-103.
32. Flegal KM, Troiano RP, Pamuk ER, Kuczmarski RJ, Campbell SM. The influence of smoking cessation on the prevalence of overweight in the United States. *N Engl J Med* 1995 Nov 2; 333(18):1165-70.

33. O'Hara P, Connett JE, Lee WW, Nides M, Murray R, Wise R. Early and late weight gain following smoking cessation in the Lung Health Study. *Am J Epidemiol* 1998 Nov 1; 148(9):821-30.
34. Williamson DF, Madans J, Anda RF, Kleinman JC, Giovino GA, Byers T. Smoking cessation and severity of weight gain in a national cohort. *N Engl J Med* 1991 Mar 14; 324(11):739-45.
35. Glassman AH, Covey LS, Stetner F, Rivelli S. Smoking cessation and the course of major depression: a follow-up study. *Lancet* 2001 Jun 16; 357(9272):1929-32.
36. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. *Cochrane Database Syst Rev* 2007(1):CD006103.
37. Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. *Cochrane Database Syst Rev* 2007(1):CD000031.
38. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. *Cochrane Database Syst Rev* 2004(3):CD000146.
39. Wilkes S. The use of bupropion SR in cigarette smoking cessation. *Int J Chron Obstruct Pulmon Dis* 2008; 3(1):45-53.
40. Fagerstrom K, Hughes J. Varenicline in the treatment of tobacco dependence. *Neuropsychiatr Dis Treat* 2008 Apr; 4(2):353-63.
41. Databases, Tables & Calculators by Subject, Bureau of Labor Statistics (2009) Consumer Price Inflation Calculator. Washington, D.C.: Department of Labor, Bureau of Labor Statistics, 2008. Retrived on September 14, 2009 at http://www.bls.gov/data/inflation_calculator.htm.
42. CDC. Behavioral Risk Factor Surveillance System Survey Data. . Atlanta, Georgia: Centers for Disease Control and Prevention, 2008.
43. Campaign for Tobaccor Free Kids (2009) State cigarette tax rates 7 rank, Date of last increase, annual pack sales & revenues, and related data. Washington, D.C. Retrived on September 14, 2009 at <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>

44. World Health Organization (2003). Gender, health and tobacco, Department of Gender and Women's Health, World Health Organization, Geneva, Switzerland. Retrieved September 14, 2009 from:
http://www.who.int/entity/gender/documents/Gender_Tobacco_2.pdf
45. U.S. Department of Commerce, International Trade Commission, Manufacturing and Services, Office of Travel and Tourism Industries (2008) . International visitation to the United States: A statistical summary of U.S. arrivals (2008). Washington, D.C. Retrieved on September 2, 2009 at
http://tinet.ita.doc.gov/outreachpages/download_data_table/2008_Visitation_Report.pdf
46. BRFSS. Prevalence and trend data: Adults who are current smokers. Atlanta, GA: National Center for Chronic Disease Prevention & Health Promotion, 2005.
47. Levin ML. The occurrence of lung cancer in man. *Acta Unio Internationalis Contra Cancrum* 1953; 9:531-41.
48. Lilienfeld AM, Lilienfeld DE. Foundations of epidemiology. 2nd ed. New York: Oxford University Press; 1980.
49. SAMMEC M. MCH SAMMEC - Medical Economics Report. Washington, D.C.: CDC; 2008.
50. U.S. Census Bureau. Current Population Survey (CPS): May 2007 Supplemental. A joint effort between the Bureau of Labor Statistics and the Census Bureau. Washington, D.C.
51. Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R, 2006. Effect of smoking status on productivity loss. *J Occup Environ Med* 2006 Oct; 48(10):1099-108.
52. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC. 2008.
53. Actuary Oot. Health Expenditure Data, Health Expenditures by State of Residence, Centers for Medicare and Medicaid Services. Baltimore, MD: Centers for Medicare and Medicaid Services, National Health Statistics Group, 2007.
54. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator [database on the Internet]. CDC. 2008. Available from:
http://apps.nccd.cdc.gov/sammec/exp_comp.asp.

55. Boonn A. 2007. STATE CIGARETTE PRICES, TAXES, AND COSTS PER PACK. Economic Research Service, Department of Agriculture, November 27, 2007. Report No.
56. CDC. Tobacco use among adults--United States, 2005. MMWR Morb Mortal Wkly Rep 2006 Oct 27; 55(42):1145-8.
57. Weiss SJ, Jurs S, Lesage JP, Iverson DC. A cost-benefit analysis of a smoking cessation program. Eval Program Plann 1984; 7(4):337-46.
58. WEG. The net benefits and economic impacts of investing in employee-smoking cessation programs in the public and private sectors in Florida. Coral Gables: The Washington Economics Group, 2008 January 4, 2008. Report No.
59. Volpp KG, Troxel AB, Pauly MV, Glick HA, Puig A, Asch DA, et al. A randomized, controlled trial of financial incentives for smoking cessation. N Engl J Med 2009 Feb 12; 360(7):699-709.
60. CDC. Annual smoking-attributable mortality, years of potential life lost, and economic costs--United States, 1995-1999. MMWR Morb Mortal Wkly Rep 2002 Apr 12; 51(14):300-3.
61. Chirikos TN, Herzog TA, Meade CD, Webb MS, Brandon TH. Cost-effectiveness analysis of a complementary health intervention: the case of smoking relapse prevention. Int J Technol Assess Health Care 2004 Fall; 20(4):475-80.
62. Cromwell J, Bartosch WJ, Fiore MC, Hasselblad V, Baker T. Cost-effectiveness of the clinical practice recommendations in the AHCPR guideline for smoking cessation. Agency for Health Care Policy and Research. Jama 1997 Dec 3; 278(21):1759-66.
63. Fiscella K, Franks P. Cost-effectiveness of the transdermal nicotine patch as an adjunct to physicians' smoking cessation counseling. Jama 1996 Apr 24; 275(16):1247-51.
64. Stapleton JA, Lowin A, Russell MA. Prescription of transdermal nicotine patches for smoking cessation in general practice: evaluation of cost-effectiveness. Lancet 1999 Jul 17; 354(9174):210-5.

65. Wasley MA, McNagny SE, Phillips VL, Ahluwalia JS. The cost-effectiveness of the nicotine transdermal patch for smoking cessation. *Prev Med* 1997 Mar-Apr; 26(2):264-70.
66. Feenstra TL, Hamberg-van Reenen HH, Hoogenveen RT, Rutten-van Molken MP. Cost-effectiveness of face-to-face smoking cessation interventions: a dynamic modeling study. *Value Health* 2005 May-Jun; 8(3):178-90.
67. Gilbert AR, Pinget C, Bovet P, Cornuz J, Shamlaye C, Paccaud F. The cost effectiveness of pharmacological smoking cessation therapies in developing countries: a case study in the Seychelles. *Tob Control* 2004 Jun; 13(2):190-5.
68. Javitz HS, Swan GE, Zbikowski SM, Curry SJ, McAfee TA, Decker DL, et al. Cost-effectiveness of different combinations of bupropion SR dose and behavioral treatment for smoking cessation: a societal perspective. *Am J Manag Care* 2004 Mar; 10(3):217-26.
69. Song F, Raftery J, Aveyard P, Hyde C, Barton P, Woolacott N. Cost-effectiveness of pharmacological interventions for smoking cessation: a literature review and a decision analytic analysis. *Med Decis Making* 2002 Sep-Oct; 22(5 Suppl):S26-37.
70. Tran MT, Holdford DA, Kennedy DT, Small RE. Modeling the cost-effectiveness of a smoking-cessation program in a community pharmacy practice. *Pharmacotherapy* 2002 Dec; 22(12):1623-31.
71. USDOHHS. Healthy People 2010: Understanding and Improving Health. Washington, DC: U.S. Government Printing Office, 2000 November 2000. Report No.
72. Wen CP, Tsai SP, Cheng TY, Chan HT, Chung WS, Chen CJ. Excess injury mortality among smokers: a neglected tobacco hazard. *Tob Control* 2005 Jun; 14 Suppl 1:i28-32.
73. Ahrens M. Smoking and fire. *Am J Public Health* 2004 Jul; 94(7):1076-7.

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for Alaska

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Alaska the annual direct costs to the economy attributable to smoking were in excess of \$723 million, including workplace productivity losses of \$194 million, premature death losses of \$202 million, and direct medical expenditures of \$337 million. While the retail price of a pack of cigarettes in Alaska is on average \$6.92, combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$23.30 per pack of cigarettes. The ratio of benefits to cost varies from \$0.81 to \$2.30 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective at the mid-point and higher for the range of treatment effectiveness. Only brand name bupropion did not have positive benefits to cost ratio at the low end of the treatment effectiveness range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in AK ¹	116,126
Visiting Smokers in AK ²	2,487
Total Smokers	118,613
Total Packs Sold to Residents	31,426,897
Total Packs Sold to Visitors	673,103
Total Packs Sold ³	32,100,000
Average Packs Per Resident Smoker Per Year	271

¹ Data from the Behavioral Risk factor Surveillance System, Alaska Calculated Variable Data Report, 2005. Retrieved on September 7, 2009 from:

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

² Data from http://www.commerce.state.ak.us/oed/toubus/pub/FW_whole_doc.pdf, Alaska Visitor Statistics Program Fall/Winter 2006-2007.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$129,779,553	\$4.13	\$1,117.58
Women	\$71,529,748	\$2.28	\$615.97
Combined	\$201,309,300	\$6.41	\$1,733.54
Workplace Productivity²			
Current Smokers ³	\$131,820,563	\$4.19	\$1,135.15
Former Smokers ⁴	\$62,025,214	\$1.97	\$534.12
Combined	\$193,845,777	\$6.17	\$1,669.27
Total Productivity Losses	\$395,155,077	\$12.57	\$3,402.81

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Alaska. Total expenditures per pack for both medical care and productivity losses are \$23.29 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$58,140,677	\$1.85	\$500.67
Hospital Care	\$199,858,578	\$6.36	\$1,721.05
Rx	\$36,337,923	\$1.16	\$312.92
Nursing Home	\$7,267,585	\$0.23	\$62.58
Other Care ²	\$35,126,659	\$1.12	\$302.49
Total	\$336,731,422	\$10.71	\$2,899.71
Neonatal Expenditures	\$314,700	\$0.01	\$2.71
Total Expenditures	\$337,046,122	\$10.72	\$2,902.42

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$3.01
Federal Tax ²	\$1.01
State Tax ²	\$2.00
State Sales Tax ³	\$0.00
Distributor & Retailer Mark-ups ¹	\$1.55
Final Retail Price	\$6.92

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$4,237,649	\$5,101,755	\$5,101,755	\$10,913,453
Costs of Cessation Program	\$2,682,511	\$4,114,460	\$2,352,829	\$3,478,438
Lost Tax Revenue	\$547,473	\$659,109	\$659,109	\$1,409,937
Lost Business Revenue	\$282,294	\$339,858	\$339,858	\$727,008
Benefit/Cost Ratio	1.21	1.00	1.52	1.94

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,839,802	\$6,833,524	\$6,833,524	\$13,516,977
Costs of Cessation Program	\$4,308,275	\$5,740,224	\$3,978,593	\$5,104,202
Lost Tax Revenue	\$754,459	\$882,841	\$882,841	\$1,746,293
Lost Business Revenue	\$389,023	\$455,221	\$455,221	\$900,444
Benefit/Cost Ratio	1.07	0.97	1.29	1.74

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$3,665,501	\$3,978,873	\$3,978,873	\$7,463,926
Costs of Cessation Program	\$2,682,511	\$4,114,460	\$2,352,829	\$3,478,438
Lost Tax Revenue	\$473,556	\$514,041	\$514,041	\$964,284
Lost Business Revenue	\$244,180	\$265,056	\$265,056	\$497,215
Benefit/Cost Ratio	1.08	0.81	1.27	1.51

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,181,832	\$5,542,210	\$5,542,210	\$9,550,020
Costs of Cessation Program	\$4,308,275	\$5,740,224	\$3,978,593	\$5,104,202
Lost Tax Revenue	\$669,454	\$716,012	\$716,012	\$1,233,792
Lost Business Revenue	\$345,192	\$369,199	\$369,199	\$636,182
Benefit/Cost Ratio	0.97	0.81	1.09	1.37

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$4,799,517	\$6,329,985	\$6,329,985	\$14,921,785
Costs of Cessation Program	\$2,682,511	\$4,114,460	\$2,352,829	\$3,478,438
Lost Tax Revenue	\$620,062	\$817,787	\$817,787	\$1,927,784
Lost Business Revenue	\$319,724	\$421,677	\$421,677	\$994,027
Benefit/Cost Ratio	1.32	1.18	1.76	2.33
Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,485,950	\$8,245,989	\$8,245,989	\$18,126,558
Costs of Cessation Program	\$4,308,275	\$5,740,224	\$3,978,593	\$5,104,202
Lost Tax Revenue	\$837,937	\$1,065,321	\$1,065,321	\$2,341,817
Lost Business Revenue	\$432,067	\$549,313	\$549,313	\$1,207,515
Benefit/Cost Ratio	1.16	1.12	1.47	2.09

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Alabama

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Alabama the annual direct costs to the economy attributable to smoking were in excess of \$5.6 billion, including workplace productivity losses of \$1.1 billion, premature death losses of \$2.7 billion, and direct medical expenditures of \$1.7 billion. While the retail price of a pack of cigarettes in Alabama is on average \$4.56, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$16.10 per pack of cigarettes. The ratio of benefits to cost varies from \$0.89 to \$2.79 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the treatment effectiveness range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in AL ¹	846,986
Visiting Smokers in AL ²	29,161
Total Smokers	876,147
Total Packs Sold to Residents	349,081,516
Total Packs Sold to Visitors	12,018,484
Total Packs Sold ³	361,100,000
Average Packs Per Resident Smoker Per Year	412

¹ Data from the Behavioral Risk Factor Surveillance System, Alabama Calculated Variable Data Report, 2005. Retrieved on September 7, 2009 from:

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

² Data from <http://www.alabama.travel/media-room/2008TourismReport.pdf>, 2008 Economic Impact Report: Alabama Travel Industry 2008.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,835,961,990	\$5.26	\$2,167.64
Women	\$888,302,430	\$2.54	\$1,048.78
Combined	\$2,724,264,420	\$7.80	\$3,216.42
Workplace Productivity²			
Current Smokers ³	\$784,203,192	\$2.25	\$925.88
Former Smokers ⁴	\$368,989,247	\$1.06	\$435.65
Combined	\$1,153,192,440	\$3.30	\$1,361.52
Total Productivity Losses	\$3,877,456,860	\$11.11	\$4,577.95

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Alabama. Total expenditures per pack for both medical care and productivity losses are \$16.10 per pack.

Cost Component	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$295,548,442	\$0.85	\$348.94
Hospital Care	\$841,828,555	\$2.41	\$993.91
Rx	\$350,055,327	\$1.00	\$413.30
Nursing Home	\$124,760,203	\$0.36	\$147.30
Other Care	\$128,393,995	\$0.37	\$151.59
Total	\$1,740,586,524	\$4.99	\$2,055.04
Neonatal Expenditures	\$3,029,925	\$0.01	\$3.58
Total Expenditures	\$1,743,616,449	\$4.99	\$2,058.61

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.59
Federal Tax ²	\$1.01
State Tax ²	\$0.425
State Sales Tax ³	\$0.16
Distributor & Retailer Mark-ups ¹	\$0.61
Final Retail Price	\$4.56

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$32,532,230	\$39,165,931	\$39,165,931	\$83,782,056
Costs of Cessation Program	\$19,565,377	\$30,009,561	\$17,160,783	\$25,370,619
Lost Tax Revenue	\$3,220,771	\$3,877,523	\$3,877,523	\$8,294,629
Lost Business Revenue	\$1,233,356	\$1,484,851	\$1,484,851	\$3,176,330
Benefit/Cost Ratio	1.35	1.11	1.74	2.27

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$44,831,882	\$52,460,637	\$52,460,637	\$103,769,182
Costs of Cessation Program	\$31,423,181	\$41,867,365	\$29,018,587	\$37,228,423
Lost Tax Revenue	\$4,438,466	\$5,193,732	\$5,193,732	\$10,273,404
Lost Business Revenue	\$1,699,658	\$1,988,878	\$1,988,878	\$3,934,078
Benefit/Cost Ratio	1.19	1.07	1.45	2.02

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$28,139,877	\$30,545,619	\$30,545,619	\$57,300,198
Costs of Cessation Program	\$19,565,377	\$30,009,561	\$17,160,783	\$25,370,619
Lost Tax Revenue	\$2,785,917	\$3,024,091	\$3,024,091	\$5,672,860
Lost Business Revenue	\$1,066,834	\$1,158,040	\$1,158,040	\$2,172,354
Benefit/Cost Ratio	1.20	0.89	1.43	1.73

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$39,780,675	\$42,547,279	\$42,547,279	\$73,315,044
Costs of Cessation Program	\$31,423,181	\$41,867,365	\$29,018,587	\$37,228,423
Lost Tax Revenue	\$3,938,384	\$4,212,285	\$4,212,285	\$7,258,369
Lost Business Revenue	\$1,508,157	\$1,613,044	\$1,613,044	\$2,779,506
Benefit/Cost Ratio	1.08	0.89	1.22	1.55

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$36,845,660	\$48,594,991	\$48,594,991	\$114,553,821
Costs of Cessation Program	\$19,565,377	\$30,009,561	\$17,160,783	\$25,370,619
Lost Tax Revenue	\$3,647,811	\$4,811,023	\$4,811,023	\$11,341,110
Lost Business Revenue	\$1,396,886	\$1,842,324	\$1,842,324	\$4,342,943
Benefit/Cost Ratio	1.50	1.33	2.04	2.79

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$49,792,325	\$63,304,056	\$63,304,056	\$139,156,711
Costs of Cessation Program	\$31,423,181	\$41,867,365	\$29,018,587	\$37,228,423
Lost Tax Revenue	\$4,929,562	\$6,267,257	\$6,267,257	\$13,776,856
Lost Business Revenue	\$1,887,717	\$2,399,971	\$2,399,971	\$5,275,683
Benefit/Cost Ratio	1.30	1.25	1.68	2.47

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Arkansas

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April 30, 2010

Acknowledgements

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Arkansas the annual direct costs to the economy attributable to smoking were in excess of \$ 3.4 billion, including workplace productivity losses of \$667 million, premature death losses of approximately \$1.7 billion, and direct medical expenditures of \$1 billion. While the retail price of a pack of cigarettes in Arkansas is on average \$5.45, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$16.66 per pack of cigarettes. The ratio of benefits to cost varies from \$0.90 to \$2.54 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the treatment effectiveness range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in AR ¹	483,914
Visiting Smokers in AR ²	31,490
Total Smokers	515,404
Total Packs Sold to Residents	205,056,107
Total Packs Sold to Visitors	13,343,893
Total Packs Sold ³	218,400,000
Average Packs Per Resident Smoker Per Year	424

¹ Data from the Behavioral Risk factor Surveillance System, Arkansas Calculated Variable Data Report, 2005. Retrieved on September 7, 2009 from:

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

² Data from <http://www.arkansas.com/governors-conference/pdfs/APT-10369-INT.pdf>, Economic Impact of Tourism 2008.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,123,676,436	\$5.48	\$2,322.06
Women	\$572,094,881	\$2.79	\$1,182.22
Combined	\$1,695,771,317	\$8.27	\$3,504.28
Workplace Productivity²			
Current Smokers ³	\$453,595,979	\$2.21	\$937.35
Former Smokers ⁴	\$213,429,428	\$1.04	\$441.05
Combined	\$667,025,407	\$3.25	\$1,378.40
Total Productivity Losses	\$2,362,796,724	\$11.52	\$4,882.68

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Arkansas. Total expenditures per pack for both medical care and productivity losses are \$16.66 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$150,196,749	\$0.73	\$310.38
Hospital Care	\$557,181,490	\$2.72	\$1,151.41
Rx	\$174,422,032	\$0.85	\$360.44
Nursing Home	\$93,267,336	\$0.45	\$192.74
Other Care ²	\$75,098,375	\$0.37	\$155.19
Total	\$1,050,165,982	\$5.12	\$2,170.15
Neonatal Expenditures	\$2,878,303	\$0.01	\$5.95
Total Expenditures	\$1,053,044,285	\$5.14	\$2,176.10

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.47
Federal Tax ²	\$1.01
State Tax ²	\$1.15
State Sales Tax ³	\$0.31
Distributor & Retailer Mark-ups ¹	\$0.62
Final Retail Price	\$5.45

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$19,769,343	\$23,800,542	\$23,800,542	\$50,913,085
Costs of Cessation Program	\$11,178,413	\$17,145,557	\$9,804,582	\$14,495,160
Lost Tax Revenue	\$2,929,424	\$3,526,767	\$3,526,767	\$7,544,307
Lost Business Revenue	\$736,773	\$887,009	\$887,009	\$1,897,451
Benefit/Cost Ratio	1.33	1.10	1.67	2.13
Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$27,243,655	\$31,879,534	\$31,879,534	\$63,058,958
Costs of Cessation Program	\$17,953,209	\$23,920,353	\$16,579,378	\$21,269,956
Lost Tax Revenue	\$4,036,968	\$4,723,913	\$4,723,913	\$9,344,084
Lost Business Revenue	\$1,015,329	\$1,188,101	\$1,188,101	\$2,350,109
Benefit/Cost Ratio	1.18	1.07	1.42	1.91

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$17,100,176	\$18,562,110	\$18,562,110	\$34,820,461
Costs of Cessation Program	\$11,178,413	\$17,145,557	\$9,804,582	\$14,495,160
Lost Tax Revenue	\$2,533,906	\$2,750,536	\$2,750,536	\$5,159,700
Lost Business Revenue	\$637,297	\$691,781	\$691,781	\$1,297,704
Benefit/Cost Ratio	1.19	0.90	1.40	1.66

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$24,174,113	\$25,855,336	\$25,855,336	\$44,552,441
Costs of Cessation Program	\$17,953,209	\$23,920,353	\$16,579,378	\$21,269,956
Lost Tax Revenue	\$3,582,123	\$3,831,247	\$3,831,247	\$6,601,786
Lost Business Revenue	\$900,932	\$963,588	\$963,588	\$1,660,400
Benefit/Cost Ratio	1.08	0.90	1.21	1.51

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$22,390,549	\$29,530,439	\$29,530,439	\$69,612,620
Costs of Cessation Program	\$11,178,413	\$17,145,557	\$9,804,582	\$14,495,160
Lost Tax Revenue	\$3,317,834	\$4,375,824	\$4,375,824	\$10,315,207
Lost Business Revenue	\$834,461	\$1,100,553	\$1,100,553	\$2,594,354
Benefit/Cost Ratio	1.46	1.31	1.93	2.54

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$30,258,041	\$38,468,915	\$38,468,915	\$84,563,423
Costs of Cessation Program	\$17,953,209	\$23,920,353	\$16,579,378	\$21,269,956
Lost Tax Revenue	\$4,483,640	\$5,700,329	\$5,700,329	\$12,530,619
Lost Business Revenue	\$1,127,670	\$1,433,677	\$1,433,677	\$3,151,547
Benefit/Cost Ratio	1.28	1.24	1.62	2.29

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Arizona

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Arizona the annual direct costs to the economy attributable to smoking were in excess of \$5 billion, including workplace productivity losses of \$1.2 billion, premature death losses of \$1.9 billion, and direct medical expenditures of \$1.8 billion. While the retail price of a pack of cigarettes in Arizona is on average \$6.38, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$26.57 per pack of cigarettes. The ratio of benefits to cost varies from \$0.80 to \$2.51 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low point of the treatment effectiveness range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in AZ ¹	851,820
Visiting Smokers in AZ ²	49,050
Total Smokers	900,870
Total Packs Sold to Residents	190,339,686
Total Packs Sold to Visitors	10,960,314
Total Packs Sold ³	201,300,000
Average Packs Per Resident Smoker Per Year	223

¹ Data from the Behavioral Risk factor Surveillance System, Arizona Calculated Variable Data Report, 2005. Retrieved on September 7, 2009 from:

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

² Data from <http://www.azot.gov/documents/Arizona%202008%20Tourism%20Facts.pdf>, Arizona 2008 Tourism Facts

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,232,252,146	\$6.47	\$1,446.61
Women	\$677,441,747	\$3.56	\$795.29
Combined	\$1,909,693,894	\$10.03	\$2,241.90
Workplace Productivity²			
Current Smokers ³	\$868,719,041	\$4.56	\$1,019.84
Former Smokers ⁴	\$408,756,287	\$2.15	\$479.86
Combined	\$1,277,475,328	\$6.71	\$1,499.70
Total Productivity Losses	\$3,187,169,221	\$16.74	\$3,741.60

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Arizona. Total expenditures per pack for both medical care and productivity losses are \$26.56 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$347,632,799	\$1.83	\$408.11
Hospital Care	\$976,278,871	\$5.13	\$1,146.11
Rx	\$283,435,801	\$1.49	\$332.74
Nursing Home	\$96,901,129	\$0.51	\$113.76
Other Care ²	\$164,731,919	\$0.87	\$193.39
Total	\$1,867,769,255	\$9.81	\$2,192.68
Neonatal Expenditures	\$2,048,206	\$0.01	\$2.40
Total Expenditures	\$1,869,817,462	\$9.82	\$2,195.09

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$3.35
Federal Tax ²	\$1.01
State Tax ²	\$2.00
State Sales Tax ³	\$0.34
Distributor & Retailer Mark-ups ¹	\$0.67
Final Retail Price	\$6.38

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$29,267,552	\$35,235,547	\$35,235,547	\$75,374,349
Costs of Cessation Program	\$19,677,042	\$30,180,834	\$17,258,725	\$25,515,416
Lost Tax Revenue	\$3,688,525	\$4,440,658	\$4,440,658	\$9,499,262
Lost Business Revenue	\$740,887	\$891,963	\$891,963	\$1,908,048
Benefit/Cost Ratio	1.21	0.99	1.56	2.04

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$40,332,907	\$47,196,101	\$47,196,101	\$93,355,724
Costs of Cessation Program	\$31,602,522	\$42,106,314	\$29,184,205	\$37,440,896
Lost Tax Revenue	\$5,083,067	\$5,948,020	\$5,948,020	\$11,765,415
Lost Business Revenue	\$1,020,999	\$1,194,736	\$1,194,736	\$2,363,234
Benefit/Cost Ratio	1.07	0.96	1.30	1.81

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$25,315,980	\$27,480,302	\$27,480,302	\$51,550,002
Costs of Cessation Program	\$19,677,042	\$30,180,834	\$17,258,725	\$25,515,416
Lost Tax Revenue	\$3,190,517	\$3,463,281	\$3,463,281	\$6,496,732
Lost Business Revenue	\$640,856	\$695,644	\$695,644	\$1,304,952
Benefit/Cost Ratio	1.08	0.80	1.28	1.55

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$35,788,600	\$38,277,569	\$38,277,569	\$65,957,724
Costs of Cessation Program	\$31,602,522	\$42,106,314	\$29,184,205	\$37,440,896
Lost Tax Revenue	\$4,510,358	\$4,824,037	\$4,824,037	\$8,312,505
Lost Business Revenue	\$905,963	\$968,970	\$968,970	\$1,669,673
Benefit/Cost Ratio	0.97	0.80	1.09	1.39

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$33,148,120	\$43,718,380	\$43,718,380	\$103,058,103
Costs of Cessation Program	\$19,677,042	\$30,180,834	\$17,258,725	\$25,515,416
Lost Tax Revenue	\$4,177,584	\$5,509,730	\$5,509,730	\$12,988,184
Lost Business Revenue	\$839,121	\$1,106,700	\$1,106,700	\$2,608,843
Benefit/Cost Ratio	1.34	1.19	1.83	2.51

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$44,795,560	\$56,951,360	\$56,951,360	\$125,192,040
Costs of Cessation Program	\$31,602,522	\$42,106,314	\$29,184,205	\$37,440,896
Lost Tax Revenue	\$5,645,485	\$7,177,453	\$7,177,453	\$15,777,675
Lost Business Revenue	\$1,133,968	\$1,441,683	\$1,441,683	\$3,169,148
Benefit/Cost Ratio	1.17	1.12	1.51	2.22

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for California

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April 30, 2010

Acknowledgements

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Executive Summary

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Results. Results from our model suggested that in California the annual direct costs to the economy attributable to smoking were in excess of \$ 26.8 billion, including workplace productivity losses of approximately \$ 5.7 billion, premature death losses of \$9.5 billion, and direct medical expenditures of \$11.6 billion. While the retail price of a pack of cigarettes in California is on average \$5.17, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$27.07 per pack of cigarettes. The ratio of benefits to cost varies from \$0.92 to \$3.08 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in CA ¹	4,038,869
Visiting Smokers in CA ²	464,117
Total Smokers	4,502,986
Total Packs Sold to Residents	992,902,897
Total Packs Sold to Visitors	114,097,103
Total Packs Sold ³	1,107,000,000
Average Packs Per Resident Smoker Per Year	246

¹ Data from the Behavioral Risk factor Surveillance System, California Calculated Variable Data Report, 2005. Retrieved on September 7, 2009 from:

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

² Data from

[http://tourism.visitcalifornia.com/media/uploads/files/editor/Research/California%20Tourism%20Highlights%20July%2009\(2\).pdf](http://tourism.visitcalifornia.com/media/uploads/files/editor/Research/California%20Tourism%20Highlights%20July%2009(2).pdf), California Tourism Highlights, 2008 Data

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$6,308,582,575	\$10.19	\$2,504.37
Women	\$3,247,667,693	\$8.69	\$2,136.86
Combined	\$9,556,250,268	\$9.62	\$2,366.07
Workplace Productivity²			
Current Smokers ³	\$3,869,217,282	\$3.90	\$958.00
Former Smokers ⁴	\$1,820,573,529	\$1.83	\$450.76
Combined	\$5,689,790,811	\$5.73	\$1,408.76
Total Productivity Losses	\$15,246,041,078	\$15.36	\$3,774.83

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in California. Total expenditures per pack for both medical care and productivity losses are \$27.07 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$2,157,261,377	\$2.17	\$534.13
Hospital Care	\$6,073,278,239	\$6.12	\$1,503.71
Rx	\$1,608,558,736	\$1.62	\$398.27
Nursing Home	\$695,265,598	\$0.70	\$172.14
Other Care ²	\$1,080,447,585	\$1.09	\$267.51
Total	\$11,613,600,271	\$11.70	\$2,875.46
Neonatal Expenditures	\$14,254,455	\$0.01	\$3.53
Total Expenditures	\$11,627,854,726	\$11.71	\$2,878.99

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.23
Federal Tax ²	\$1.01
State Tax ²	\$0.87
State Sales Tax ³	\$0.35
Distributor & Retailer Mark-ups ¹	\$0.58
Final Retail Price	\$5.17

Adjusted for inflation to 2009

¹ 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).

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Treatment	Alone	With Counseling
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Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$155,533,956	\$187,249,141	\$187,249,141	\$400,555,219
Costs of Cessation Program	\$93,297,874	\$143,101,168	\$81,831,525	\$120,980,282
Lost Tax Revenue	\$12,810,870	\$15,423,156	\$15,423,156	\$32,992,545
Lost Business Revenue	\$3,329,694	\$4,008,657	\$4,008,657	\$8,575,145
Benefit/Cost Ratio	1.42	1.15	1.85	2.46

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$214,337,591	\$250,810,055	\$250,810,055	\$496,112,044
Costs of Cessation Program	\$149,842,040	\$199,645,334	\$138,375,691	\$177,524,448
Lost Tax Revenue	\$17,654,352	\$20,658,480	\$20,658,480	\$40,863,277
Lost Business Revenue	\$4,588,571	\$5,369,379	\$5,369,379	\$10,620,840
Benefit/Cost Ratio	1.25	1.11	1.53	2.17

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$134,534,469	\$146,036,130	\$146,036,130	\$273,947,601
Costs of Cessation Program	\$93,297,874	\$143,101,168	\$81,831,525	\$120,980,282
Lost Tax Revenue	\$11,081,205	\$12,028,563	\$12,028,563	\$22,564,251
Lost Business Revenue	\$2,880,134	\$3,126,363	\$3,126,363	\$5,864,711
Benefit/Cost Ratio	1.25	0.92	1.51	1.83
Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$190,188,182	\$203,415,092	\$203,415,092	\$350,513,284
Costs of Cessation Program	\$149,842,040	\$199,645,334	\$138,375,691	\$177,524,448
Lost Tax Revenue	\$15,665,236	\$16,754,698	\$16,754,698	\$28,870,739
Lost Business Revenue	\$4,071,577	\$4,354,740	\$4,354,740	\$7,503,840
Benefit/Cost Ratio	1.12	0.92	1.28	1.64

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$176,156,112	\$232,328,712	\$232,328,712	\$547,672,534
Costs of Cessation Program	\$93,297,874	\$143,101,168	\$81,831,525	\$120,980,282
Lost Tax Revenue	\$14,509,456	\$19,136,227	\$19,136,227	\$45,110,162
Lost Business Revenue	\$3,771,176	\$4,973,727	\$4,973,727	\$11,724,655
Benefit/Cost Ratio	1.58	1.39	2.19	3.08

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$238,053,072	\$302,651,561	\$302,651,561	\$665,296,956
Costs of Cessation Program	\$149,842,040	\$199,645,334	\$138,375,691	\$177,524,448
Lost Tax Revenue	\$19,607,725	\$24,928,511	\$24,928,511	\$54,798,537
Lost Business Revenue	\$5,096,275	\$6,479,209	\$6,479,209	\$14,242,776
Benefit/Cost Ratio	1.36	1.31	1.78	2.70

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Colorado

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Colorado the annual direct costs to the economy attributable to smoking were in excess of \$4.1 billion, including workplace productivity losses of \$1.2 billion, premature death losses of \$1.2 billion, and direct medical expenditures of \$1.6 billion. While the retail price of a pack of cigarettes in Colorado is on average \$4.90, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$19.25 per pack of cigarettes. The ratio of benefits to cost varies from \$0.82 to \$2.66 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had a break-even benefits to costs ratio across the range of treatment effectiveness percentages. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range and an approximate break even at the mid-point of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in CO ¹	684,754
Visiting Smokers in CO ²	67,412
Total Smokers	752,166
Total Packs Sold to Residents	214,302,543
Total Packs Sold to Visitors	21,097,457
Total Packs Sold ³	235,400,000
Average Packs Per Resident Smoker Per Year	313

¹ Data from the Behavioral Risk factor Surveillance System, Colorado Calculated Variable Data Report, 2005. Retrieved on September 7, 2009 from:

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

² Data from <http://www.colorado.com/MediaRoom/NewsReleases.aspx?prid=1225202>, Colorado Travel Year Study 2008 and <http://tinet.ita.doc.gov/view/f-2002-45-540/index.html>, Overseas Visitors to U.S. States 2002

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$811,515,447	\$6.93	\$2,167.76
Women	\$450,501,579	\$4.64	\$1,451.37
Combined	\$1,262,017,026	\$5.89	\$1,843.02
Workplace Productivity²			
Current Smokers ³	\$836,031,077	\$3.90	\$1,220.92
Former Smokers ⁴	\$393,375,698	\$1.84	\$574.48
Combined	\$1,229,406,775	\$5.74	\$1,795.40
Total Productivity Losses	\$2,491,423,800	\$11.63	\$3,638.42

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Colorado. Total expenditures per pack for both medical care and productivity losses are \$19.25 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$307,661,084	\$1.44	\$449.30
Hospital Care	\$869,687,630	\$4.06	\$1,270.07
Rx	\$185,323,409	\$0.86	\$270.64
Nursing Home	\$104,168,713	\$0.49	\$152.13
Other Care ²	\$164,731,919	\$0.77	\$240.57
Total	\$1,631,572,754	\$7.61	\$2,382.71
Neonatal Expenditures	\$2,134,187	\$0.01	\$3.12
Total Expenditures	\$1,633,706,941	\$7.62	\$2,385.83

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.85
Federal Tax ²	\$1.01
State Tax ²	\$0.84
State Sales Tax ³	\$0.00
Distributor & Retailer Mark-ups ¹	\$0.69
Final Retail Price	\$4.90

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$23,874,391	\$28,742,658	\$28,742,658	\$61,485,043
Costs of Cessation Program	\$15,817,817	\$24,261,519	\$13,873,801	\$20,511,121
Lost Tax Revenue	\$2,294,529	\$2,762,411	\$2,762,411	\$5,909,229
Lost Business Revenue	\$859,828	\$1,035,157	\$1,035,157	\$2,214,363
Benefit/Cost Ratio	1.26	1.02	1.63	2.15

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$32,900,722	\$38,499,229	\$38,499,229	\$76,152,972
Costs of Cessation Program	\$25,404,373	\$33,848,075	\$23,460,357	\$30,097,677
Lost Tax Revenue	\$3,162,036	\$3,700,099	\$3,700,099	\$7,318,940
Lost Business Revenue	\$1,184,908	\$1,386,537	\$1,386,537	\$2,742,623
Benefit/Cost Ratio	1.11	0.99	1.35	1.90

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$20,650,980	\$22,416,479	\$22,416,479	\$42,050,832
Costs of Cessation Program	\$15,817,817	\$24,261,519	\$13,873,801	\$20,511,121
Lost Tax Revenue	\$1,984,733	\$2,154,412	\$2,154,412	\$4,041,438
Lost Business Revenue	\$743,738	\$807,322	\$807,322	\$1,514,446
Benefit/Cost Ratio	1.11	0.82	1.33	1.61

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$29,193,799	\$31,224,124	\$31,224,124	\$53,803,629
Costs of Cessation Program	\$25,404,373	\$33,848,075	\$23,460,357	\$30,097,677
Lost Tax Revenue	\$2,805,769	\$3,000,901	\$3,000,901	\$5,170,981
Lost Business Revenue	\$1,051,405	\$1,124,526	\$1,124,526	\$1,937,719
Benefit/Cost Ratio	1.00	0.82	1.13	1.45

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$27,039,883	\$35,662,351	\$35,662,351	\$84,067,484
Costs of Cessation Program	\$15,817,817	\$24,261,519	\$13,873,801	\$20,511,121
Lost Tax Revenue	\$2,598,760	\$3,427,451	\$3,427,451	\$8,079,591
Lost Business Revenue	\$973,832	\$1,284,367	\$1,284,367	\$3,027,662
Benefit/Cost Ratio	1.39	1.23	1.92	2.66

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$36,541,038	\$46,456,876	\$46,456,876	\$102,122,779
Costs of Cessation Program	\$25,404,373	\$33,848,075	\$23,460,357	\$30,097,677
Lost Tax Revenue	\$3,511,901	\$4,464,896	\$4,464,896	\$9,814,857
Lost Business Revenue	\$1,316,013	\$1,673,129	\$1,673,129	\$3,677,917
Benefit/Cost Ratio	1.21	1.16	1.57	2.34

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Connecticut

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April 30, 2010

Acknowledgements

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Connecticut the annual direct costs to the economy attributable to smoking were in excess of \$3.5 billion, including workplace productivity losses of \$654 million, premature death losses of \$1.1 billion, and direct medical expenditures of \$1.7 billion. While the retail price of a pack of cigarettes in Connecticut is on average \$7.45, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$22.94 per pack of cigarettes. The ratio of benefits to cost varies from \$0.97 to \$2.48 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the range of values used for treatment effectiveness. Only brand name bupropion was marginally a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in CT ¹	442,035
Visiting Smokers in CT ²	28,768
Total Smokers	470,803
Total Packs Sold to Residents	155,856,741
Total Packs Sold to Visitors	10,143,259
Total Packs Sold ³	166,000,000
Average Packs Per Resident Smoker Per Year	353

¹ Data from the Behavioral Risk factor Surveillance System, Connecticut Calculated Variable Data Report, 2005. Retrieved on September 7, 2009 from:

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

² Data from http://www.cultureandtourism.org/cct/lib/cct/CCT_Impact_Report_Web_.pdf, The Economic Impact of the Arts, Film, History and Tourism Industries in Connecticut

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$760,084,489	\$9.95	\$3,508.66
Women	\$418,318,757	\$5.26	\$1,855.86
Combined	\$1,178,403,246	\$7.56	\$2,665.86
Workplace Productivity²			
Current Smokers ³	\$444,972,014	\$2.86	\$1,006.64
Former Smokers ⁴	\$209,371,615	\$1.34	\$473.65
Combined	\$654,343,628	\$4.20	\$1,480.30
Total Productivity Losses	\$1,832,746,874	\$11.76	\$4,146.16

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Connecticut. Total expenditures per pack for both medical care and productivity losses are \$22.94 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$264,055,576	\$1.69	\$597.36
Hospital Care	\$775,209,029	\$4.97	\$1,753.73
Rx	\$296,759,707	\$1.90	\$671.35
Nursing Home	\$259,210,519	\$1.66	\$586.40
Other Care ²	\$146,562,957	\$0.94	\$331.56
Total	\$1,741,797,788	\$11.18	\$3,940.41
Neonatal Expenditures	\$1,139,173	\$0.01	\$2.58
Total Expenditures	\$1,742,936,961	\$11.18	\$3,942.98

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$4.43
Federal Tax ²	\$1.01
State Tax ²	\$3.00
State Sales Tax ³	\$0.42
Distributor & Retailer Mark-ups ¹	\$0.66
Final Retail Price	\$7.45

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$20,694,441	\$24,914,279	\$24,914,279	\$53,295,541
Costs of Cessation Program	\$10,211,009	\$15,661,742	\$8,956,071	\$13,240,716
Lost Tax Revenue	\$3,997,681	\$4,812,855	\$4,812,855	\$10,295,450
Lost Business Revenue	\$597,331	\$719,134	\$719,134	\$1,538,340
Benefit/Cost Ratio	1.40	1.18	1.72	2.13

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$28,518,510	\$33,371,323	\$33,371,323	\$66,009,775
Costs of Cessation Program	\$16,399,499	\$21,850,232	\$15,144,561	\$19,429,206
Lost Tax Revenue	\$5,509,108	\$6,446,558	\$6,446,558	\$12,751,542
Lost Business Revenue	\$823,167	\$963,241	\$963,241	\$1,905,327
Benefit/Cost Ratio	1.25	1.14	1.48	1.94

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$17,900,372	\$19,430,716	\$19,430,716	\$36,449,870
Costs of Cessation Program	\$10,211,009	\$15,661,742	\$8,956,071	\$13,240,716
Lost Tax Revenue	\$3,457,932	\$3,753,559	\$3,753,559	\$7,041,261
Lost Business Revenue	\$516,682	\$560,854	\$560,854	\$1,052,101
Benefit/Cost Ratio	1.26	0.97	1.46	1.71

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$25,305,330	\$27,065,226	\$27,065,226	\$46,637,253
Costs of Cessation Program	\$16,399,499	\$21,850,232	\$15,144,561	\$19,429,206
Lost Tax Revenue	\$4,888,397	\$5,228,367	\$5,228,367	\$9,009,224
Lost Business Revenue	\$730,421	\$781,219	\$781,219	\$1,346,153
Benefit/Cost Ratio	1.15	0.97	1.28	1.57

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$23,438,305	\$30,912,303	\$30,912,303	\$72,870,113
Costs of Cessation Program	\$10,211,009	\$15,661,742	\$8,956,071	\$13,240,716
Lost Tax Revenue	\$4,527,731	\$5,971,533	\$5,971,533	\$14,076,798
Lost Business Revenue	\$676,531	\$892,263	\$892,263	\$2,103,346
Benefit/Cost Ratio	1.52	1.37	1.95	2.48

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$31,673,953	\$40,269,052	\$40,269,052	\$88,520,533
Costs of Cessation Program	\$16,399,499	\$21,850,232	\$15,144,561	\$19,429,206
Lost Tax Revenue	\$6,118,665	\$7,779,037	\$7,779,037	\$17,100,092
Lost Business Revenue	\$914,247	\$1,162,339	\$1,162,339	\$2,555,085
Benefit/Cost Ratio	1.35	1.31	1.67	2.26

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for Washington D.C.

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state or district level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using district specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Washington D.C. the annual direct costs to the economy attributable to smoking were in excess of \$875 million, including workplace productivity losses of approximately \$139 million, premature death losses of \$258 million, and direct medical expenditures of \$478 million. While the retail price of a pack of cigarettes in Washington D.C. is on average \$6.99, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$47.53 per pack of cigarettes. The ratio of benefits to cost varies from \$1.30 to \$4.02 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Due to the high cost of premature death for men and the high direct medical expenditures, all therapies exceeded the break-even point at all points along the range of therapy effectiveness. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs in the district greatly outweigh the cost to implement them.

Tables

Table 1: Baseline data on smokers and smoking in Washington, D.C.

Variable	Total
Resident Smokers in DC ¹	90,133
Visiting Smokers in DC ²	21,421
Total Smokers	111,554
Total Packs Sold to Residents	18,421,897
Total Packs Sold to Visitors	4,378,103
Total Packs Sold ³	22,800,000
Average Packs Per Resident Smoker Per Year	204

¹ Data from the Behavioral Risk factor Surveillance System, District of Columbia Calculated Variable Data Report, 2005. Retrieved on September 14, 2009 from:

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

² Data from <http://washington.org/planning/press-room/corporate-and-convention-info/research-and-statistics>, Travel and Tourism in D.C.: General Facts and Figures (2008)

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$176,480,249	\$17.99	\$3,676.83
Women	\$81,843,197	\$9.50	\$1,942.36
Combined	\$258,323,445	\$14.02	\$2,866.03
Workplace Productivity²			
Current Smokers ³	\$94,226,149	\$5.11	\$1,045.41
Former Smokers ⁴	\$44,336,004	\$2.41	\$491.90
Combined	\$138,562,152	\$7.52	\$1,537.31
Total Productivity Losses	\$396,885,597.64	\$21.54	\$4,403.33

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Washington, D.C. Total expenditures per pack for both medical care and productivity losses are \$47.53 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$52,084,357	\$2.83	\$577.86
Hospital Care	\$348,844,063	\$18.94	\$3,870.33
Rx	\$27,859,074	\$1.51	\$309.09
Nursing Home	\$30,281,603	\$1.64	\$335.97
Other Care ²	\$19,380,226	\$1.05	\$215.02
Total	\$478,449,323	\$25.97	\$5,308.26
Neonatal Expenditures	\$297,381	\$0.02	\$3.30
Total Expenditures	\$478,746,704	\$25.99	\$5,311.56

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$3.89
Federal Tax ²	\$1.01
State Tax ²	\$2.50
State Sales Tax ³	\$0.38
Distributor & Retailer Mark-ups ¹	\$0.74
Final Retail Price	\$6.99

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,067,764	\$6,101,140	\$6,101,140	\$13,051,293
Costs of Cessation Program	\$2,082,072	\$3,193,502	\$1,826,185	\$2,699,844
Lost Tax Revenue	\$414,776	\$499,353	\$499,353	\$1,068,195
Lost Business Revenue	\$79,428	\$95,625	\$95,625	\$204,557
Benefit/Cost Ratio	1.97	1.61	2.52	3.29

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,983,763	\$8,172,145	\$8,172,145	\$16,164,822
Costs of Cessation Program	\$3,343,934	\$4,455,364	\$3,088,047	\$3,961,706
Lost Tax Revenue	\$571,592	\$668,857	\$668,857	\$1,323,024
Lost Business Revenue	\$109,458	\$128,084	\$128,084	\$253,356
Benefit/Cost Ratio	1.74	1.56	2.10	2.92

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$4,383,537	\$4,758,296	\$4,758,296	\$8,926,036
Costs of Cessation Program	\$2,082,072	\$3,193,502	\$1,826,185	\$2,699,844
Lost Tax Revenue	\$358,775	\$389,447	\$389,447	\$730,559
Lost Business Revenue	\$68,704	\$74,578	\$74,578	\$139,900
Benefit/Cost Ratio	1.75	1.30	2.08	2.50

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,196,903	\$6,627,875	\$6,627,875	\$11,420,776
Costs of Cessation Program	\$3,343,934	\$4,455,364	\$3,088,047	\$3,961,706
Lost Tax Revenue	\$507,191	\$542,464	\$542,464	\$934,744
Lost Business Revenue	\$97,126	\$103,881	\$103,881	\$179,001
Benefit/Cost Ratio	1.57	1.30	1.77	2.25

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,739,696	\$7,569,968	\$7,569,968	\$17,844,817
Costs of Cessation Program	\$2,082,072	\$3,193,502	\$1,826,185	\$2,699,844
Lost Tax Revenue	\$469,771	\$619,571	\$619,571	\$1,460,525
Lost Business Revenue	\$89,960	\$118,646	\$118,646	\$279,687
Benefit/Cost Ratio	2.17	1.93	2.95	4.02

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$7,756,485	\$9,861,298	\$9,861,298	\$21,677,375
Costs of Cessation Program	\$3,343,934	\$4,455,364	\$3,088,047	\$3,961,706
Lost Tax Revenue	\$634,836	\$807,107	\$807,107	\$1,774,204
Lost Business Revenue	\$121,570	\$154,559	\$154,559	\$339,756
Benefit/Cost Ratio	1.89	1.82	2.44	3.57

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Delaware

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Delaware the annual direct costs to the economy attributable to smoking were in excess of \$1 billion, including workplace productivity losses of approximately \$204 million, premature death losses of \$417 million, and direct medical expenditures of \$430 million. While the retail price of a pack of cigarettes in Delaware is on average \$6.05, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$9.87 per pack of cigarettes. The ratio of benefits to cost varies from \$0.85 to \$1.80 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. The benefits per pack are significantly lower than neighboring states and it is posited that Delaware's lower price per pack and lower state taxes contribute to a large number of packs being sold in Delaware but consumed in neighboring states like Pennsylvania and New Jersey. Nicotine replacement therapies had an approximately break-even benefits to costs ratio at the mid-point. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range of treatment effectiveness percentages. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in DE ¹	130,702
Visiting Smokers in DE ²	10,710
Total Smokers	141,412
Total Packs Sold to Residents	106,567,324
Total Packs Sold to Visitors	8,732,676
Total Packs Sold ³	115,300,000
Average Packs Per Resident Smoker Per Year	815

¹ Data from the Behavioral Risk factor Surveillance System, Delaware Calculated Variable Data Report, 2005. Retrieved on September 14, 2009 from:

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

² Data from <http://dedo.delaware.gov/DEBarometer06.pdf>, Delaware Travel Barometer.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$283,433,019	\$5.11	\$4,162.38
Women	\$134,332,644	\$2.63	\$2,145.58
Combined	\$417,765,663	\$3.92	\$3,196.32
Workplace Productivity²			
Current Smokers ³	\$138,641,199	\$1.30	\$1,060.74
Former Smokers ⁴	\$65,234,511	\$0.61	\$499.11
Combined	\$203,875,709	\$1.91	\$1,559.85
Total Productivity Losses	\$621,641,372	\$5.83	\$4,756.17

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Delaware. Total expenditures per pack for both medical care and productivity losses are \$9.87 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$70,253,318	\$0.66	\$537.51
Hospital Care	\$211,971,219	\$1.99	\$1,621.79
Rx	\$72,675,847	\$0.68	\$556.04
Nursing Home	\$38,760,451	\$0.36	\$296.56
Other Care ²	\$35,126,659	\$0.33	\$268.75
Total	\$429,998,758	\$4.03	\$3,289.92
Neonatal Expenditures	\$675,590	\$0.01	\$5.17
Total Expenditures	\$430,674,348	\$4.04	\$3,295.09

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.61
Federal Tax ²	\$1.01
State Tax ²	\$1.60
State Sales Tax ³	\$0.00
Distributor & Retailer Mark-ups ¹	\$1.08
Final Retail Price	\$6.05

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	Alone	With Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,090,327	\$7,332,216	\$7,332,216	\$15,684,758
Costs of Cessation Program	\$3,019,216	\$4,630,903	\$2,648,153	\$3,915,048
Lost Tax Revenue	\$1,609,753	\$1,938,000	\$1,938,000	\$4,145,685
Lost Business Revenue	\$663,692	\$799,027	\$799,027	\$1,709,244
Benefit/Cost Ratio	1.15	1.00	1.36	1.61
Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$8,392,933	\$9,821,105	\$9,821,105	\$19,426,529
Costs of Cessation Program	\$4,849,044	\$6,460,731	\$4,477,981	\$5,744,876
Lost Tax Revenue	\$2,218,361	\$2,595,846	\$2,595,846	\$5,134,684
Lost Business Revenue	\$914,619	\$1,070,253	\$1,070,253	\$2,117,003
Benefit/Cost Ratio	1.05	0.97	1.21	1.49

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,268,039	\$5,718,416	\$5,718,416	\$10,727,115
Costs of Cessation Program	\$3,019,216	\$4,630,903	\$2,648,153	\$3,915,048
Lost Tax Revenue	\$1,392,411	\$1,511,452	\$1,511,452	\$2,835,316
Lost Business Revenue	\$574,084	\$623,164	\$623,164	\$1,168,986
Benefit/Cost Ratio	1.06	0.85	1.20	1.35

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$7,447,302	\$7,965,235	\$7,965,235	\$13,725,239
Costs of Cessation Program	\$4,849,044	\$6,460,731	\$4,477,981	\$5,744,876
Lost Tax Revenue	\$1,968,419	\$2,105,315	\$2,105,315	\$3,627,759
Lost Business Revenue	\$811,569	\$868,010	\$868,010	\$1,495,706
Benefit/Cost Ratio	0.98	0.84	1.07	1.26

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,897,840	\$9,097,421	\$9,097,421	\$21,445,511
Costs of Cessation Program	\$3,019,216	\$4,630,903	\$2,648,153	\$3,915,048
Lost Tax Revenue	\$1,823,189	\$2,404,567	\$2,404,567	\$5,668,327
Lost Business Revenue	\$751,691	\$991,390	\$991,390	\$2,337,021
Benefit/Cost Ratio	1.23	1.13	1.51	1.80

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$9,321,573	\$11,851,091	\$11,851,091	\$26,051,394
Costs of Cessation Program	\$4,849,044	\$6,460,731	\$4,477,981	\$5,744,876
Lost Tax Revenue	\$2,463,813	\$3,132,397	\$3,132,397	\$6,885,722
Lost Business Revenue	\$1,015,817	\$1,291,471	\$1,291,471	\$2,838,947
Benefit/Cost Ratio	1.12	1.09	1.33	1.68

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Florida

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Florida the annual direct costs to the economy attributable to smoking were in excess of \$19.6 billion, including workplace productivity losses of \$4.4 billion, premature death losses of \$7.9 billion, and direct medical expenditures of \$7.2 billion. While the retail price of a pack of cigarettes in Florida is on average \$5.63, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$16.43 per pack of cigarettes. The ratio of benefits to cost varies from \$0.86 to \$2.40 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had an approximately break-even benefits to costs ratio at the mid-point of the effectiveness range. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the treatment effectiveness range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in FL ¹	2,909,729
Visiting Smokers in FL ²	111,335
Total Smokers	3,021,064
Total Packs Sold to Residents	1,192,857,583
Total Packs Sold to Visitors	45,642,417
Total Packs Sold ³	1,238,500,000
Average Packs Per Resident Smoker Per Year	410

¹ Data from the Behavioral Risk factor Surveillance System, Florida Calculated Variable Data Report, 2005. Retrieved on September 14, 2009 from:

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

² Data from <http://media.visitflorida.org/research.php>, VISIT FLORIDA Research.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$5,242,971,958	\$7.98	\$3,275.99
Women	\$2,697,964,615	\$5.02	\$2,060.61
Combined	\$7,940,936,572	\$6.65	\$2,729.10
Workplace Productivity²			
Current Smokers ³	\$2,995,854,132	\$2.51	\$1,029.60
Former Smokers ⁴	\$1,409,632,060	\$1.18	\$484.45
Combined	\$4,405,486,192	\$3.69	\$1,514.05
Total Productivity Losses	\$12,346,422,765	\$10.33	\$4,243.15

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Florida. Total expenditures per pack for both medical care and productivity losses are \$16.42 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$1,279,094,898	\$1.07	\$439.59
Hospital Care	\$3,479,961,783	\$2.91	\$1,195.97
Rx	\$1,299,686,388	\$1.09	\$446.67
Nursing Home	\$604,420,790	\$0.51	\$207.72
Other Care ²	\$609,265,847	\$0.51	\$209.39
Total	\$7,272,429,707	\$6.09	\$2,499.35
Neonatal Expenditures	\$8,093,784	\$0.01	\$2.78
Total Expenditures	\$7,280,523,491	\$6.09	\$2,502.13

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.67
Federal Tax ²	\$1.01
State Tax ²	\$1.34
State Sales Tax ³	\$0.32
Distributor & Retailer Mark-ups ¹	\$0.60
Final Retail Price	\$5.63

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

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 ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$113,591,889	\$136,754,598	\$136,754,598	\$292,539,489
Costs of Cessation Program	\$67,214,740	\$103,094,608	\$58,954,019	\$87,158,022
Lost Tax Revenue	\$18,447,126	\$22,208,710	\$22,208,710	\$47,507,906
Lost Business Revenue	\$4,150,191	\$4,996,463	\$4,996,463	\$10,688,216
Benefit/Cost Ratio	1.26	1.05	1.59	2.01

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$156,538,241	\$183,175,357	\$183,175,357	\$362,327,982
Costs of Cessation Program	\$107,950,946	\$143,830,814	\$99,690,225	\$127,894,228
Lost Tax Revenue	\$25,421,539	\$29,747,360	\$29,747,360	\$58,841,436
Lost Business Revenue	\$5,719,278	\$6,692,491	\$6,692,491	\$13,238,007
Benefit/Cost Ratio	1.13	1.02	1.35	1.81

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$98,255,229	\$106,655,295	\$106,655,295	\$200,073,517
Costs of Cessation Program	\$67,214,740	\$103,094,608	\$58,954,019	\$87,158,022
Lost Tax Revenue	\$15,956,479	\$17,320,635	\$17,320,635	\$32,491,592
Lost Business Revenue	\$3,589,851	\$3,896,755	\$3,896,755	\$7,309,882
Benefit/Cost Ratio	1.13	0.86	1.33	1.58

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$138,901,083	\$148,561,158	\$148,561,158	\$255,992,114
Costs of Cessation Program	\$107,950,946	\$143,830,814	\$99,690,225	\$127,894,228
Lost Tax Revenue	\$22,557,295	\$24,126,075	\$24,126,075	\$41,572,676
Lost Business Revenue	\$5,074,887	\$5,427,827	\$5,427,827	\$9,352,922
Benefit/Cost Ratio	1.02	0.86	1.15	1.43

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$128,652,971	\$169,677,786	\$169,677,786	\$399,984,411
Costs of Cessation Program	\$67,214,740	\$103,094,608	\$58,954,019	\$87,158,022
Lost Tax Revenue	\$20,893,020	\$27,555,378	\$27,555,378	\$64,956,775
Lost Business Revenue	\$4,700,462	\$6,199,344	\$6,199,344	\$14,613,822
Benefit/Cost Ratio	1.39	1.24	1.83	2.40

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$173,858,486	\$221,037,023	\$221,037,023	\$485,889,642
Costs of Cessation Program	\$107,950,946	\$143,830,814	\$99,690,225	\$127,894,228
Lost Tax Revenue	\$28,234,317	\$35,896,029	\$35,896,029	\$78,907,636
Lost Business Revenue	\$6,352,090	\$8,075,804	\$8,075,804	\$17,752,453
Benefit/Cost Ratio	1.22	1.18	1.54	2.16

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Georgia

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April 30, 2010

Acknowledgements

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Georgia the annual direct costs to the economy attributable to smoking were in excess of \$9 billion, including workplace productivity losses of \$2.4 billion, premature death losses of \$3.7 billion, and direct medical expenditures of \$2.9 billion. While the retail price of a pack of cigarettes in Georgia is on average \$4.53, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$16.06 per pack of cigarettes. The ratio of benefits to cost varies from \$0.85 to \$2.70 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in GA ¹	1,443,667
Visiting Smokers in GA ²	63,469
Total Smokers	1,507,136
Total Packs Sold to Residents	563,429,527
Total Packs Sold to Visitors	24,770,473
Total Packs Sold ³	588,200,000
Average Packs Per Resident Smoker Per Year	390

¹ Data from the Behavioral Risk factor Surveillance System, Georgia Calculated Variable Data Report, 2005. Retrieved on September 14, 2009 from:

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

² Data from

http://gov.georgia.gov/00/press/detail/0,2668,78006749_92321069_92696610,00.html, Georgia TIA Economic Impact Report.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$2,534,526,944	\$8.16	\$3,184.94
Women	\$1,173,976,220	\$4.64	\$1,812.02
Combined	\$3,708,503,163	\$6.58	\$2,568.81
Workplace Productivity²			
Current Smokers ³	\$1,661,215,793	\$2.95	\$1,150.69
Former Smokers ⁴	\$781,647,883	\$1.39	\$541.43
Combined	\$2,442,863,677	\$4.34	\$1,692.12
Total Productivity Losses	\$6,151,366,840	\$10.92	\$4,260.93

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Georgia. Total expenditures per pack for both medical care and productivity losses are \$16.06 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$467,547,946	\$0.83	\$323.86
Hospital Care	\$1,489,854,853	\$2.64	\$1,031.99
Rx	\$514,787,246	\$0.91	\$356.58
Nursing Home	\$185,323,409	\$0.33	\$128.37
Other Care ²	\$233,773,973	\$0.41	\$161.93
Total	\$2,891,287,427	\$5.13	\$2,002.74
Neonatal Expenditures	\$5,044,284	\$0.01	\$3.49
Total Expenditures	\$2,896,331,711	\$5.14	\$2,006.23

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.54
Federal Tax ²	\$1.01
State Tax ²	\$0.37
State Sales Tax ³	\$0.16
Distributor & Retailer Mark-ups ¹	\$0.63
Final Retail Price	\$4.53

Adjusted for inflation to 2009

¹ Data from the Behavioral Risk Factor Surveillance System, Minnesota Calculated Variable Data Report, 2005. Retrieved on September 28, 2009 from:

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

² Data from

http://www.tourismroi.com/Content_Attachments/26124/File_633480214451131154.pdf, 2008 Explore Minnesota Tourism.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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

Treatment	Alone	With Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$52,363,988	\$63,041,615	\$63,041,615	\$134,855,880
Costs of Cessation Program	\$33,348,708	\$51,150,565	\$29,250,137	\$43,243,601
Lost Tax Revenue	\$5,021,785	\$6,045,786	\$6,045,786	\$12,932,882
Lost Business Revenue	\$2,058,159	\$2,477,842	\$2,477,842	\$5,300,491
Benefit/Cost Ratio	1.30	1.06	1.67	2.19

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$72,161,548	\$84,440,819	\$84,440,819	\$167,027,224
Costs of Cessation Program	\$53,560,046	\$71,361,903	\$49,461,475	\$63,454,939
Lost Tax Revenue	\$6,920,401	\$8,098,002	\$8,098,002	\$16,018,162
Lost Business Revenue	\$2,836,299	\$3,318,934	\$3,318,934	\$6,564,981
Benefit/Cost Ratio	1.14	1.02	1.39	1.94

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$45,294,040	\$49,166,332	\$49,166,332	\$92,230,592
Costs of Cessation Program	\$33,348,708	\$51,150,565	\$29,250,137	\$43,243,601
Lost Tax Revenue	\$4,343,767	\$4,715,125	\$4,715,125	\$8,845,053
Lost Business Revenue	\$1,780,276	\$1,932,476	\$1,932,476	\$3,625,110
Benefit/Cost Ratio	1.15	0.85	1.37	1.66

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$64,031,109	\$68,484,244	\$68,484,244	\$118,008,143
Costs of Cessation Program	\$53,560,046	\$71,361,903	\$49,461,475	\$63,454,939
Lost Tax Revenue	\$6,140,680	\$6,567,742	\$6,567,742	\$11,317,159
Lost Business Revenue	\$2,516,734	\$2,691,764	\$2,691,764	\$4,638,293
Benefit/Cost Ratio	1.03	0.85	1.17	1.49

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$59,306,898	\$78,218,661	\$78,218,661	\$184,386,217
Costs of Cessation Program	\$33,348,708	\$51,150,565	\$29,250,137	\$43,243,601
Lost Tax Revenue	\$5,687,621	\$7,501,287	\$7,501,287	\$17,682,916
Lost Business Revenue	\$2,331,049	\$3,074,373	\$3,074,373	\$7,247,274
Benefit/Cost Ratio	1.43	1.27	1.96	2.70

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$80,145,895	\$101,894,422	\$101,894,422	\$223,987,112
Costs of Cessation Program	\$53,560,046	\$71,361,903	\$49,461,475	\$63,454,939
Lost Tax Revenue	\$7,686,112	\$9,771,829	\$9,771,829	\$21,480,701
Lost Business Revenue	\$3,150,123	\$4,004,946	\$4,004,946	\$8,803,782
Benefit/Cost Ratio	1.24	1.20	1.61	2.39

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for Hawaii

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Hawaii the annual direct costs to the economy attributable to smoking were in excess of \$1.1 billion, including workplace productivity losses of \$215 million, premature death losses of \$449 million, and direct medical expenditures of \$444 million. While the retail price of a pack of cigarettes in Hawaii is on average \$7.45, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$23.26 per pack of cigarettes. The ratio of benefits to cost varies from \$0.84 to \$2.28 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in HI ¹	165,945
Visiting Smokers in HI ²	30,594
Total Smokers	196,539
Total Packs Sold to Residents	47,704,916
Total Packs Sold to Visitors	8,795,084
Total Packs Sold ³	56,500,000
Average Packs Per Resident Smoker Per Year	287

¹ Data from the Behavioral Risk factor Surveillance System, Hawaii Calculated Variable Data Report, 2005. Retrieved on September 14, 2009 from:

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

² Data from <http://hawaii.gov/dbedt/info/visitor-stats/visitor-research/2007-annual-research.pdf>, 2007 Annual Visitor Research Report.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$324,516,457	\$12.15	\$3,494.05
Women	\$125,132,198	\$5.96	\$1,712.54
Combined	\$449,648,655	\$9.43	\$2,709.62
Workplace Productivity²			
Current Smokers ³	\$146,361,577	\$3.07	\$881.99
Former Smokers ⁴	\$68,867,162	\$1.44	\$415.00
Combined	\$215,228,739	\$4.51	\$1,296.99
Total Productivity Losses	\$664,877,394	\$13.94	\$4,006.61

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Hawaii. Total expenditures per pack for both medical care and productivity losses are \$23.26 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$62,985,734	\$1.32	\$379.56
Hospital Care	\$251,942,935	\$5.28	\$1,518.23
Rx	\$514,787,246	\$10.79	\$3,102.16
Nursing Home	\$23,014,018	\$0.48	\$138.68
Other Care ²	\$38,760,451	\$0.81	\$233.57
Total	\$444,533,928	\$9.32	\$2,678.80
Neonatal Expenditures	\$168,930	\$0.00	\$1.02
Total Expenditures	\$444,702,858	\$9.32	\$2,679.82

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$3.90
Federal Tax ²	\$1.01
State Tax ²	\$2.60
State Sales Tax ³	\$0.29
Distributor & Retailer Mark-ups ¹	\$1.19
Final Retail Price	\$7.45

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,421,749	\$7,731,218	\$7,731,218	\$16,538,285
Costs of Cessation Program	\$3,833,330	\$5,879,597	\$3,362,212	\$4,970,717
Lost Tax Revenue	\$1,075,764	\$1,295,125	\$1,295,125	\$2,770,474
Lost Business Revenue	\$328,527	\$395,517	\$395,517	\$846,073
Benefit/Cost Ratio	1.23	1.02	1.53	1.93

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$8,849,657	\$10,355,547	\$10,355,547	\$20,483,674
Costs of Cessation Program	\$6,156,560	\$8,202,827	\$5,685,442	\$7,293,947
Lost Tax Revenue	\$1,482,484	\$1,734,749	\$1,734,749	\$3,431,401
Lost Business Revenue	\$452,735	\$529,773	\$529,773	\$1,047,913
Benefit/Cost Ratio	1.09	0.99	1.30	1.74

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,554,713	\$6,029,599	\$6,029,599	\$11,310,859
Costs of Cessation Program	\$3,833,330	\$5,879,597	\$3,362,212	\$4,970,717
Lost Tax Revenue	\$930,519	\$1,010,071	\$1,010,071	\$1,894,782
Lost Business Revenue	\$284,170	\$308,465	\$308,465	\$578,646
Benefit/Cost Ratio	1.10	0.84	1.29	1.52

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$7,852,566	\$8,398,684	\$8,398,684	\$14,472,134
Costs of Cessation Program	\$6,156,560	\$8,202,827	\$5,685,442	\$7,293,947
Lost Tax Revenue	\$1,315,453	\$1,406,938	\$1,406,938	\$2,424,355
Lost Business Revenue	\$401,725	\$429,663	\$429,663	\$740,372
Benefit/Cost Ratio	1.00	0.84	1.12	1.38

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$7,273,205	\$9,592,482	\$9,592,482	\$22,612,525
Costs of Cessation Program	\$3,833,330	\$5,879,597	\$3,362,212	\$4,970,717
Lost Tax Revenue	\$1,218,399	\$1,606,921	\$1,606,921	\$3,788,023
Lost Business Revenue	\$372,086	\$490,736	\$490,736	\$1,156,821
Benefit/Cost Ratio	1.34	1.20	1.76	2.28

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$9,828,831	\$12,496,000	\$12,496,000	\$27,469,049
Costs of Cessation Program	\$6,156,560	\$8,202,827	\$5,685,442	\$7,293,947
Lost Tax Revenue	\$1,646,514	\$2,093,315	\$2,093,315	\$4,601,583
Lost Business Revenue	\$502,828	\$639,276	\$639,276	\$1,405,273
Benefit/Cost Ratio	1.18	1.14	1.48	2.07

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Iowa

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Iowa the annual direct costs to the economy attributable to smoking were in excess of \$2.9 billion, including workplace productivity losses of \$711 million, premature death losses of \$1.1 billion, and direct medical expenditures of \$1 billion. While the retail price of a pack of cigarettes in Iowa is on average \$5.54, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$18.83 per pack of cigarettes. The ratio of benefits to cost varies from \$0.85 to \$2.53 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had an approximately break-even benefits to costs ratio at the mid-point of the treatment effectiveness range. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in IA ¹	460,709
Visiting Smokers in IA ²	39,139
Total Smokers	499,848
Total Packs Sold to Residents	158,624,189
Total Packs Sold to Visitors	13,475,811
Total Packs Sold ³	172,100,000
Average Packs Per Resident Smoker Per Year	344

¹ Data from the Behavioral Risk factor Surveillance System, Iowa Calculated Variable Data Report, 2005. Retrieved on September 21, 2009 from:

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

² Data from http://www.travelfederationofiowa.org/files/tourism_fast_facts_WEB.pdf, 2007 Tourism Fast Facts Booklet.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$786,283,216	\$9.58	\$3,298.47
Women	\$392,410,774	\$5.13	\$1,764.98
Combined	\$1,178,693,990	\$7.43	\$2,558.43
Workplace Productivity²			
Current Smokers ³	\$484,011,419	\$3.05	\$1,050.58
Former Smokers ⁴	\$227,740,732	\$1.44	\$494.33
Combined	\$711,752,151	\$4.49	\$1,544.91
Total Productivity Losses	\$1,890,446,141	\$11.92	\$4,103.34

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Iowa. Total expenditures per pack for both medical care and productivity losses are \$18.84 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$148,985,485	\$0.94	\$323.38
Hospital Care	\$581,406,772	\$3.67	\$1,261.98
Rx	\$161,098,126	\$1.02	\$349.67
Nursing Home	\$132,027,788	\$0.83	\$286.58
Other Care ²	\$71,464,582	\$0.45	\$155.12
Total	\$1,094,982,754	\$6.90	\$2,376.73
Neonatal Expenditures	\$2,114,509	\$0.01	\$4.59
Total Expenditures	\$1,097,097,263	\$6.92	\$2,381.32

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.68
Federal Tax ²	\$1.01
State Tax ²	\$1.36
State Sales Tax ³	\$0.31
Distributor & Retailer Mark-ups ¹	\$0.50
Final Retail Price	\$5.54

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	Alone	With Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$17,290,550	\$20,816,295	\$20,816,295	\$44,529,312
Costs of Cessation Program	\$10,642,378	\$16,323,381	\$9,334,425	\$13,800,077
Lost Tax Revenue	\$2,463,617	\$2,965,977	\$2,965,977	\$6,344,689
Lost Business Revenue	\$455,953	\$548,927	\$548,927	\$1,174,241
Benefit/Cost Ratio	1.27	1.05	1.62	2.09

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$23,827,690	\$27,882,296	\$27,882,296	\$55,152,267
Costs of Cessation Program	\$17,092,304	\$22,773,307	\$15,784,351	\$20,250,003
Lost Tax Revenue	\$3,395,051	\$3,972,765	\$3,972,765	\$7,858,283
Lost Business Revenue	\$628,338	\$735,258	\$735,258	\$1,454,369
Benefit/Cost Ratio	1.13	1.01	1.36	1.87

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$14,956,059	\$16,234,687	\$16,234,687	\$30,454,474
Costs of Cessation Program	\$10,642,378	\$16,323,381	\$9,334,425	\$13,800,077
Lost Tax Revenue	\$2,130,990	\$2,313,174	\$2,313,174	\$4,339,257
Lost Business Revenue	\$394,392	\$428,110	\$428,110	\$803,087
Benefit/Cost Ratio	1.14	0.85	1.34	1.61

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$21,143,025	\$22,613,447	\$22,613,447	\$38,966,202
Costs of Cessation Program	\$17,092,304	\$22,773,307	\$15,784,351	\$20,250,003
Lost Tax Revenue	\$3,012,530	\$3,222,041	\$3,222,041	\$5,552,038
Lost Business Revenue	\$557,543	\$596,318	\$596,318	\$1,027,542
Benefit/Cost Ratio	1.02	0.85	1.15	1.45

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$19,583,094	\$25,827,744	\$25,827,744	\$60,884,193
Costs of Cessation Program	\$10,642,378	\$16,323,381	\$9,334,425	\$13,800,077
Lost Tax Revenue	\$2,790,266	\$3,680,025	\$3,680,025	\$8,674,988
Lost Business Revenue	\$516,408	\$681,080	\$681,080	\$1,605,521
Benefit/Cost Ratio	1.40	1.25	1.89	2.53

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$26,464,116	\$33,645,463	\$33,645,463	\$73,960,380
Costs of Cessation Program	\$17,092,304	\$22,773,307	\$15,784,351	\$20,250,003
Lost Tax Revenue	\$3,770,698	\$4,793,921	\$4,793,921	\$10,538,127
Lost Business Revenue	\$697,861	\$887,233	\$887,233	\$1,950,341
Benefit/Cost Ratio	1.23	1.18	1.57	2.26

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Idaho

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April 30, 2010

Acknowledgements

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Idaho the annual direct costs to the economy attributable to smoking were in excess of \$1 billion, including workplace productivity losses of \$288 million, premature death losses of \$411 million, and direct medical expenditures of \$396 million. While the retail price of a pack of cigarettes in Idaho is on average \$4.79, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$15.52 per pack of cigarettes. The ratio of benefits to cost varies from \$0.80 to \$2.49 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in ID ¹	182,801
Visiting Smokers in ID ²	33,982
Total Smokers	216,783
Total Packs Sold to Residents	70,663,742
Total Packs Sold to Visitors	13,136,258
Total Packs Sold ³	83,800,000
Average Packs Per Resident Smoker Per Year	387

¹ Data from the Behavioral Risk factor Surveillance System, Idaho Calculated Variable Data Report, 2005. Retrieved on September 21, 2009 from:

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

² Data from http://commerce.idaho.gov/assets/content/docs/2005_Idaho_Visitor_Profile.pdf, Idaho 2005 Visitor Profile Public Version.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$289,477,307	\$7.54	\$2,913.24
Women	\$121,936,289	\$3.78	\$1,461.45
Combined	\$411,413,596	\$5.82	\$2,250.61
Workplace Productivity²			
Current Smokers ³	\$196,088,018	\$2.77	\$1,072.69
Former Smokers ⁴	\$92,264,825	\$1.31	\$504.73
Combined	\$288,352,843	\$4.08	\$1,577.41
Total Productivity Losses	\$699,766,439	\$9.90	\$3,828.02

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Idaho. Total expenditures per pack for both medical care and productivity losses are \$15.52 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$55,718,149	\$0.79	\$304.80
Hospital Care	\$207,126,163	\$2.93	\$1,133.07
Rx	\$66,619,526	\$0.94	\$364.44
Nursing Home	\$29,070,339	\$0.41	\$159.03
Other Care ²	\$38,760,451	\$0.55	\$212.04
Total	\$396,083,363	\$5.61	\$2,166.75
Neonatal Expenditures	\$811,861	\$0.01	\$4.44
Total Expenditures	\$396,895,224	\$5.62	\$2,171.19

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.85
Federal Tax ²	\$1.01
State Tax ²	\$0.57
State Sales Tax ³	\$0.27
Distributor & Retailer Mark-ups ¹	\$0.58
Final Retail Price	\$4.79

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	Alone	With Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,346,982	\$7,641,205	\$7,641,205	\$16,345,734
Costs of Cessation Program	\$4,222,703	\$6,476,822	\$3,703,731	\$5,475,621
Lost Tax Revenue	\$757,049	\$911,420	\$911,420	\$1,949,671
Lost Business Revenue	\$236,970	\$285,291	\$285,291	\$610,283
Benefit/Cost Ratio	1.22	1.00	1.56	2.03

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$8,746,622	\$10,234,979	\$10,234,979	\$20,245,188
Costs of Cessation Program	\$6,781,917	\$9,036,036	\$6,262,945	\$8,034,835
Lost Tax Revenue	\$1,043,271	\$1,220,798	\$1,220,798	\$2,414,786
Lost Business Revenue	\$326,563	\$382,132	\$382,132	\$755,873
Benefit/Cost Ratio	1.07	0.96	1.30	1.81

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,490,041	\$5,959,397	\$5,959,397	\$11,179,169
Costs of Cessation Program	\$4,222,703	\$6,476,822	\$3,703,731	\$5,475,621
Lost Tax Revenue	\$654,836	\$710,819	\$710,819	\$1,333,418
Lost Business Revenue	\$204,976	\$222,500	\$222,500	\$417,385
Benefit/Cost Ratio	1.08	0.80	1.29	1.55

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$7,761,141	\$8,300,900	\$8,300,900	\$14,303,638
Costs of Cessation Program	\$6,781,917	\$9,036,036	\$6,262,945	\$8,034,835
Lost Tax Revenue	\$925,726	\$990,107	\$990,107	\$1,706,096
Lost Business Revenue	\$289,769	\$309,922	\$309,922	\$534,040
Benefit/Cost Ratio	0.97	0.80	1.10	1.39

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$7,188,524	\$9,480,799	\$9,480,799	\$22,349,252
Costs of Cessation Program	\$4,222,703	\$6,476,822	\$3,703,731	\$5,475,621
Lost Tax Revenue	\$857,426	\$1,130,842	\$1,130,842	\$2,665,753
Lost Business Revenue	\$268,390	\$353,974	\$353,974	\$834,430
Benefit/Cost Ratio	1.34	1.19	1.83	2.49

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$9,714,396	\$12,350,512	\$12,350,512	\$27,149,233
Costs of Cessation Program	\$6,781,917	\$9,036,036	\$6,262,945	\$8,034,835
Lost Tax Revenue	\$1,158,705	\$1,473,133	\$1,473,133	\$3,238,281
Lost Business Revenue	\$362,696	\$461,118	\$461,118	\$1,013,642
Benefit/Cost Ratio	1.17	1.13	1.51	2.21

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Illinois

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Illinois the annual direct costs to the economy attributable to smoking were in excess of \$12.7 billion, including workplace productivity losses of \$2.9 billion, premature death losses of \$5 billion, and direct medical expenditures of \$4.8 billion. While the retail price of a pack of cigarettes in Illinois is on average \$6.07, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$21.99 per pack of cigarettes. The ratio of benefits to cost varies from \$0.88 to \$2.58 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in IL ¹	1,892,886
Visiting Smokers in IL ²	118,740
Total Smokers	2,011,626
Total Packs Sold to Residents	579,733,559
Total Packs Sold to Visitors	36,366,441
Total Packs Sold ³	616,100,000
Average Packs Per Resident Smoker Per Year	306

¹ Data from the Behavioral Risk factor Surveillance System, Illinois Calculated Variable Data Report, 2005. Retrieved on September 21, 2009 from:

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

² Data from <http://www.enjoyillinois.com/illinoismediacenter/fastfacts.aspx>, 2007 Illinois Tourism Visitor Information.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$3,364,229,768	\$11.30	\$3,461.82
Women	\$1,636,347,180	\$5.80	\$1,776.56
Combined	\$5,000,576,948	\$8.63	\$2,641.77
Workplace Productivity²			
Current Smokers ³	\$1,998,301,476	\$3.45	\$1,055.69
Former Smokers ⁴	\$940,256,001	\$1.62	\$496.73
Combined	\$2,938,557,477	\$5.07	\$1,552.42
Total Productivity Losses	\$7,939,134,425	\$13.69	\$4,194.20

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

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Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$720,702,144	\$1.24	\$380.74
Hospital Care	\$2,561,823,589	\$4.42	\$1,353.40
Rx	\$741,293,634	\$1.28	\$391.62
Nursing Home	\$433,632,551	\$0.75	\$229.09
Other Care ²	\$346,421,535	\$0.60	\$183.01
Total	\$4,802,662,190	\$8.28	\$2,537.22
Neonatal Expenditures	\$7,827,219	\$0.01	\$4.14
Total Expenditures	\$4,810,489,409	\$8.30	\$2,541.35

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

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 ¹	\$2.36
Total Taxes	\$2.35
Federal Tax ²	\$1.01
State Tax ²	\$0.98
State Sales Tax ³	\$0.36
Distributor & Retailer Mark-ups ¹	\$1.37
Final Retail Price	\$6.07

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	<i>Baseline</i>	<i>Low</i>	<i>High</i>
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Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$73,789,057	\$88,835,505	\$88,835,505	\$190,033,049
Costs of Cessation Program	\$43,725,667	\$67,066,844	\$38,351,763	\$56,699,507
Lost Tax Revenue	\$7,875,351	\$9,481,227	\$9,481,227	\$20,281,829
Lost Business Revenue	\$4,582,599	\$5,517,045	\$5,517,045	\$11,801,822
Benefit/Cost Ratio	1.31	1.08	1.67	2.14

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$101,686,919	\$118,990,334	\$118,990,334	\$235,367,510
Costs of Cessation Program	\$70,226,071	\$93,567,248	\$64,852,167	\$83,199,911
Lost Tax Revenue	\$10,852,832	\$12,699,589	\$12,699,589	\$25,120,281
Lost Business Revenue	\$6,315,169	\$7,389,782	\$7,389,782	\$14,617,276
Benefit/Cost Ratio	1.16	1.05	1.40	1.91

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$63,826,394	\$69,283,060	\$69,283,060	\$129,967,344
Costs of Cessation Program	\$43,725,667	\$67,066,844	\$38,351,763	\$56,699,507
Lost Tax Revenue	\$6,812,057	\$7,394,436	\$7,394,436	\$13,871,142
Lost Business Revenue	\$3,963,878	\$4,302,759	\$4,302,759	\$8,071,498
Benefit/Cost Ratio	1.17	0.88	1.38	1.65

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$90,229,857	\$96,505,022	\$96,505,022	\$166,291,949
Costs of Cessation Program	\$70,226,071	\$93,567,248	\$64,852,167	\$83,199,911
Lost Tax Revenue	\$9,630,043	\$10,299,779	\$10,299,779	\$17,747,991
Lost Business Revenue	\$5,603,640	\$5,993,353	\$5,993,353	\$10,327,403
Benefit/Cost Ratio	1.06	0.88	1.19	1.49

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$83,572,705	\$110,222,340	\$110,222,340	\$259,829,049
Costs of Cessation Program	\$43,725,667	\$67,066,844	\$38,351,763	\$56,699,507
Lost Tax Revenue	\$8,919,540	\$11,763,799	\$11,763,799	\$27,731,009
Lost Business Revenue	\$5,190,203	\$6,845,254	\$6,845,254	\$16,136,436
Benefit/Cost Ratio	1.45	1.29	1.94	2.58

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$112,938,114	\$143,585,194	\$143,585,194	\$315,632,910
Costs of Cessation Program	\$70,226,071	\$93,567,248	\$64,852,167	\$83,199,911
Lost Tax Revenue	\$12,053,648	\$15,324,547	\$15,324,547	\$33,686,838
Lost Business Revenue	\$7,013,914	\$8,917,222	\$8,917,222	\$19,602,082
Benefit/Cost Ratio	1.26	1.22	1.61	2.31

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Indiana

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Indiana the annual direct costs to the economy attributable to smoking were in excess of \$7.7 billion, including workplace productivity losses of \$2 billion, premature death losses of \$3 billion, and direct medical expenditures of \$2.6 billion. While the retail price of a pack of cigarettes in Indiana is on average \$5.13, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$15.90 per pack of cigarettes. The ratio of benefits to cost varies from \$0.81 to \$2.41 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in IN ¹	1,261,401
Visiting Smokers in IN ²	83,039
Total Smokers	1,344,440
Total Packs Sold to Residents	486,568,938
Total Packs Sold to Visitors	32,031,062
Total Packs Sold ³	518,600,000
Average Packs Per Resident Smoker Per Year	386

¹ Data from the Behavioral Risk factor Surveillance System, Indiana Calculated Variable Data Report, 2005. Retrieved on September 21, 2009 from:

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

² Data from <http://www.in.gov/tourism/pdfs/2006VisitorProfileReport.pdf>, Indiana 2006 Visitor Profile Public Version.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,971,702,923	\$7.68	\$2,963.22
Women	\$1,049,420,967	\$4.56	\$1,760.75
Combined	\$3,021,123,890	\$6.21	\$2,395.05
Workplace Productivity²			
Current Smokers ³	\$1,405,861,880	\$2.89	\$1,114.52
Former Smokers ⁴	\$661,496,819	\$1.36	\$524.41
Combined	\$2,067,358,699	\$4.25	\$1,638.94
Total Productivity Losses	\$5,088,482,589	\$10.46	\$4,033.99

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Indiana. Total expenditures per pack for both medical care and productivity losses are \$15.90 per pack.

Cost Component ¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$385,181,986	\$0.79	\$305.36
Hospital Care	\$1,377,207,291	\$2.83	\$1,091.81
Rx	\$450,590,248	\$0.93	\$357.21
Nursing Home	\$260,421,783	\$0.54	\$206.45
Other Care ²	\$167,154,447	\$0.34	\$132.51
Total	\$2,640,555,756	\$5.43	\$2,093.35
Neonatal Expenditures	\$6,084,404	\$0.01	\$4.82
Total Expenditures	\$2,646,640,160	\$5.44	\$2,098.18

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.34
Federal Tax ²	\$1.01
State Tax ²	\$1.00
State Sales Tax ³	\$0.34
Distributor & Retailer Mark-ups ¹	\$0.43
Final Retail Price	\$5.13

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	Alone	With Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$44,767,392	\$53,895,985	\$53,895,985	\$115,291,948
Costs of Cessation Program	\$29,138,363	\$44,692,699	\$25,557,246	\$37,784,006
Lost Tax Revenue	\$6,592,094	\$7,936,299	\$7,936,299	\$16,976,986
Lost Business Revenue	\$1,223,780	\$1,473,322	\$1,473,322	\$3,151,667
Benefit/Cost Ratio	1.21	1.00	1.54	1.99

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$61,692,863	\$72,190,745	\$72,190,745	\$142,796,102
Costs of Cessation Program	\$46,797,977	\$62,352,313	\$43,216,860	\$55,443,620
Lost Tax Revenue	\$9,084,406	\$10,630,242	\$10,630,242	\$21,027,031
Lost Business Revenue	\$1,686,461	\$1,973,435	\$1,973,435	\$3,903,532
Benefit/Cost Ratio	1.07	0.96	1.29	1.78

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$38,723,103	\$42,033,630	\$42,033,630	\$78,850,433
Costs of Cessation Program	\$29,138,363	\$44,692,699	\$25,557,246	\$37,784,006
Lost Tax Revenue	\$5,702,060	\$6,189,542	\$6,189,542	\$11,610,895
Lost Business Revenue	\$1,058,550	\$1,149,048	\$1,149,048	\$2,155,487
Benefit/Cost Ratio	1.08	0.81	1.28	1.53

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$54,741,930	\$58,549,037	\$58,549,037	\$100,888,360
Costs of Cessation Program	\$46,797,977	\$62,352,313	\$43,216,860	\$55,443,620
Lost Tax Revenue	\$8,060,866	\$8,621,471	\$8,621,471	\$14,856,027
Lost Business Revenue	\$1,496,448	\$1,600,520	\$1,600,520	\$2,757,925
Benefit/Cost Ratio	0.97	0.81	1.10	1.38

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$50,703,075	\$66,871,254	\$66,871,254	\$157,636,775
Costs of Cessation Program	\$29,138,363	\$44,692,699	\$25,557,246	\$37,784,006
Lost Tax Revenue	\$7,466,136	\$9,846,935	\$9,846,935	\$23,212,352
Lost Business Revenue	\$1,386,040	\$1,828,020	\$1,828,020	\$4,309,223
Benefit/Cost Ratio	1.33	1.19	1.80	2.41

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$68,518,898	\$87,112,304	\$87,112,304	\$191,492,654
Costs of Cessation Program	\$46,797,977	\$62,352,313	\$43,216,860	\$55,443,620
Lost Tax Revenue	\$10,089,554	\$12,827,473	\$12,827,473	\$28,197,703
Lost Business Revenue	\$1,873,060	\$2,381,337	\$2,381,337	\$5,234,721
Benefit/Cost Ratio	1.17	1.12	1.49	2.15

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Kansas

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Executive Summary

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Results. Results from our model suggested that in Kansas the annual direct costs to the economy attributable to smoking were in excess of \$2.5 billion, including workplace productivity losses of \$557 million, premature death losses of \$1 billion, and direct medical expenditures of \$964 million. While the retail price of a pack of cigarettes in Kansas is on average \$5.12, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$20.05 per pack of cigarettes. The ratio of benefits to cost varies from \$0.94 to \$2.89 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Component	Total	Per Pack	Per Smoker
Premature Death¹			
Men	\$699,522,363	\$10.52	\$3,705.67
Women	\$345,606,728	\$5.62	\$1,977.95
Combined	\$1,045,129,091	\$8.16	\$2,875.18
Workplace Productivity²			
Current Smokers ³	\$379,287,489	\$2.96	\$1,043.43
Former Smokers ⁴	\$178,465,233	\$1.39	\$490.96
Combined	\$557,752,722	\$4.36	\$1,534.39
Total Productivity Losses	\$1,602,881,813	\$12.52	\$4,409.57

Adjusted for inflation to 2009

¹ Data from the Behavioral Risk factor Surveillance System, Kansas Calculated Variable Data Report, 2005. Retrieved on September 21, 2009 from:

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

² Data from <http://www.travelks.com/resources/PDF/211-2006-EconomicImpact.pdf>, Kansas Tourism in 2006.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$702,019,994	\$10.56	\$3,718.90
Women	\$346,840,709	\$5.64	\$1,985.01
Combined	\$1,048,860,703	\$8.19	\$2,885.44
Workplace Productivity²			
Current Smokers ³	\$380,641,728	\$2.97	\$1,047.15
Former Smokers ⁴	\$179,102,439	\$1.40	\$492.72
Combined	\$559,744,167	\$4.37	\$1,539.87
Total Productivity Losses	\$1,608,604,870	\$12.56	\$4,425.31

Adjusted for inflation to 2008

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in Kansas. Total expenditures per pack for both medical care and productivity losses are \$20.05 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$161,098,126	\$1.26	\$443.18
Hospital Care	\$476,026,795	\$3.72	\$1,309.56
Rx	\$155,041,806	\$1.21	\$426.52
Nursing Home	\$92,056,072	\$0.72	\$253.25
Other Care ²	\$77,520,903	\$0.61	\$213.26
Total	\$962,954,966	\$7.52	\$2,649.11
Neonatal Expenditures	\$1,741,771	\$0.01	\$4.79
Total Expenditures	\$964,696,737	\$7.53	\$2,653.90

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.06
Federal Tax ²	\$1.01
State Tax ²	\$0.79
State Sales Tax ³	\$0.26
Distributor & Retailer Mark-ups ¹	\$0.70
Final Retail Price	\$5.12

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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Treatment	With	
	Alone	Counseling
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Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

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Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$14,859,983	\$17,890,107	\$17,890,107	\$38,269,739
Costs of Cessation Program	\$8,396,873	\$12,879,204	\$7,364,894	\$10,888,309
Lost Tax Revenue	\$1,524,744	\$1,835,657	\$1,835,657	\$3,926,758
Lost Business Revenue	\$521,355	\$627,666	\$627,666	\$1,342,675
Benefit/Cost Ratio	1.42	1.17	1.82	2.37

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$20,478,185	\$23,962,827	\$23,962,827	\$47,399,404
Costs of Cessation Program	\$13,485,887	\$17,968,218	\$12,453,908	\$15,977,323
Lost Tax Revenue	\$2,101,213	\$2,458,763	\$2,458,763	\$4,863,530
Lost Business Revenue	\$718,467	\$840,724	\$840,724	\$1,662,985
Benefit/Cost Ratio	1.26	1.13	1.52	2.11

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$12,853,656	\$13,952,545	\$13,952,545	\$26,173,428
Costs of Cessation Program	\$8,396,873	\$12,879,204	\$7,364,894	\$10,888,309
Lost Tax Revenue	\$1,318,880	\$1,431,634	\$1,431,634	\$2,685,587
Lost Business Revenue	\$450,964	\$489,518	\$489,518	\$918,282
Benefit/Cost Ratio	1.26	0.94	1.50	1.81

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$18,170,908	\$19,434,630	\$19,434,630	\$33,488,646
Costs of Cessation Program	\$13,485,887	\$17,968,218	\$12,453,908	\$15,977,323
Lost Tax Revenue	\$1,864,470	\$1,994,137	\$1,994,137	\$3,436,183
Lost Business Revenue	\$637,517	\$681,854	\$681,854	\$1,174,933
Benefit/Cost Ratio	1.14	0.94	1.28	1.63

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$16,830,260	\$22,197,088	\$22,197,088	\$52,325,582
Costs of Cessation Program	\$8,396,873	\$12,879,204	\$7,364,894	\$10,888,309
Lost Tax Revenue	\$1,726,909	\$2,277,585	\$2,277,585	\$5,368,992
Lost Business Revenue	\$590,481	\$778,774	\$778,774	\$1,835,817
Benefit/Cost Ratio	1.57	1.39	2.13	2.89

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$22,744,003	\$28,915,854	\$28,915,854	\$63,563,623
Costs of Cessation Program	\$13,485,887	\$17,968,218	\$12,453,908	\$15,977,323
Lost Tax Revenue	\$2,333,703	\$2,966,981	\$2,966,981	\$6,522,098
Lost Business Revenue	\$797,962	\$1,014,499	\$1,014,499	\$2,230,099
Benefit/Cost Ratio	1.37	1.32	1.76	2.57

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Kentucky

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Kentucky the annual direct costs to the economy attributable to smoking were in excess of \$5.6 billion, including workplace productivity losses of \$1.2 billion, premature death losses of \$2.6 billion, and direct medical expenditures of \$1.7 billion. While the retail price of a pack of cigarettes in Kentucky is on average \$4.76, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$10.08 per pack of cigarettes. The ratio of benefits to cost varies from \$0.78 to \$2.12 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had slightly more than break-even benefits to costs ratio at the mid-point of the treatment effectiveness range. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in KY ¹	906,734
Visiting Smokers in KY ²	62,932
Total Smokers	969,666
Total Packs Sold to Residents	562,836,532
Total Packs Sold to Visitors	39,063,468
Total Packs Sold ³	601,900,000
Average Packs Per Resident Smoker Per Year	621

¹ Data from the Behavioral Risk factor Surveillance System, Kentucky Calculated Variable Data Report, 2005. Retrieved on September 21, 2009 from:

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

² Data estimated from like states in surrounding geographic area. No data sources were available from the state.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,726,897,921	\$5.96	\$3,701.17
Women	\$910,347,839	\$3.33	\$2,068.26
Combined	\$2,637,245,760	\$4.69	\$2,908.51
Workplace Productivity²			
Current Smokers ³	\$856,430,748	\$1.52	\$944.52
Former Smokers ⁴	\$402,974,306	\$0.72	\$444.42
Combined	\$1,259,405,054	\$2.24	\$1,388.95
Total Productivity Losses	\$3,896,650,814	\$6.92	\$4,297.46

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Kentucky. Total expenditures per pack for both medical care and productivity losses are \$10.08 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$270,111,896	\$0.48	\$297.90
Hospital Care	\$895,124,176	\$1.59	\$987.20
Rx	\$354,900,384	\$0.63	\$391.41
Nursing Home	\$135,661,580	\$0.24	\$149.62
Other Care ²	\$116,281,354	\$0.21	\$128.24
Total	\$1,772,079,391	\$3.15	\$1,954.35
Neonatal Expenditures	\$5,614,639	\$0.01	\$6.19
Total Expenditures	\$1,777,694,030	\$3.16	\$1,960.55

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.88
Federal Tax ²	\$1.01
State Tax ²	\$0.60
State Sales Tax ³	\$0.27
Distributor & Retailer Mark-ups ¹	\$0.52
Final Retail Price	\$4.76

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$32,840,542	\$39,537,111	\$39,537,111	\$84,576,068
Costs of Cessation Program	\$20,945,555	\$32,126,492	\$18,371,338	\$27,160,310
Lost Tax Revenue	\$6,121,349	\$7,369,563	\$7,369,563	\$15,764,649
Lost Business Revenue	\$1,685,240	\$2,028,880	\$2,028,880	\$4,340,092
Benefit/Cost Ratio	1.14	0.95	1.42	1.79

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$45,256,758	\$52,957,813	\$52,957,813	\$104,752,614
Costs of Cessation Program	\$33,639,831	\$44,820,768	\$31,065,614	\$39,854,586
Lost Tax Revenue	\$8,435,683	\$9,871,130	\$9,871,130	\$19,525,478
Lost Business Revenue	\$2,322,389	\$2,717,575	\$2,717,575	\$5,375,469
Benefit/Cost Ratio	1.02	0.92	1.21	1.62

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$28,406,561	\$30,835,104	\$30,835,104	\$57,843,238
Costs of Cessation Program	\$20,945,555	\$32,126,492	\$18,371,338	\$27,160,310
Lost Tax Revenue	\$5,294,872	\$5,747,543	\$5,747,543	\$10,781,754
Lost Business Revenue	\$1,457,707	\$1,582,329	\$1,582,329	\$2,968,275
Benefit/Cost Ratio	1.03	0.78	1.20	1.41

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$40,157,681	\$42,950,504	\$42,950,504	\$74,009,859
Costs of Cessation Program	\$33,639,831	\$44,820,768	\$31,065,614	\$39,854,586
Lost Tax Revenue	\$7,485,235	\$8,005,806	\$8,005,806	\$13,795,149
Lost Business Revenue	\$2,060,725	\$2,204,041	\$2,204,041	\$3,797,878
Benefit/Cost Ratio	0.93	0.78	1.04	1.29

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$37,194,850	\$49,055,531	\$49,055,531	\$115,639,461
Costs of Cessation Program	\$20,945,555	\$32,126,492	\$18,371,338	\$27,160,310
Lost Tax Revenue	\$6,932,975	\$9,143,760	\$9,143,760	\$21,554,744
Lost Business Revenue	\$1,908,685	\$2,517,326	\$2,517,326	\$5,934,137
Benefit/Cost Ratio	1.25	1.12	1.63	2.12

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$50,264,213	\$63,903,996	\$63,903,996	\$140,475,515
Costs of Cessation Program	\$33,639,831	\$44,820,768	\$31,065,614	\$39,854,586
Lost Tax Revenue	\$9,369,053	\$11,911,455	\$11,911,455	\$26,184,088
Lost Business Revenue	\$2,579,351	\$3,279,287	\$3,279,287	\$7,208,620
Benefit/Cost Ratio	1.10	1.06	1.38	1.92

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Louisiana

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Louisiana the annual direct costs to the economy attributable to smoking were in excess of \$ 5 billion, including workplace productivity losses of \$864 million, premature death losses of \$2.4 billion, and direct medical expenditures of \$1.7 billion. While the retail price of a pack of cigarettes in Louisiana is on average \$4.55, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$13.90 per pack of cigarettes. The ratio of benefits to cost varies from \$1.01 to \$2.90 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. All therapies had a positive break even to costs at the mid-point of the range of treatment effectiveness. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in LA ¹	645,428
Visiting Smokers in LA ²	24,726
Total Smokers	670,154
Total Packs Sold to Residents	363,475,197
Total Packs Sold to Visitors	13,924,803
Total Packs Sold ³	377,400,000
Average Packs Per Resident Smoker Per Year	563

¹ Data from the Behavioral Risk factor Surveillance System, Louisiana Calculated Variable Data Report, 2005. Retrieved on September 28, 2009 from:

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

² Data from [http://www.crt.state.la.us/TOURISM/RESEARCH/Documents/2007-](http://www.crt.state.la.us/TOURISM/RESEARCH/Documents/2007-08/LouisianaForecastSep08.pdf)

[08/LouisianaForecastSep08.pdf](http://www.crt.state.la.us/TOURISM/RESEARCH/Documents/2007-08/LouisianaForecastSep08.pdf), Louisiana Tourism Forecast: 2008-2012.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,637,538,547	\$8.56	\$4,822.47
Women	\$786,079,922	\$4.56	\$2,570.04
Combined	\$2,423,618,470	\$6.67	\$3,755.06
Workplace Productivity²			
Current Smokers ³	\$587,581,034	\$1.62	\$910.37
Former Smokers ⁴	\$276,473,095	\$0.76	\$428.36
Combined	\$864,054,128	\$2.38	\$1,338.73
Total Productivity Losses	\$3,287,672,598	\$9.05	\$5,093.79

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in Louisiana. Total expenditures per pack for both medical care and productivity losses are \$13.90 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$260,421,783	\$0.72	\$403.49
Hospital Care	\$964,166,230	\$2.65	\$1,493.84
Rx	\$294,337,178	\$0.81	\$456.03
Nursing Home	\$133,239,052	\$0.37	\$206.44
Other Care ²	\$107,802,506	\$0.30	\$167.02
Total	\$1,761,178,014	\$4.85	\$2,728.70
Neonatal Expenditures	\$3,273,591	\$0.01	\$5.07
Total Expenditures	\$1,764,451,605	\$4.85	\$2,733.77

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.54
Federal Tax ²	\$1.01
State Tax ²	\$0.36
State Sales Tax ³	\$0.17
Distributor & Retailer Mark-ups ¹	\$0.64
Final Retail Price	\$4.55

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$29,239,410	\$35,201,666	\$35,201,666	\$75,301,874
Costs of Cessation Program	\$14,909,387	\$22,868,159	\$13,077,017	\$19,333,150
Lost Tax Revenue	\$3,249,741	\$3,912,401	\$3,912,401	\$8,369,238
Lost Business Revenue	\$1,349,510	\$1,624,690	\$1,624,690	\$3,475,467
Benefit/Cost Ratio	1.50	1.24	1.89	2.42

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$40,294,126	\$47,150,720	\$47,150,720	\$93,265,959
Costs of Cessation Program	\$23,945,379	\$31,904,151	\$22,113,009	\$28,369,142
Lost Tax Revenue	\$4,478,390	\$5,240,449	\$5,240,449	\$10,365,811
Lost Business Revenue	\$1,859,727	\$2,176,184	\$2,176,184	\$4,304,578
Benefit/Cost Ratio	1.33	1.20	1.60	2.17

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$25,291,638	\$27,453,878	\$27,453,878	\$51,500,434
Costs of Cessation Program	\$14,909,387	\$22,868,159	\$13,077,017	\$19,333,150
Lost Tax Revenue	\$2,810,976	\$3,051,293	\$3,051,293	\$5,723,887
Lost Business Revenue	\$1,167,305	\$1,267,101	\$1,267,101	\$2,376,940
Benefit/Cost Ratio	1.34	1.01	1.58	1.88

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$35,754,188	\$38,240,764	\$38,240,764	\$65,894,303
Costs of Cessation Program	\$23,945,379	\$31,904,151	\$22,113,009	\$28,369,142
Lost Tax Revenue	\$3,973,810	\$4,250,174	\$4,250,174	\$7,323,657
Lost Business Revenue	\$1,650,191	\$1,764,956	\$1,764,956	\$3,041,272
Benefit/Cost Ratio	1.21	1.01	1.36	1.70

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$33,116,247	\$43,676,344	\$43,676,344	\$102,959,008
Costs of Cessation Program	\$14,909,387	\$22,868,159	\$13,077,017	\$19,333,150
Lost Tax Revenue	\$3,680,622	\$4,854,298	\$4,854,298	\$11,443,121
Lost Business Revenue	\$1,528,440	\$2,015,829	\$2,015,829	\$4,751,948
Benefit/Cost Ratio	1.65	1.47	2.19	2.90

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$44,752,487	\$56,896,599	\$56,896,599	\$125,071,664
Costs of Cessation Program	\$23,945,379	\$31,904,151	\$22,113,009	\$28,369,142
Lost Tax Revenue	\$4,973,903	\$6,323,630	\$6,323,630	\$13,900,777
Lost Business Revenue	\$2,065,497	\$2,625,994	\$2,625,994	\$5,772,531
Benefit/Cost Ratio	1.44	1.39	1.83	2.60

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for Massachusetts

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Massachusetts the annual direct costs to the economy attributable to smoking were in excess of \$7 billion, including workplace productivity losses of \$1.2 billion, premature death losses of approximately \$2.2 billion, and direct medical expenditures of \$3.65 billion. While the retail price of a pack of cigarettes in Massachusetts is on average \$7.23, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$26.34 per pack of cigarettes. The ratio of benefits to cost varies from \$0.99 to \$2.70 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. All therapies had a positive break even to costs at the mid-point of the range of treatment effectiveness. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in MA ¹	895,779
Visiting Smokers in MA ²	27,900
Total Smokers	923,679
Total Packs Sold to Residents	269,505,971
Total Packs Sold to Visitors	8,394,029
Total Packs Sold ³	277,900,000
Average Packs Per Resident Smoker Per Year	301

¹ Data from the Behavioral Risk factor Surveillance System, Massachusetts Calculated Variable Data Report, 2005. Retrieved on September 28, 2009 from:

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

² Data from <http://www.massvacation.com/research/>, Overview Statistics.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,387,730,711	\$10.72	\$3,226.47
Women	\$807,522,265	\$5.76	\$1,734.10
Combined	\$2,195,252,976	\$8.15	\$2,450.66
Workplace Productivity²			
Current Smokers ³	\$851,951,639	\$3.16	\$951.07
Former Smokers ⁴	\$400,866,762	\$1.49	\$447.51
Combined	\$1,252,818,401	\$4.65	\$1,398.58
Total Productivity Losses	\$3,448,071,377	\$12.79	\$3,849.24

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Massachusetts. Total expenditures per pack for both medical care and productivity losses are \$26.34 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$485,716,907	\$1.80	\$542.23
Hospital Care	\$2,016,754,740	\$7.48	\$2,251.40
Rx	\$489,350,700	\$1.82	\$546.29
Nursing Home	\$383,970,722	\$1.42	\$428.64
Other Care ²	\$273,745,688	\$1.02	\$305.60
Total	\$3,648,327,494	\$13.54	\$4,072.80
Neonatal Expenditures	\$2,454,563	\$0.01	\$2.74
Total Expenditures	\$3,650,782,057	\$13.55	\$4,075.54

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$3.86
Federal Tax ²	\$1.01
State Tax ²	\$2.51
State Sales Tax ³	\$0.34
Distributor & Retailer Mark-ups ¹	\$1.00
Final Retail Price	\$7.23

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ¹	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$41,084,953	\$49,462,654	\$49,462,654	\$105,808,358
Costs of Cessation Program	\$20,692,495	\$31,738,346	\$18,149,378	\$26,832,164
Lost Tax Revenue	\$6,027,202	\$7,256,218	\$7,256,218	\$15,522,186
Lost Business Revenue	\$1,565,488	\$1,884,709	\$1,884,709	\$4,031,687
Benefit/Cost Ratio	1.45	1.21	1.81	2.28

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$56,618,183	\$66,252,539	\$66,252,539	\$131,050,098
Costs of Cessation Program	\$33,233,401	\$44,279,252	\$30,690,284	\$39,373,070
Lost Tax Revenue	\$8,305,941	\$9,719,310	\$9,719,310	\$19,225,173
Lost Business Revenue	\$2,157,361	\$2,524,465	\$2,524,465	\$4,993,490
Benefit/Cost Ratio	1.30	1.17	1.54	2.06

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$35,537,850	\$38,576,063	\$38,576,063	\$72,364,420
Costs of Cessation Program	\$20,692,495	\$31,738,346	\$18,149,378	\$26,832,164
Lost Tax Revenue	\$5,213,436	\$5,659,145	\$5,659,145	\$10,615,929
Lost Business Revenue	\$1,354,123	\$1,469,890	\$1,469,890	\$2,757,350
Benefit/Cost Ratio	1.30	0.99	1.53	1.80

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$50,239,014	\$53,732,958	\$53,732,958	\$92,589,569
Costs of Cessation Program	\$33,233,401	\$44,279,252	\$30,690,284	\$39,373,070
Lost Tax Revenue	\$7,370,111	\$7,882,676	\$7,882,676	\$13,582,977
Lost Business Revenue	\$1,914,291	\$2,047,423	\$2,047,423	\$3,528,003
Benefit/Cost Ratio	1.18	0.99	1.32	1.64

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$46,532,383	\$61,370,614	\$61,370,614	\$144,670,020
Costs of Cessation Program	\$20,692,495	\$31,738,346	\$18,149,378	\$26,832,164
Lost Tax Revenue	\$6,826,345	\$9,003,127	\$9,003,127	\$21,223,229
Lost Business Revenue	\$1,773,055	\$2,338,446	\$2,338,446	\$5,512,459
Benefit/Cost Ratio	1.59	1.42	2.08	2.70

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$62,882,727	\$79,946,692	\$79,946,692	\$175,741,010
Costs of Cessation Program	\$33,233,401	\$44,279,252	\$30,690,284	\$39,373,070
Lost Tax Revenue	\$9,224,956	\$11,728,255	\$11,728,255	\$25,781,372
Lost Business Revenue	\$2,396,063	\$3,046,263	\$3,046,263	\$6,696,378
Benefit/Cost Ratio	1.40	1.35	1.76	2.45

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for Maryland

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Maryland the annual direct costs to the economy attributable to smoking were in excess of \$5.5 billion, including workplace productivity losses of \$1.2 billion, premature death losses of \$2 billion, and direct medical expenditures of \$2.2 billion. While the retail price of a pack of cigarettes in Maryland is on average \$6.34, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$23.96 per pack of cigarettes. The ratio of benefits to cost varies from \$0.92 to \$2.67 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in MD ¹	790,203
Visiting Smokers in MD ²	35,966
Total Smokers	826,169
Total Packs Sold to Residents	232,421,432
Total Packs Sold to Visitors	10,578,568
Total Packs Sold ³	243,000,000
Average Packs Per Resident Smoker Per Year	294

¹ Data from the Behavioral Risk factor Surveillance System, Maryland Calculated Variable Data Report, 2005. Retrieved on September 28, 2009 from:

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

² Data from

http://www.visitmaryland.org/AboutMDTourism/Documents/2008_Tourism_Economic_Impact.pdf, 2008 Tourism Economic Impact.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,353,762,542	\$11.84	\$3,482.93
Women	\$721,572,315	\$6.11	\$1,797.12
Combined	\$2,075,334,856	\$8.93	\$2,626.33
Workplace Productivity²			
Current Smokers ³	\$872,706,847	\$3.75	\$1,104.41
Former Smokers ⁴	\$410,632,660	\$1.77	\$519.65
Combined	\$1,283,339,506	\$5.52	\$1,624.06
Total Productivity Losses	\$3,358,674,363	\$14.45	\$4,250.39

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in Maryland. Total expenditures per pack for both medical care and productivity losses are \$23.96 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$353,689,120	\$1.52	\$447.59
Hospital Care	\$1,101,039,074	\$4.74	\$1,393.36
Rx	\$364,590,497	\$1.57	\$461.39
Nursing Home	\$215,605,011	\$0.93	\$272.85
Other Care ²	\$173,210,767	\$0.75	\$219.20
Total	\$2,206,923,205	\$9.50	\$2,792.86
Neonatal Expenditures	\$3,175,446	\$0.01	\$4.02
Total Expenditures	\$2,210,098,652	\$9.51	\$2,796.87

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$3.37
Federal Tax ²	\$1.01
State Tax ²	\$2.00
State Sales Tax ³	\$0.36
Distributor & Retailer Mark-ups ¹	\$0.61
Final Retail Price	\$6.34

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$32,229,540	\$38,801,518	\$38,801,518	\$83,002,521
Costs of Cessation Program	\$18,253,689	\$27,997,682	\$16,010,303	\$23,669,741
Lost Tax Revenue	\$4,531,509	\$5,455,536	\$5,455,536	\$11,670,246
Lost Business Revenue	\$821,179	\$988,627	\$988,627	\$2,114,827
Benefit/Cost Ratio	1.37	1.13	1.73	2.22

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$44,414,751	\$51,972,527	\$51,972,527	\$102,803,679
Costs of Cessation Program	\$29,316,531	\$39,060,524	\$27,073,145	\$34,732,583
Lost Tax Revenue	\$6,244,763	\$7,307,395	\$7,307,395	\$14,454,311
Lost Business Revenue	\$1,131,647	\$1,324,212	\$1,324,212	\$2,619,342
Benefit/Cost Ratio	1.21	1.09	1.46	1.98

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$27,878,054	\$30,261,413	\$30,261,413	\$56,767,058
Costs of Cessation Program	\$18,253,689	\$27,997,682	\$16,010,303	\$23,669,741
Lost Tax Revenue	\$3,919,685	\$4,254,788	\$4,254,788	\$7,981,511
Lost Business Revenue	\$710,307	\$771,033	\$771,033	\$1,446,372
Benefit/Cost Ratio	1.22	0.92	1.44	1.72

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$39,410,543	\$42,151,405	\$42,151,405	\$72,632,897
Costs of Cessation Program	\$29,316,531	\$39,060,524	\$27,073,145	\$34,732,583
Lost Tax Revenue	\$5,541,166	\$5,926,534	\$5,926,534	\$10,212,266
Lost Business Revenue	\$1,004,144	\$1,073,979	\$1,073,979	\$1,850,619
Benefit/Cost Ratio	1.10	0.92	1.24	1.55

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$36,502,836	\$48,142,847	\$48,142,847	\$113,487,975
Costs of Cessation Program	\$18,253,689	\$27,997,682	\$16,010,303	\$23,669,741
Lost Tax Revenue	\$5,132,339	\$6,768,937	\$6,768,937	\$15,956,535
Lost Business Revenue	\$930,058	\$1,226,635	\$1,226,635	\$2,891,568
Benefit/Cost Ratio	1.50	1.34	2.01	2.67

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$49,329,041	\$62,715,055	\$62,715,055	\$137,861,952
Costs of Cessation Program	\$29,316,531	\$39,060,524	\$27,073,145	\$34,732,583
Lost Tax Revenue	\$6,935,718	\$8,817,806	\$8,817,806	\$19,383,543
Lost Business Revenue	\$1,256,858	\$1,597,921	\$1,597,921	\$3,512,594
Benefit/Cost Ratio	1.32	1.27	1.67	2.39

Adjusted for inflation to 2009

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This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Maine the annual direct costs to the economy attributable to smoking were in excess of \$1.5 billion, including workplace productivity losses of \$309 million, premature death losses of \$612 million, and direct medical expenditures of \$667 million. While the retail price of a pack of cigarettes in Maine is on average \$6.46, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$26.16 per pack of cigarettes. The ratio of benefits to cost varies from \$0.96 to \$2.81 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in ME ¹	214,555
Visiting Smokers in ME ²	42,248
Total Smokers	256,803
Total Packs Sold to Residents	60,739,687
Total Packs Sold to Visitors	11,960,313
Total Packs Sold ³	72,700,000
Average Packs Per Resident Smoker Per Year	283

¹ Data from the Behavioral Risk factor Surveillance System, Maine Calculated Variable Data Report, 2005. Retrieved on September 28, 2009 from:

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

² Data from <http://www.visitmaine.com/resource/visitmaine/powerpoint/tourism/2008-Maine-Visitor-Research.ppt>, Maine Office of Tourism Visitor Tracking Research 2008 Annual Report: *Executive Summary*.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$407,423,821	\$13.06	\$3,696.83
Women	\$204,990,160	\$6.94	\$1,964.52
Combined	\$612,413,981	\$10.08	\$2,854.34
Workplace Productivity²			
Current Smokers ³	\$210,435,252	\$3.46	\$980.80
Former Smokers ⁴	\$99,015,595	\$1.63	\$461.49
Combined	\$309,450,847	\$5.09	\$1,442.29
Total Productivity Losses	\$921,864,828	\$15.18	\$4,296.64

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Maine. Total expenditures per pack for both medical care and productivity losses are \$26.16 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$90,844,808	\$1.50	\$423.41
Hospital Care	\$341,576,479	\$5.62	\$1,592.02
Rx	\$105,379,977	\$1.73	\$491.16
Nursing Home	\$61,774,470	\$1.02	\$287.92
Other Care ²	\$66,619,526	\$1.10	\$310.50
Total	\$666,195,260	\$10.97	\$3,105.01
Neonatal Expenditures	\$826,156	\$0.01	\$3.85
Total Expenditures	\$667,021,416	\$10.98	\$3,108.86

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$3.32
Federal Tax ²	\$1.01
State Tax ²	\$2.00
State Sales Tax ³	\$0.31
Distributor & Retailer Mark-ups ¹	\$0.79
Final Retail Price	\$6.46

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$9,195,755	\$11,070,877	\$11,070,877	\$23,682,338
Costs of Cessation Program	\$4,956,221	\$7,601,898	\$4,347,099	\$6,426,780
Lost Tax Revenue	\$1,166,310	\$1,404,134	\$1,404,134	\$3,003,663
Lost Business Revenue	\$276,437	\$332,805	\$332,805	\$711,923
Benefit/Cost Ratio	1.44	1.19	1.82	2.33

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$12,672,448	\$14,828,838	\$14,828,838	\$29,332,018
Costs of Cessation Program	\$7,959,991	\$10,605,668	\$7,350,869	\$9,430,550
Lost Tax Revenue	\$1,607,264	\$1,880,762	\$1,880,762	\$3,720,219
Lost Business Revenue	\$380,951	\$445,775	\$445,775	\$881,760
Benefit/Cost Ratio	1.27	1.15	1.53	2.09

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$7,954,186	\$8,634,208	\$8,634,208	\$16,196,817
Costs of Cessation Program	\$4,956,221	\$7,601,898	\$4,347,099	\$6,426,780
Lost Tax Revenue	\$1,008,840	\$1,095,088	\$1,095,088	\$2,054,264
Lost Business Revenue	\$239,113	\$259,556	\$259,556	\$486,898
Benefit/Cost Ratio	1.28	0.96	1.51	1.81

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$11,244,644	\$12,026,669	\$12,026,669	\$20,723,670
Costs of Cessation Program	\$7,959,991	\$10,605,668	\$7,350,869	\$9,430,550
Lost Tax Revenue	\$1,426,173	\$1,525,359	\$1,525,359	\$2,628,411
Lost Business Revenue	\$338,029	\$361,538	\$361,538	\$622,981
Benefit/Cost Ratio	1.16	0.96	1.30	1.63

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$10,415,015	\$13,736,151	\$13,736,151	\$32,380,469
Costs of Cessation Program	\$4,956,221	\$7,601,898	\$4,347,099	\$6,426,780
Lost Tax Revenue	\$1,320,950	\$1,742,175	\$1,742,175	\$4,106,859
Lost Business Revenue	\$313,089	\$412,927	\$412,927	\$973,400
Benefit/Cost Ratio	1.58	1.41	2.11	2.81

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$14,074,597	\$17,893,904	\$17,893,904	\$39,334,869
Costs of Cessation Program	\$7,959,991	\$10,605,668	\$7,350,869	\$9,430,550
Lost Tax Revenue	\$1,785,100	\$2,269,508	\$2,269,508	\$4,988,895
Lost Business Revenue	\$423,101	\$537,915	\$537,915	\$1,182,459
Benefit/Cost Ratio	1.38	1.33	1.76	2.52

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Michigan

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April 30, 2010

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Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Michigan the annual direct costs to the economy attributable to smoking were in excess of \$10.9 billion, including workplace productivity losses of \$2.4 billion, premature death losses of \$4.5 billion, and direct medical expenditures of \$4 billion. While the retail price of a pack of cigarettes in Michigan is on average \$6.54, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$22.48 per pack of cigarettes. The ratio of benefits to cost varies from \$0.85 to \$2.44 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in MI ¹	1,673,477
Visiting Smokers in MI ²	137,410
Total Smokers	1,810,887
Total Packs Sold to Residents	487,935,281
Total Packs Sold to Visitors	40,064,719
Total Packs Sold ³	528,000,000
Average Packs Per Resident Smoker Per Year	292

¹ Data from the Behavioral Risk factor Surveillance System, Michigan Calculated Variable Data Report, 2005. Retrieved on September 28, 2009 from:

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

² Data from [http://ref.michigan.org/cm/attach/7FCE50AA-1D21-411D-A4CE-](http://ref.michigan.org/cm/attach/7FCE50AA-1D21-411D-A4CE-B2C55EE09612/2007_research_review.pdf)

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³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$2,973,778,107	\$11.53	\$3,362.74
Women	\$1,563,469,336	\$6.79	\$1,981.21
Combined	\$4,537,247,442	\$9.30	\$2,711.27
Workplace Productivity²			
Current Smokers ³	\$1,644,801,697	\$3.37	\$982.86
Former Smokers ⁴	\$773,924,598	\$1.59	\$462.47
Combined	\$2,418,726,294	\$4.96	\$1,445.33
Total Productivity Losses	\$6,955,973,737	\$14.26	\$4,156.60

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in Michigan. Total expenditures per pack for both medical care and productivity losses are \$22.48 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$542,646,321	\$1.11	\$324.26
Hospital Care	\$2,156,050,113	\$4.42	\$1,288.37
Rx	\$701,321,919	\$1.44	\$419.08
Nursing Home	\$290,703,386	\$0.60	\$173.71
Other Care ²	\$312,506,140	\$0.64	\$186.74
Total	\$4,004,439,142	\$8.21	\$2,392.89
Neonatal Expenditures	\$7,729,564	\$0.02	\$4.62
Total Expenditures	\$4,012,168,707	\$8.22	\$2,397.50

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$3.38
Federal Tax ²	\$1.01
State Tax ²	\$2.00
State Sales Tax ³	\$0.37
Distributor & Retailer Mark-ups ¹	\$0.80
Final Retail Price	\$6.54

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

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Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
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². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

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Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$63,478,648	\$76,422,684	\$76,422,684	\$163,480,082
Costs of Cessation Program	\$38,657,319	\$59,292,964	\$33,906,317	\$50,127,330
Lost Tax Revenue	\$9,544,806	\$11,491,104	\$11,491,104	\$24,581,269
Lost Business Revenue	\$2,249,896	\$2,708,676	\$2,708,676	\$5,794,282
Benefit/Cost Ratio	1.26	1.04	1.59	2.03

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$87,478,394	\$102,364,035	\$102,364,035	\$202,480,043
Costs of Cessation Program	\$62,085,997	\$82,721,642	\$57,334,995	\$73,556,008
Lost Tax Revenue	\$13,153,467	\$15,391,709	\$15,391,709	\$30,445,400
Lost Business Revenue	\$3,100,527	\$3,628,124	\$3,628,124	\$7,176,571
Benefit/Cost Ratio	1.12	1.01	1.34	1.82

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$54,908,050	\$59,602,266	\$59,602,266	\$111,807,247
Costs of Cessation Program	\$38,657,319	\$59,292,964	\$33,906,317	\$50,127,330
Lost Tax Revenue	\$8,256,110	\$8,961,944	\$8,961,944	\$16,811,614
Lost Business Revenue	\$1,946,125	\$2,112,504	\$2,112,504	\$3,962,824
Benefit/Cost Ratio	1.12	0.85	1.33	1.58

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$77,622,206	\$83,020,554	\$83,020,554	\$143,056,282
Costs of Cessation Program	\$62,085,997	\$82,721,642	\$57,334,995	\$73,556,008
Lost Tax Revenue	\$11,671,467	\$12,483,176	\$12,483,176	\$21,510,296
Lost Business Revenue	\$2,751,191	\$2,942,527	\$2,942,527	\$5,070,394
Benefit/Cost Ratio	1.01	0.85	1.14	1.43

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$71,895,245	\$94,821,176	\$94,821,176	\$223,523,616
Costs of Cessation Program	\$38,657,319	\$59,292,964	\$33,906,317	\$50,127,330
Lost Tax Revenue	\$10,810,347	\$14,257,546	\$14,257,546	\$33,609,563
Lost Business Revenue	\$2,548,208	\$3,360,780	\$3,360,780	\$7,922,426
Benefit/Cost Ratio	1.38	1.23	1.84	2.44

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$97,157,480	\$123,522,300	\$123,522,300	\$271,530,106
Costs of Cessation Program	\$62,085,997	\$82,721,642	\$57,334,995	\$73,556,008
Lost Tax Revenue	\$14,608,839	\$18,573,118	\$18,573,118	\$40,827,938
Lost Business Revenue	\$3,443,587	\$4,378,044	\$4,378,044	\$9,623,937
Benefit/Cost Ratio	1.21	1.17	1.54	2.19

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for Minnesota

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Minnesota the annual direct costs to the economy attributable to smoking were in excess of \$5 billion, including workplace productivity losses of \$1.2 billion, premature death losses of \$1.5 billion, and direct medical expenditures of \$2.3 billion. While the retail price of a pack of cigarettes in Minnesota is on average \$5.53, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$20.83 per pack of cigarettes. The ratio of benefits to cost varies from \$0.89 to \$2.69 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in MN ¹	767,940
Visiting Smokers in MN ²	54,213
Total Smokers	822,153
Total Packs Sold to Residents	247,338,980
Total Packs Sold to Visitors	17,461,020
Total Packs Sold ³	264,800,000
Average Packs Per Resident Smoker Per Year	322

¹ Data from the Behavioral Risk Factor Surveillance System, Minnesota Calculated Variable Data Report, 2005. Retrieved on September 28, 2009 from:

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

² Data from

http://www.tourismroi.com/Content_Attachments/26124/File_633480214451131154.pdf, 2008

Explore Minnesota Tourism.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,006,434,066	\$7.91	\$2,547.79
Women	\$509,865,522	\$4.24	\$1,367.23
Combined	\$1,516,299,589	\$6.13	\$1,974.50
Workplace Productivity²			
Current Smokers ³	\$879,388,291	\$3.56	\$1,145.13
Former Smokers ⁴	\$413,776,464	\$1.67	\$538.81
Combined	\$1,293,164,755	\$5.23	\$1,683.94
Total Productivity Losses	\$2,809,464,344	\$11.36	\$3,658.44

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Minnesota. Total expenditures per pack for both medical care and productivity losses are \$20.83 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$419,097,381	\$1.69	\$545.74
Hospital Care	\$1,182,193,770	\$4.78	\$1,539.44
Rx	\$312,506,140	\$1.26	\$406.94
Nursing Home	\$216,816,275	\$0.88	\$282.33
Other Care ²	\$209,548,691	\$0.85	\$272.87
Total	\$2,340,162,257	\$9.46	\$3,047.32
Neonatal Expenditures	\$2,334,113	\$0.01	\$3.04
Total Expenditures	\$2,342,496,371	\$9.47	\$3,050.36

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.57
Federal Tax ²	\$1.01
State Tax ²	\$1.56
State Sales Tax ³	\$0.00
Distributor & Retailer Mark-ups ¹	\$0.60
Final Retail Price	\$5.53

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
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Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$29,817,219	\$35,897,297	\$35,897,297	\$76,789,937
Costs of Cessation Program	\$17,739,414	\$27,208,882	\$15,559,232	\$23,002,875
Lost Tax Revenue	\$3,678,919	\$4,429,094	\$4,429,094	\$9,474,525
Lost Business Revenue	\$859,073	\$1,034,248	\$1,034,248	\$2,212,418
Benefit/Cost Ratio	1.34	1.10	1.71	2.21

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$41,090,390	\$48,082,480	\$48,082,480	\$95,109,015
Costs of Cessation Program	\$28,490,574	\$37,960,042	\$26,310,392	\$33,754,035
Lost Tax Revenue	\$5,069,830	\$5,932,531	\$5,932,531	\$11,734,777
Lost Business Revenue	\$1,183,868	\$1,385,319	\$1,385,319	\$2,740,215
Benefit/Cost Ratio	1.18	1.06	1.43	1.97

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$25,791,434	\$27,996,403	\$27,996,403	\$52,518,150
Costs of Cessation Program	\$17,739,414	\$27,208,882	\$15,559,232	\$23,002,875
Lost Tax Revenue	\$3,182,208	\$3,454,263	\$3,454,263	\$6,479,814
Lost Business Revenue	\$743,085	\$806,613	\$806,613	\$1,513,116
Benefit/Cost Ratio	1.19	0.89	1.41	1.69

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$36,460,737	\$38,996,451	\$38,996,451	\$67,196,460
Costs of Cessation Program	\$28,490,574	\$37,960,042	\$26,310,392	\$33,754,035
Lost Tax Revenue	\$4,498,613	\$4,811,475	\$4,811,475	\$8,290,859
Lost Business Revenue	\$1,050,481	\$1,123,539	\$1,123,539	\$1,936,018
Benefit/Cost Ratio	1.07	0.89	1.21	1.53

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$33,770,666	\$44,539,445	\$44,539,445	\$104,993,612
Costs of Cessation Program	\$17,739,414	\$27,208,882	\$15,559,232	\$23,002,875
Lost Tax Revenue	\$4,166,705	\$5,495,383	\$5,495,383	\$12,954,362
Lost Business Revenue	\$972,977	\$1,283,240	\$1,283,240	\$3,025,003
Benefit/Cost Ratio	1.48	1.31	1.99	2.69

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$45,636,854	\$58,020,950	\$58,020,950	\$127,543,241
Costs of Cessation Program	\$28,490,574	\$37,960,042	\$26,310,392	\$33,754,035
Lost Tax Revenue	\$5,630,784	\$7,158,763	\$7,158,763	\$15,736,589
Lost Business Revenue	\$1,314,857	\$1,671,659	\$1,671,659	\$3,674,687
Benefit/Cost Ratio	1.29	1.24	1.65	2.40

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for Missouri

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Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Missouri the annual direct costs to the economy attributable to smoking were in excess of \$7.2 billion, including workplace productivity losses of \$1.5 billion, premature death losses of \$2.9 billion, and direct medical expenditures of \$2.7 billion. While the retail price of a pack of cigarettes in Missouri is on average \$4.29, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$12.86 per pack of cigarettes. The ratio of benefits to cost varies from \$0.93 to \$2.80 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in MO ¹	1,017,039
Visiting Smokers in MO ²	51,569
Total Smokers	1,068,608
Total Packs Sold to Residents	560,195,503
Total Packs Sold to Visitors	28,404,497
Total Packs Sold ³	588,600,000
Average Packs Per Resident Smoker Per Year	551

¹ Data from the Behavioral Risk Factor Surveillance System, Missouri Calculated Variable Data Report, 2005. Retrieved on September 28, 2009 from:

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

² Data from <http://news.visitmo.com/StatewideNews/Detail/National-Tourism-Week-Highlights-Value-Of-Missouris-Tourism-Industry>, Missouri Division of Tourism.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,943,459,905	\$6.80	\$3,744.57
Women	\$1,007,782,163	\$3.67	\$2,023.53
Combined	\$2,951,242,068	\$5.27	\$2,901.80
Workplace Productivity²			
Current Smokers ³	\$1,039,342,068	\$1.86	\$1,021.93
Former Smokers ⁴	\$489,039,131	\$0.87	\$480.85
Combined	\$1,528,381,198	\$2.73	\$1,502.78
Total Productivity Losses	\$4,479,623,266	\$8.00	\$4,404.57

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in Missouri. Total expenditures per pack for both medical care and productivity losses are \$12.86 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$337,942,686	\$0.60	\$332.28
Hospital Care	\$1,571,009,549	\$2.80	\$1,544.69
Rx	\$398,505,892	\$0.71	\$391.83
Nursing Home	\$227,717,652	\$0.41	\$223.90
Other Care ²	\$182,900,880	\$0.33	\$179.84
Total	\$2,716,865,395	\$4.85	\$2,671.35
Neonatal Expenditures	\$5,251,925	\$0.01	\$5.16
Total Expenditures	\$2,722,117,320	\$4.86	\$2,676.51

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.35
Federal Tax ²	\$1.01
State Tax ²	\$0.17
State Sales Tax ³	\$0.17
Distributor & Retailer Mark-ups ¹	\$0.58
Final Retail Price	\$4.29

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
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Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
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Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
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Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$41,680,418	\$50,179,540	\$50,179,540	\$107,341,890
Costs of Cessation Program	\$23,493,601	\$36,034,709	\$20,606,227	\$30,464,386
Lost Tax Revenue	\$4,365,984	\$5,256,259	\$5,256,259	\$11,243,960
Lost Business Revenue	\$1,878,612	\$2,261,683	\$2,261,683	\$4,838,094
Benefit/Cost Ratio	1.40	1.15	1.78	2.31

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$57,438,778	\$67,212,769	\$67,212,769	\$132,949,472
Costs of Cessation Program	\$37,732,147	\$50,273,255	\$34,844,773	\$44,702,932
Lost Tax Revenue	\$6,016,657	\$7,040,473	\$7,040,473	\$13,926,330
Lost Business Revenue	\$2,588,870	\$3,029,402	\$3,029,402	\$5,992,275
Benefit/Cost Ratio	1.24	1.11	1.50	2.06

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$36,052,917	\$39,135,164	\$39,135,164	\$73,413,232
Costs of Cessation Program	\$23,493,601	\$36,034,709	\$20,606,227	\$30,464,386
Lost Tax Revenue	\$3,776,509	\$4,099,371	\$4,099,371	\$7,689,966
Lost Business Revenue	\$1,624,971	\$1,763,893	\$1,763,893	\$3,308,868
Benefit/Cost Ratio	1.25	0.93	1.48	1.77

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$50,967,153	\$54,511,736	\$54,511,736	\$93,931,515
Costs of Cessation Program	\$37,732,147	\$50,273,255	\$34,844,773	\$44,702,932
Lost Tax Revenue	\$5,338,760	\$5,710,052	\$5,710,052	\$9,839,236
Lost Business Revenue	\$2,297,182	\$2,456,943	\$2,456,943	\$4,233,664
Benefit/Cost Ratio	1.12	0.93	1.27	1.60

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$47,206,800	\$62,260,088	\$62,260,088	\$146,766,793
Costs of Cessation Program	\$23,493,601	\$36,034,709	\$20,606,227	\$30,464,386
Lost Tax Revenue	\$4,944,867	\$6,521,685	\$6,521,685	\$15,373,681
Lost Business Revenue	\$2,127,696	\$2,806,175	\$2,806,175	\$6,615,046
Benefit/Cost Ratio	1.54	1.37	2.08	2.80

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$63,794,118	\$81,105,399	\$81,105,399	\$178,288,110
Costs of Cessation Program	\$37,732,147	\$50,273,255	\$34,844,773	\$44,702,932
Lost Tax Revenue	\$6,682,373	\$8,495,713	\$8,495,713	\$18,675,509
Lost Business Revenue	\$2,875,317	\$3,655,568	\$3,655,568	\$8,035,770
Benefit/Cost Ratio	1.35	1.30	1.73	2.50

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Mississippi

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Mississippi the annual direct costs to the economy attributable to smoking were in excess of approximately \$3.5 billion, including workplace productivity losses of \$660 million, premature death losses of \$1.7 billion, and direct medical expenditures of \$1 billion. While the retail price of a pack of cigarettes in Mississippi is on average \$4.91, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$13.43 per pack of cigarettes. The ratio of benefits to cost varies from \$0.88 to \$2.48 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in MS ¹	504,651
Visiting Smokers in MS ²	29,090
Total Smokers	533,741
Total Packs Sold to Residents	258,215,497
Total Packs Sold to Visitors	14,884,503
Total Packs Sold ³	273,100,000
Average Packs Per Resident Smoker Per Year	512

¹ Data from the Behavioral Risk Factor Surveillance System, Mississippi Calculated Variable Data Report, 2005. Retrieved on September 28, 2009 from:

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

² Data from http://www.visitmississippi.org/press_news/docs/07_EIR-TEXT-FINAL-01-31-08.pdf, Fiscal Year 2007 Economic Impact for Tourism in Mississippi.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,230,181,734	\$9.19	\$4,700.98
Women	\$541,204,506	\$4.35	\$2,227.49
Combined	\$1,771,386,240	\$6.86	\$3,510.12
Workplace Productivity²			
Current Smokers ³	\$449,354,001	\$1.74	\$890.43
Former Smokers ⁴	\$211,433,460	\$0.82	\$418.97
Combined	\$660,787,461	\$2.56	\$1,309.39
Total Productivity Losses	\$2,432,173,700	\$9.42	\$4,819.52

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Mississippi. Total expenditures per pack for both medical care and productivity losses are \$13.43 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$134,450,316	\$0.52	\$266.42
Hospital Care	\$559,604,018	\$2.17	\$1,108.89
Rx	\$181,689,616	\$0.70	\$360.03
Nursing Home	\$89,633,544	\$0.35	\$177.61
Other Care ²	\$66,619,526	\$0.26	\$132.01
Total	\$1,033,208,284	\$4.00	\$2,047.37
Neonatal Expenditures	\$2,352,167	\$0.01	\$4.66
Total Expenditures	\$1,035,560,452	\$4.01	\$2,052.03

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.01
Federal Tax ²	\$1.01
State Tax ²	\$0.68
State Sales Tax ³	\$0.32
Distributor & Retailer Mark-ups ¹	\$0.54
Final Retail Price	\$4.91

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$20,069,677	\$24,162,118	\$24,162,118	\$51,686,552
Costs of Cessation Program	\$11,657,438	\$17,880,290	\$10,224,734	\$15,116,316
Lost Tax Revenue	\$3,005,459	\$3,618,308	\$3,618,308	\$7,740,126
Lost Business Revenue	\$804,072	\$968,032	\$968,032	\$2,070,772
Benefit/Cost Ratio	1.30	1.08	1.63	2.07

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$27,657,538	\$32,363,845	\$32,363,845	\$64,016,944
Costs of Cessation Program	\$18,722,552	\$24,945,404	\$17,289,848	\$22,181,430
Lost Tax Revenue	\$4,141,751	\$4,846,526	\$4,846,526	\$9,586,618
Lost Business Revenue	\$1,108,073	\$1,296,626	\$1,296,626	\$2,564,778
Benefit/Cost Ratio	1.15	1.04	1.38	1.86

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$17,359,961	\$18,844,104	\$18,844,104	\$35,349,451
Costs of Cessation Program	\$11,657,438	\$17,880,290	\$10,224,734	\$15,116,316
Lost Tax Revenue	\$2,599,676	\$2,821,928	\$2,821,928	\$5,293,625
Lost Business Revenue	\$695,510	\$754,971	\$754,971	\$1,416,242
Benefit/Cost Ratio	1.16	0.88	1.37	1.62

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$24,541,364	\$26,248,128	\$26,248,128	\$45,229,277
Costs of Cessation Program	\$18,722,552	\$24,945,404	\$17,289,848	\$22,181,430
Lost Tax Revenue	\$3,675,100	\$3,930,690	\$3,930,690	\$6,773,141
Lost Business Revenue	\$983,226	\$1,051,606	\$1,051,606	\$1,812,068
Benefit/Cost Ratio	1.05	0.88	1.18	1.47

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$22,730,704	\$29,979,063	\$29,979,063	\$70,670,169
Costs of Cessation Program	\$11,657,438	\$17,880,290	\$10,224,734	\$15,116,316
Lost Tax Revenue	\$3,403,952	\$4,489,402	\$4,489,402	\$10,582,947
Lost Business Revenue	\$910,684	\$1,201,082	\$1,201,082	\$2,831,333
Benefit/Cost Ratio	1.42	1.27	1.88	2.48

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$30,717,718	\$39,053,331	\$39,053,331	\$85,848,103
Costs of Cessation Program	\$18,722,552	\$24,945,404	\$17,289,848	\$22,181,430
Lost Tax Revenue	\$4,600,017	\$5,848,285	\$5,848,285	\$12,855,861
Lost Business Revenue	\$1,230,676	\$1,564,634	\$1,564,634	\$3,439,422
Benefit/Cost Ratio	1.25	1.21	1.58	2.23

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for Montana

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Montana the annual direct costs to the economy attributable to smoking were in excess of \$939 million, including workplace productivity losses of \$228 million, premature death losses of \$349 million, and direct medical expenditures of \$361 million. While the retail price of a pack of cigarettes in Montana is on average \$5.78, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$21.24 per pack of cigarettes. The ratio of benefits to cost varies from \$0.90 to \$2.67 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. All therapies had a positive break even to costs at the mid-point of the range of treatment effectiveness. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in MT ¹	136,046
Visiting Smokers in MT ²	18,633
Total Smokers	154,679
Total Packs Sold to Residents	44,240,616
Total Packs Sold to Visitors	6,059,384
Total Packs Sold ³	50,300,000
Average Packs Per Resident Smoker Per Year	325

¹ Data from the Behavioral Risk Factor Surveillance System, Montana Calculated Variable Data Report, 2005. Retrieved on September 28, 2009 from:

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

² Data from <http://www.itrr.umt.edu/nonres/08VisitationTrends.pdf>, Montana Nonresident Visitation.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$222,147,442	\$10.13	\$3,295.22
Women	\$127,022,031	\$5.69	\$1,850.82
Combined	\$349,169,473	\$7.89	\$2,566.55
Workplace Productivity²			
Current Smokers ³	\$155,578,245	\$3.52	\$1,143.57
Former Smokers ⁴	\$73,203,858	\$1.65	\$538.08
Combined	\$228,782,103	\$5.17	\$1,681.65
Total Productivity Losses	\$577,951,576	\$13.06	\$4,248.21

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Montana. Total expenditures per pack for both medical care and productivity losses are \$21.23 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$53,295,621	\$1.20	\$391.75
Hospital Care	\$207,126,163	\$4.68	\$1,522.47
Rx	\$42,394,244	\$0.96	\$311.62
Nursing Home	\$29,070,339	\$0.66	\$213.68
Other Care ²	\$29,070,339	\$0.66	\$213.68
Total	\$360,956,704	\$8.16	\$2,653.20
Neonatal Expenditures	\$595,018	\$0.01	\$4.37
Total Expenditures	\$361,551,722	\$8.17	\$2,657.57

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.71
Federal Tax ²	\$1.01
State Tax ²	\$1.70
State Sales Tax ³	\$0.00
Distributor & Retailer Mark-ups ¹	\$0.71
Final Retail Price	\$5.78

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,437,420	\$6,546,174	\$6,546,174	\$14,003,290
Costs of Cessation Program	\$3,142,663	\$4,820,246	\$2,756,428	\$4,075,122
Lost Tax Revenue	\$693,881	\$835,372	\$835,372	\$1,786,990
Lost Business Revenue	\$182,802	\$220,077	\$220,077	\$470,779
Benefit/Cost Ratio	1.35	1.11	1.72	2.21

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$7,493,178	\$8,768,244	\$8,768,244	\$17,343,928
Costs of Cessation Program	\$5,047,307	\$6,724,890	\$4,661,072	\$5,979,766
Lost Tax Revenue	\$956,221	\$1,118,935	\$1,118,935	\$2,213,296
Lost Business Revenue	\$251,914	\$294,781	\$294,781	\$583,088
Benefit/Cost Ratio	1.20	1.08	1.44	1.98

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$4,703,284	\$5,105,379	\$5,105,379	\$9,577,126
Costs of Cessation Program	\$3,142,663	\$4,820,246	\$2,756,428	\$4,075,122
Lost Tax Revenue	\$600,196	\$651,509	\$651,509	\$1,222,158
Lost Business Revenue	\$158,120	\$171,639	\$171,639	\$321,975
Benefit/Cost Ratio	1.21	0.90	1.43	1.70

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,648,922	\$7,111,330	\$7,111,330	\$12,253,839
Costs of Cessation Program	\$5,047,307	\$6,724,890	\$4,661,072	\$5,979,766
Lost Tax Revenue	\$848,483	\$907,492	\$907,492	\$1,563,739
Lost Business Revenue	\$223,531	\$239,077	\$239,077	\$411,964
Benefit/Cost Ratio	1.09	0.90	1.22	1.54

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,158,365	\$8,122,142	\$8,122,142	\$19,146,467
Costs of Cessation Program	\$3,142,663	\$4,820,246	\$2,756,428	\$4,075,122
Lost Tax Revenue	\$785,882	\$1,036,484	\$1,036,484	\$2,443,322
Lost Business Revenue	\$207,039	\$273,060	\$273,060	\$643,688
Benefit/Cost Ratio	1.49	1.33	2.00	2.67

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$8,322,264	\$10,580,607	\$10,580,607	\$23,258,581
Costs of Cessation Program	\$5,047,307	\$6,724,890	\$4,661,072	\$5,979,766
Lost Tax Revenue	\$1,062,022	\$1,350,214	\$1,350,214	\$2,968,078
Lost Business Revenue	\$279,788	\$355,711	\$355,711	\$781,934
Benefit/Cost Ratio	1.30	1.25	1.66	2.39

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for North Carolina

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April 30, 2010

Acknowledgements

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in North Carolina the annual direct costs to the economy attributable to smoking were in excess of \$9.6 billion, including workplace productivity losses of \$2.2 billion, premature death losses of \$4 billion, and direct medical expenditures of \$3.3 billion. While the retail price of a pack of cigarettes in North Carolina is on average \$4.45, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$14.97 per pack of cigarettes. The ratio of benefits to cost varies from \$0.89 to \$2.77 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. All therapies had a positive break even to costs at the mid-point of the range of treatment effectiveness. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

Table 1: Baseline data on smokers and smoking in North Carolina.

Variable	Total
Resident Smokers in NC ¹	1,455,039
Visiting Smokers in NC ²	49,585
Total Smokers	1,504,624
Total Packs Sold to Residents	645,985,938
Total Packs Sold to Visitors	22,014,062
Total Packs Sold ³	668,000,000
Average Packs Per Resident Smoker Per Year	444

¹ Data from the Behavioral Risk Factor Surveillance System, North Carolina Calculated Variable Data Report, 2005. Retrieved on October 5, 2009 from:

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

² Data from <http://www.nccommerce.com/NR/rdonlyres/62941F72-A743-4BA2-8343-74E65039C3EE/0/2008NorthCarolinaRegionalTravelSummary.pdf>, 2008 North Carolina Regional Travel Summary.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$2,727,970,266	\$7.69	\$3,415.55
Women	\$1,329,743,256	\$4.56	\$2,025.98
Combined	\$4,057,713,522	\$6.28	\$2,788.73
Workplace Productivity²			
Current Smokers ³	\$1,525,345,755	\$2.36	\$1,048.32
Former Smokers ⁴	\$717,717,280	\$1.11	\$493.26
Combined	\$2,243,063,036	\$3.47	\$1,541.58
Total Productivity Losses	\$6,300,776,558	\$9.75	\$4,330.31

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 North Carolina. Total expenditures per pack for both medical care and productivity losses are \$14.97 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$472,393,002	\$0.73	\$324.66
Hospital Care	\$1,722,417,562	\$2.67	\$1,183.76
Rx	\$631,068,600	\$0.98	\$433.71
Nursing Home	\$288,280,858	\$0.45	\$198.13
Other Care ²	\$248,309,142	\$0.38	\$170.65
Total	\$3,362,469,165	\$5.21	\$2,310.91
Neonatal Expenditures	\$7,225,115	\$0.01	\$4.97
Total Expenditures	\$3,369,694,280	\$5.22	\$2,315.88

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.65
Federal Tax ²	\$1.01
State Tax ²	\$0.45
State Sales Tax ³	\$0.19
Distributor & Retailer Mark-ups ¹	\$0.43
Final Retail Price	\$4.45

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
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Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
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Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$55,968,312	\$67,380,903	\$67,380,903	\$144,138,297
Costs of Cessation Program	\$33,611,401	\$51,553,487	\$29,480,545	\$43,584,238
Lost Tax Revenue	\$6,174,108	\$7,433,080	\$7,433,080	\$15,900,521
Lost Business Revenue	\$1,624,732	\$1,956,034	\$1,956,034	\$4,184,264
Benefit/Cost Ratio	1.35	1.11	1.73	2.26

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$77,128,580	\$90,253,060	\$90,253,060	\$178,524,063
Costs of Cessation Program	\$53,981,947	\$71,924,033	\$49,851,091	\$63,954,784
Lost Tax Revenue	\$8,508,389	\$9,956,207	\$9,956,207	\$19,693,765
Lost Business Revenue	\$2,239,005	\$2,620,002	\$2,620,002	\$5,182,465
Benefit/Cost Ratio	1.19	1.07	1.45	2.01

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$48,411,725	\$52,550,555	\$52,550,555	\$98,579,019
Costs of Cessation Program	\$33,611,401	\$51,553,487	\$29,480,545	\$43,584,238
Lost Tax Revenue	\$5,340,508	\$5,797,080	\$5,797,080	\$10,874,680
Lost Business Revenue	\$1,405,369	\$1,525,517	\$1,525,517	\$2,861,700
Benefit/Cost Ratio	1.20	0.89	1.43	1.72

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$68,438,506	\$73,198,160	\$73,198,160	\$126,130,894
Costs of Cessation Program	\$53,981,947	\$71,924,033	\$49,851,091	\$63,954,784
Lost Tax Revenue	\$7,549,749	\$8,074,807	\$8,074,807	\$13,914,047
Lost Business Revenue	\$1,986,736	\$2,124,906	\$2,124,906	\$3,661,518
Benefit/Cost Ratio	1.08	0.89	1.22	1.55

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$63,389,118	\$83,602,617	\$83,602,617	\$197,077,912
Costs of Cessation Program	\$33,611,401	\$51,553,487	\$29,480,545	\$43,584,238
Lost Tax Revenue	\$6,992,729	\$9,222,568	\$9,222,568	\$21,740,520
Lost Business Revenue	\$1,840,155	\$2,426,943	\$2,426,943	\$5,721,075
Benefit/Cost Ratio	1.49	1.32	2.03	2.77

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$85,662,507	\$108,908,032	\$108,908,032	\$239,404,620
Costs of Cessation Program	\$53,981,947	\$71,924,033	\$49,851,091	\$63,954,784
Lost Tax Revenue	\$9,449,803	\$12,014,118	\$12,014,118	\$26,409,763
Lost Business Revenue	\$2,486,740	\$3,161,546	\$3,161,546	\$6,949,798
Benefit/Cost Ratio	1.30	1.25	1.67	2.46

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for North Dakota

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in North Dakota the annual direct costs to the economy attributable to smoking were in excess of \$674 million, including workplace productivity losses of approximately \$170 million, premature death losses of approximately \$202 million, and direct medical expenditures of \$303 million. While the retail price of a pack of cigarettes in North Dakota is on average \$4.45, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$17.14 per pack of cigarettes. The ratio of benefits to cost varies from \$0.94 to \$2.99 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. All therapies had a positive break even to costs at the mid-point of the range of treatment effectiveness. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the treatment effectiveness range, though it was very close to breakeven. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

Table 1: Baseline data on smokers and smoking in North Dakota.

Variable	Total
Resident Smokers in ND ¹	97,774
Visiting Smokers in ND ²	19,702
Total Smokers	117,476
Total Packs Sold to Residents	39,367,331
Total Packs Sold to Visitors	7,932,669
Total Packs Sold ³	47,300,000
Average Packs Per Resident Smoker Per Year	403

¹ Data from the Behavioral Risk Factor Surveillance System, North Dakota Calculated Variable Data Report, 2005. Retrieved on October 5, 2009 from:

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

² Data from <https://www.ndtourism.com/uploads/resources/549/06-visitor-study-webonly-mrktshare.pdf>, North Dakota 2006 Visitors Study.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$135,469,497	\$6.47	\$2,606.13
Women	\$66,398,577	\$3.60	\$1,449.97
Combined	\$201,868,073	\$5.13	\$2,064.64
Workplace Productivity²			
Current Smokers ³	\$115,425,250	\$2.93	\$1,180.53
Former Smokers ⁴	\$54,310,766	\$1.38	\$555.47
Combined	\$169,736,016	\$4.31	\$1,736.00
Total Productivity Losses	\$371,604,089	\$9.44	\$3,800.64

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in North Dakota. Total expenditures per pack for both medical care and productivity losses are \$17.14 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$36,337,923	\$0.92	\$371.65
Hospital Care	\$174,422,032	\$4.43	\$1,783.93
Rx	\$42,394,244	\$1.08	\$433.59
Nursing Home	\$32,704,131	\$0.83	\$334.49
Other Care ²	\$16,957,698	\$0.43	\$173.44
Total	\$302,816,027	\$7.69	\$3,097.10
Neonatal Expenditures	\$323,414	\$0.01	\$3.31
Total Expenditures	\$303,139,441	\$7.70	\$3,100.41

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.66
Federal Tax ²	\$1.01
State Tax ²	\$0.44
State Sales Tax ³	\$0.21
Distributor & Retailer Mark-ups ¹	\$0.42
Final Retail Price	\$4.45

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
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Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

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³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$3,905,110	\$4,701,408	\$4,701,408	\$10,057,047
Costs of Cessation Program	\$2,258,579	\$3,464,231	\$1,980,999	\$2,928,722
Lost Tax Revenue	\$378,595	\$455,795	\$455,795	\$975,016
Lost Business Revenue	\$96,656	\$116,365	\$116,365	\$248,924
Benefit/Cost Ratio	1.43	1.16	1.84	2.42

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,381,538	\$6,297,281	\$6,297,281	\$12,456,266
Costs of Cessation Program	\$3,627,415	\$4,833,067	\$3,349,835	\$4,297,558
Lost Tax Revenue	\$521,732	\$610,512	\$610,512	\$1,207,617
Lost Business Revenue	\$133,199	\$155,865	\$155,865	\$308,307
Benefit/Cost Ratio	1.26	1.12	1.53	2.14

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$3,377,860	\$3,666,641	\$3,666,641	\$6,878,213
Costs of Cessation Program	\$2,258,579	\$3,464,231	\$1,980,999	\$2,928,722
Lost Tax Revenue	\$327,479	\$355,476	\$355,476	\$666,833
Lost Business Revenue	\$83,606	\$90,754	\$90,754	\$170,244
Benefit/Cost Ratio	1.27	0.94	1.51	1.83

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$4,775,201	\$5,107,299	\$5,107,299	\$8,800,606
Costs of Cessation Program	\$3,627,415	\$4,833,067	\$3,349,835	\$4,297,558
Lost Tax Revenue	\$462,949	\$495,145	\$495,145	\$853,206
Lost Business Revenue	\$118,192	\$126,412	\$126,412	\$217,825
Benefit/Cost Ratio	1.13	0.94	1.29	1.64

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$4,422,887	\$5,833,255	\$5,833,255	\$13,750,835
Costs of Cessation Program	\$2,258,579	\$3,464,231	\$1,980,999	\$2,928,722
Lost Tax Revenue	\$428,792	\$565,526	\$565,526	\$1,333,123
Lost Business Revenue	\$109,472	\$144,380	\$144,380	\$340,349
Benefit/Cost Ratio	1.58	1.40	2.17	2.99

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,976,981	\$7,598,905	\$7,598,905	\$16,704,121
Costs of Cessation Program	\$3,627,415	\$4,833,067	\$3,349,835	\$4,297,558
Lost Tax Revenue	\$579,460	\$736,703	\$736,703	\$1,619,440
Lost Business Revenue	\$147,937	\$188,082	\$188,082	\$413,447
Benefit/Cost Ratio	1.37	1.32	1.78	2.64

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Nebraska

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April 30, 2010

Acknowledgements

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Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Nebraska the annual direct costs to the economy attributable to smoking were in excess of \$1.7 billion, including workplace productivity losses of \$492 million, premature death losses of \$574 million, and direct medical expenditures of \$718 million. While the retail price of a pack of cigarettes in Nebraska is on average \$4.84, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$17.33 per pack of cigarettes. The ratio of benefits to cost varies from \$0.86 to \$2.69 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. All therapies had a positive break even to costs at the mid-point of the range of treatment effectiveness. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in NE ¹	277,733
Visiting Smokers in NE ²	24,462
Total Smokers	302,195
Total Packs Sold to Residents	103,025,754
Total Packs Sold to Visitors	9,074,246
Total Packs Sold ³	112,100,000
Average Packs Per Resident Smoker Per Year	371

¹ Data from the Behavioral Risk Factor Surveillance System, Nebraska Calculated Variable Data Report, 2005. Retrieved on October 5, 2009 from:

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

² Data from <http://industry.visitnebraska.org/pdfs/industry/2008facts.pdf>, Nebraska Travel and Tourism Facts.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$388,664,042	\$7.03	\$2,607.99
Women	\$185,993,017	\$3.90	\$1,445.11
Combined	\$574,657,059	\$5.58	\$2,069.10
Workplace Productivity²			
Current Smokers ³	\$334,956,001	\$3.25	\$1,206.04
Former Smokers ⁴	\$157,606,044	\$1.53	\$567.47
Combined	\$492,562,045	\$4.78	\$1,773.51
Total Productivity Losses	\$1,067,219,104	\$10.36	\$3,842.61

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Nebraska. Total expenditures per pack for both medical care and productivity losses are \$17.33 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$99,323,657	\$0.96	\$357.62
Hospital Care	\$402,139,684	\$3.90	\$1,447.94
Rx	\$102,957,449	\$1.00	\$370.71
Nursing Home	\$70,253,318	\$0.68	\$252.95
Other Care ²	\$41,182,980	\$0.40	\$148.28
Total	\$717,068,352	\$6.96	\$2,581.86
Neonatal Expenditures	\$1,221,097	\$0.01	\$4.40
Total Expenditures	\$718,289,449	\$6.97	\$2,586.26

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.90
Federal Tax ²	\$1.01
State Tax ²	\$0.64
State Sales Tax ³	\$0.25
Distributor & Retailer Mark-ups ¹	\$0.58
Final Retail Price	\$4.84

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$10,333,716	\$12,440,881	\$12,440,881	\$26,612,992
Costs of Cessation Program	\$6,415,632	\$9,840,358	\$5,627,148	\$8,319,214
Lost Tax Revenue	\$1,135,688	\$1,367,268	\$1,367,268	\$2,924,799
Lost Business Revenue	\$345,496	\$415,947	\$415,947	\$889,776
Benefit/Cost Ratio	1.31	1.07	1.68	2.19

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$14,240,645	\$16,663,885	\$16,663,885	\$32,961,812
Costs of Cessation Program	\$10,303,894	\$13,728,620	\$9,515,410	\$12,207,476
Lost Tax Revenue	\$1,565,064	\$1,831,381	\$1,831,381	\$3,622,542
Lost Business Revenue	\$476,120	\$557,138	\$557,138	\$1,102,041
Benefit/Cost Ratio	1.15	1.03	1.40	1.95

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$8,938,505	\$9,702,678	\$9,702,678	\$18,201,149
Costs of Cessation Program	\$6,415,632	\$9,840,358	\$5,627,148	\$8,319,214
Lost Tax Revenue	\$982,352	\$1,066,336	\$1,066,336	\$2,000,328
Lost Business Revenue	\$298,849	\$324,398	\$324,398	\$608,535
Benefit/Cost Ratio	1.16	0.86	1.38	1.67

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$12,636,152	\$13,514,951	\$13,514,951	\$23,288,193
Costs of Cessation Program	\$10,303,894	\$13,728,620	\$9,515,410	\$12,207,476
Lost Tax Revenue	\$1,388,728	\$1,485,309	\$1,485,309	\$2,559,400
Lost Business Revenue	\$422,476	\$451,857	\$451,857	\$778,615
Benefit/Cost Ratio	1.04	0.86	1.18	1.50

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$11,703,857	\$15,435,979	\$15,435,979	\$36,387,504
Costs of Cessation Program	\$6,415,632	\$9,840,358	\$5,627,148	\$8,319,214
Lost Tax Revenue	\$1,286,268	\$1,696,432	\$1,696,432	\$3,999,030
Lost Business Revenue	\$391,305	\$516,085	\$516,085	\$1,216,576
Benefit/Cost Ratio	1.45	1.28	1.97	2.69

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$15,816,307	\$20,108,248	\$20,108,248	\$44,202,501
Costs of Cessation Program	\$10,303,894	\$13,728,620	\$9,515,410	\$12,207,476
Lost Tax Revenue	\$1,738,231	\$2,209,920	\$2,209,920	\$4,857,907
Lost Business Revenue	\$528,801	\$672,297	\$672,297	\$1,477,861
Benefit/Cost Ratio	1.26	1.21	1.62	2.38

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for New Hampshire

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in New Hampshire the annual direct costs to the economy attributable to smoking were in excess of approximately \$ 1.4 billion, including workplace productivity losses of \$344 million, premature death losses of \$483 million, and direct medical expenditures of \$681 million. While the retail price of a pack of cigarettes in New Hampshire is on average \$5.60, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$11.40 per pack of cigarettes. The ratio of benefits to cost varies from \$0.81 to \$2.00 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had an approximately break-even benefits to costs ratio at the mid-point of the treatment effectiveness range. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio until it reached the high end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

Table 1: Baseline data on smokers and smoking in New Hampshire.

Variable	Total
Resident Smokers in NH ¹	204,303
Visiting Smokers in NH ²	44,706
Total Smokers	249,009
Total Packs Sold to Residents	122,495,331
Total Packs Sold to Visitors	26,804,669
Total Packs Sold ³	149,300,000
Average Packs Per Resident Smoker Per Year	600

¹ Data from the Behavioral Risk Factor Surveillance System, New Hampshire Calculated Variable Data Report, 2005. Retrieved on October 5, 2009 from:

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

² Data from http://oz.plymouth.edu/inhs/Barometers/NH_Travel_Barometer_FY2008_Annual.doc, New Hampshire Travel Barometer Summary for Fiscal Year 2008.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$313,126,348	\$5.29	\$3,170.67
Women	\$170,167,932	\$2.69	\$1,612.25
Combined	\$483,294,280	\$3.95	\$2,365.58
Workplace Productivity²			
Current Smokers ³	\$234,123,045	\$1.91	\$1,145.96
Former Smokers ⁴	\$110,161,355	\$0.90	\$539.21
Combined	\$344,284,399	\$2.81	\$1,685.17
Total Productivity Losses	\$827,578,679	\$6.76	\$4,050.74

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in New Hampshire. Total expenditures per pack for both medical care and productivity losses are \$11.40 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$84,788,488	\$0.69	\$415.01
Hospital Care	\$294,337,178	\$2.40	\$1,440.69
Rx	\$85,999,752	\$0.70	\$420.94
Nursing Home	\$52,084,357	\$0.43	\$254.94
Other Care ²	\$52,084,357	\$0.43	\$254.94
Total	\$568,082,867	\$4.64	\$2,780.59
Neonatal Expenditures	\$709,241	\$0.01	\$3.47
Total Expenditures	\$568,792,108	\$4.64	\$2,784.06

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.79
Federal Tax ²	\$1.01
State Tax ²	\$1.78
State Sales Tax ³	\$0.00
Distributor & Retailer Mark-ups ¹	\$0.46
Final Retail Price	\$5.60

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$8,081,563	\$9,729,487	\$9,729,487	\$20,812,896
Costs of Cessation Program	\$4,719,399	\$7,238,660	\$4,139,383	\$6,119,692
Lost Tax Revenue	\$1,977,964	\$2,381,294	\$2,381,294	\$5,093,960
Lost Business Revenue	\$322,761	\$388,576	\$388,576	\$831,226
Benefit/Cost Ratio	1.15	0.97	1.41	1.73

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$11,137,006	\$13,032,120	\$13,032,120	\$25,778,040
Costs of Cessation Program	\$7,579,641	\$10,098,902	\$6,999,625	\$8,979,934
Lost Tax Revenue	\$2,725,784	\$3,189,613	\$3,189,613	\$6,309,179
Lost Business Revenue	\$444,790	\$520,477	\$520,477	\$1,029,524
Benefit/Cost Ratio	1.04	0.94	1.22	1.58

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,990,427	\$7,588,055	\$7,588,055	\$14,234,350
Costs of Cessation Program	\$4,719,399	\$7,238,660	\$4,139,383	\$6,119,692
Lost Tax Revenue	\$1,710,908	\$1,857,178	\$1,857,178	\$3,483,859
Lost Business Revenue	\$279,184	\$303,052	\$303,052	\$568,492
Benefit/Cost Ratio	1.04	0.81	1.20	1.40

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$9,882,200	\$10,569,472	\$10,569,472	\$18,212,711
Costs of Cessation Program	\$7,579,641	\$10,098,902	\$6,999,625	\$8,979,934
Lost Tax Revenue	\$2,418,670	\$2,586,880	\$2,586,880	\$4,457,564
Lost Business Revenue	\$394,675	\$422,124	\$422,124	\$727,379
Benefit/Cost Ratio	0.95	0.81	1.06	1.29

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$9,153,092	\$12,071,827	\$12,071,827	\$28,457,129
Costs of Cessation Program	\$4,719,399	\$7,238,660	\$4,139,383	\$6,119,692
Lost Tax Revenue	\$2,240,221	\$2,954,582	\$2,954,582	\$6,964,887
Lost Business Revenue	\$365,556	\$482,125	\$482,125	\$1,136,521
Benefit/Cost Ratio	1.25	1.13	1.59	2.00

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$12,369,266	\$15,725,811	\$15,725,811	\$34,568,908
Costs of Cessation Program	\$7,579,641	\$10,098,902	\$6,999,625	\$8,979,934
Lost Tax Revenue	\$3,027,380	\$3,848,895	\$3,848,895	\$8,460,746
Lost Business Revenue	\$494,004	\$628,058	\$628,058	\$1,380,613
Benefit/Cost Ratio	1.11	1.08	1.37	1.84

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for New Jersey

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

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Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in New Jersey the annual direct costs to the economy attributable to smoking were in excess of \$8.3 billion, including workplace productivity losses of \$1.8 billion, premature death losses of approximately \$2.9 billion, and direct medical expenditures of \$3.6 billion. While the retail price of a pack of cigarettes in New Jersey is on average \$7.48, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$30.29 per pack of cigarettes. The ratio of benefits to cost varies from \$0.91 to \$2.65 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

Table 1: Baseline data on smokers and smoking in New Jersey.

Variable	Total
Resident Smokers in NJ ¹	1,181,224
Visiting Smokers in NJ ²	93,785
Total Smokers	1,275,009
Total Packs Sold to Residents	275,153,827
Total Packs Sold to Visitors	21,846,173
Total Packs Sold ³	297,000,000
Average Packs Per Resident Smoker Per Year	233

¹ Data from the Behavioral Risk Factor Surveillance System, New Jersey Calculated Variable Data Report, 2005. Retrieved on October 5, 2009 from:

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

² Data from <http://visitnj.org/sites/visitnj.org/files/2008-04-tourism-econ-impact.pdf>, New Jersey Tourism Preliminary 2008 Results.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,829,077,272	\$12.87	\$2,996.80
Women	\$1,060,672,518	\$7.98	\$1,857.96
Combined	\$2,889,749,790	\$10.50	\$2,446.40
Workplace Productivity²			
Current Smokers ³	\$1,234,089,494	\$4.49	\$1,044.75
Former Smokers ⁴	\$580,673,170	\$2.11	\$491.59
Combined	\$1,814,762,665	\$6.60	\$1,536.34
Total Productivity Losses	\$4,704,512,454	\$17.10	\$3,982.74

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 New Jersey. Total expenditures per pack for both medical care and productivity losses are \$30.29 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$546,280,113	\$1.99	\$462.47
Hospital Care	\$1,723,628,826	\$6.26	\$1,459.19
Rx	\$686,786,749	\$2.50	\$581.42
Nursing Home	\$369,435,553	\$1.34	\$312.76
Other Care ²	\$299,182,235	\$1.09	\$253.28
Total	\$3,625,313,476	\$13.18	\$3,069.12
Neonatal Expenditures	\$4,699,584	\$0.02	\$3.98
Total Expenditures	\$3,630,013,060	\$13.19	\$3,073.09

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$4.20
Federal Tax ²	\$1.01
State Tax ²	\$2.70
State Sales Tax ³	\$0.49
Distributor & Retailer Mark-ups ¹	\$0.92
Final Retail Price	\$7.48

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$48,236,465	\$58,072,442	\$58,072,442	\$124,226,041
Costs of Cessation Program	\$27,286,274	\$41,851,948	\$23,932,779	\$35,382,384
Lost Tax Revenue	\$6,687,242	\$8,050,849	\$8,050,849	\$17,222,026
Lost Business Revenue	\$1,466,476	\$1,765,508	\$1,765,508	\$3,776,698
Benefit/Cost Ratio	1.36	1.12	1.72	2.20

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$66,473,508	\$77,784,881	\$77,784,881	\$153,861,521
Costs of Cessation Program	\$43,823,410	\$58,389,084	\$40,469,915	\$51,919,520
Lost Tax Revenue	\$9,215,527	\$10,783,675	\$10,783,675	\$21,330,529
Lost Business Revenue	\$2,020,916	\$2,364,802	\$2,364,802	\$4,677,670
Benefit/Cost Ratio	1.21	1.09	1.45	1.97

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$41,723,797	\$45,290,860	\$45,290,860	\$84,960,636
Costs of Cessation Program	\$27,286,274	\$41,851,948	\$23,932,779	\$35,382,384
Lost Tax Revenue	\$5,784,361	\$6,278,880	\$6,278,880	\$11,778,483
Lost Business Revenue	\$1,268,479	\$1,376,925	\$1,376,925	\$2,582,958
Benefit/Cost Ratio	1.22	0.91	1.43	1.71

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$58,983,940	\$63,086,063	\$63,086,063	\$108,706,305
Costs of Cessation Program	\$43,823,410	\$58,389,084	\$40,469,915	\$51,919,520
Lost Tax Revenue	\$8,177,214	\$8,745,910	\$8,745,910	\$15,070,454
Lost Business Revenue	\$1,793,219	\$1,917,931	\$1,917,931	\$3,304,870
Benefit/Cost Ratio	1.10	0.91	1.23	1.55

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$54,632,109	\$72,053,177	\$72,053,177	\$169,852,214
Costs of Cessation Program	\$27,286,274	\$41,851,948	\$23,932,779	\$35,382,384
Lost Tax Revenue	\$7,573,900	\$9,989,063	\$9,989,063	\$23,547,392
Lost Business Revenue	\$1,660,916	\$2,190,548	\$2,190,548	\$5,163,817
Benefit/Cost Ratio	1.50	1.33	2.00	2.65

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$73,828,499	\$93,862,727	\$93,862,727	\$206,331,620
Costs of Cessation Program	\$43,823,410	\$58,389,084	\$40,469,915	\$51,919,520
Lost Tax Revenue	\$10,235,184	\$13,012,621	\$13,012,621	\$28,604,699
Lost Business Revenue	\$2,244,521	\$2,853,598	\$2,853,598	\$6,272,857
Benefit/Cost Ratio	1.31	1.26	1.67	2.38

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for New Mexico

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in New Mexico the annual direct costs to the economy attributable to smoking were in excess of \$1.5 billion, including workplace productivity losses of \$401 million, premature death losses of \$542 million, and direct medical expenditures of \$586 million. While the retail price of a pack of cigarettes in New Mexico is on average \$4.92, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$24.00 per pack of cigarettes. The ratio of benefits to cost varies from \$0.72 to \$2.53 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies just broke even at the benefits to costs ratio at the midpoint of the treatment effectiveness range and was marginal at the low end of the range. Generic bupropion showed substantial benefits to costs from the societal perspective at high end of the range. Varenicline showed substantial benefits to costs from the societal perspective at the mid-point and high end of the range. While brand name bupropion did not have a positive benefits to cost ratio at the low end to mid-point of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

Table 1: Baseline data on smokers and smoking in New Mexico.

Variable	Total
Resident Smokers in NM ¹	300,174
Visiting Smokers in NM ²	15,333
Total Smokers	315,507
Total Packs Sold to Residents	63,743,925
Total Packs Sold to Visitors	3,256,075
Total Packs Sold ³	67,000,000
Average Packs Per Resident Smoker Per Year	212

¹ Data from the Behavioral Risk Factor Surveillance System, New Mexico Calculated Variable Data Report, 2005. Retrieved on October 5, 2009 from:

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

² Data from

<http://www.newmexico.org/department/research/docs/NM%20Tourism%20Fact%20Sheet%20007%204-10%20final.pdf>, Tourism Fact Sheet and <http://tinet.ita.doc.gov/view/f-2002-45-540/index.html>, Overseas Visitors to Select U.S. States and Territories.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$356,116,656	\$10.13	\$2,151.63
Women	\$186,339,411	\$6.52	\$1,383.73
Combined	\$542,456,066	\$8.51	\$1,807.14
Workplace Productivity²			
Current Smokers ³	\$273,164,189	\$4.29	\$910.02
Former Smokers ⁴	\$128,531,291	\$2.02	\$428.19
Combined	\$401,695,479	\$6.30	\$1,338.21
Total Productivity Losses	\$944,151,545	\$14.81	\$3,145.35

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in New Mexico. Total expenditures per pack for both medical care and productivity losses are \$24.00 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$88,422,280	\$1.39	\$294.57
Hospital Care	\$317,351,196	\$4.98	\$1,057.22
Rx	\$77,520,903	\$1.22	\$258.25
Nursing Home	\$32,704,131	\$0.51	\$108.95
Other Care ²	\$69,042,054	\$1.08	\$230.01
Total	\$585,040,564	\$9.18	\$1,949.00
Neonatal Expenditures	\$952,205	\$0.01	\$3.17
Total Expenditures	\$585,992,769	\$9.19	\$1,952.18

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.15
Federal Tax ²	\$1.01
State Tax ²	\$0.91
State Sales Tax ³	\$0.23
Distributor & Retailer Mark-ups ¹	\$0.40
Final Retail Price	\$4.92

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$8,855,783	\$10,661,581	\$10,661,581	\$22,806,790
Costs of Cessation Program	\$6,934,019	\$10,635,465	\$6,081,825	\$8,991,412
Lost Tax Revenue	\$794,705	\$956,754	\$956,754	\$2,046,647
Lost Business Revenue	\$148,872	\$179,229	\$179,229	\$383,398
Benefit/Cost Ratio	1.12	0.91	1.48	2.00

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$12,203,941	\$14,280,608	\$14,280,608	\$28,247,599
Costs of Cessation Program	\$11,136,455	\$14,837,901	\$10,284,261	\$13,193,848
Lost Tax Revenue	\$1,095,163	\$1,281,520	\$1,281,520	\$2,534,897
Lost Business Revenue	\$205,157	\$240,067	\$240,067	\$474,862
Benefit/Cost Ratio	0.98	0.87	1.21	1.74

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$7,660,116	\$8,314,997	\$8,314,997	\$15,598,013
Costs of Cessation Program	\$6,934,019	\$10,635,465	\$6,081,825	\$8,991,412
Lost Tax Revenue	\$687,407	\$746,175	\$746,175	\$1,399,742
Lost Business Revenue	\$128,772	\$139,781	\$139,781	\$262,214
Benefit/Cost Ratio	0.99	0.72	1.19	1.46

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$10,828,924	\$11,582,037	\$11,582,037	\$19,957,505
Costs of Cessation Program	\$11,136,455	\$14,837,901	\$10,284,261	\$13,193,848
Lost Tax Revenue	\$971,771	\$1,039,355	\$1,039,355	\$1,790,957
Lost Business Revenue	\$182,042	\$194,702	\$194,702	\$335,500
Benefit/Cost Ratio	0.88	0.72	1.01	1.30

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$10,029,966	\$13,228,319	\$13,228,319	\$31,183,347
Costs of Cessation Program	\$6,934,019	\$10,635,465	\$6,081,825	\$8,991,412
Lost Tax Revenue	\$900,074	\$1,187,090	\$1,187,090	\$2,798,347
Lost Business Revenue	\$168,611	\$222,377	\$222,377	\$524,214
Benefit/Cost Ratio	1.25	1.10	1.77	2.53

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$13,554,252	\$17,232,357	\$17,232,357	\$37,880,639
Costs of Cessation Program	\$11,136,455	\$14,837,901	\$10,284,261	\$13,193,848
Lost Tax Revenue	\$1,216,338	\$1,546,406	\$1,546,406	\$3,399,352
Lost Business Revenue	\$227,857	\$289,688	\$289,688	\$636,800
Benefit/Cost Ratio	1.08	1.03	1.42	2.20

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Nevada

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Nevada the annual direct costs to the economy attributable to smoking were in excess of \$2.6 billion, including workplace productivity losses of \$685 million, premature death losses of \$1 billion, and direct medical expenditures of \$860 million. While the retail price of a pack of cigarettes in Nevada is on average \$4.95, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$19.06 per pack of cigarettes. The ratio of benefits to cost varies from \$0.88 to \$2.76 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in NV ¹	400,993
Visiting Smokers in NV ²	66,216
Total Smokers	467,209
Total Packs Sold to Residents	136,293,770
Total Packs Sold to Visitors	22,506,230
Total Packs Sold ¹	158,800,000
Average Packs Per Resident Smoker Per Year	340

¹ Data from the Behavioral Risk Factor Surveillance System, Nevada Calculated Variable Data Report, 2005. Retrieved on October 5, 2009 from:

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

² Data from http://travelnevada.biz/documents/statistics/df_2009_1st_qtr.pdf, Discover the Facts.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$659,986,908	\$8.75	\$2,973.34
Women	\$393,127,411	\$6.46	\$2,195.92
Combined	\$1,053,114,319	\$7.73	\$2,626.27
Workplace Productivity²			
Current Smokers ³	\$465,983,582	\$3.42	\$1,162.07
Former Smokers ⁴	\$219,258,137	\$1.61	\$546.79
Combined	\$685,241,719	\$5.03	\$1,708.86
Total Productivity Losses	\$1,738,356,038	\$12.75	\$4,335.13

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Nevada. Total expenditures per pack for both medical care and productivity losses are \$19.06 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$174,422,032	\$1.28	\$434.98
Hospital Care	\$422,731,174	\$3.10	\$1,054.21
Rx	\$138,084,108	\$1.01	\$344.36
Nursing Home	\$32,704,131	\$0.24	\$81.56
Other Care ²	\$90,844,808	\$0.67	\$226.55
Total	\$858,786,253	\$6.30	\$2,141.65
Neonatal Expenditures	\$1,217,893	\$0.01	\$3.04
Total Expenditures	\$860,004,146	\$6.31	\$2,144.69

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.11
Federal Tax ²	\$1.01
State Tax ²	\$0.80
State Sales Tax ³	\$0.30
Distributor & Retailer Mark-ups ¹	\$0.48
Final Retail Price	\$4.95

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$15,038,134	\$18,104,584	\$18,104,584	\$38,728,539
Costs of Cessation Program	\$9,262,938	\$14,207,583	\$8,124,519	\$12,011,344
Lost Tax Revenue	\$1,665,905	\$2,005,602	\$2,005,602	\$4,290,297
Lost Business Revenue	\$375,442	\$452,000	\$452,000	\$966,898
Benefit/Cost Ratio	1.33	1.09	1.71	2.24

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$20,723,689	\$24,250,107	\$24,250,107	\$47,967,656
Costs of Cessation Program	\$14,876,840	\$19,821,485	\$13,738,421	\$17,625,246
Lost Tax Revenue	\$2,295,743	\$2,686,395	\$2,686,395	\$5,313,794
Lost Business Revenue	\$517,388	\$605,429	\$605,429	\$1,197,562
Benefit/Cost Ratio	1.17	1.05	1.42	1.99

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$13,007,753	\$14,119,816	\$14,119,816	\$26,487,211
Costs of Cessation Program	\$9,262,938	\$14,207,583	\$8,124,519	\$12,011,344
Lost Tax Revenue	\$1,440,982	\$1,564,175	\$1,564,175	\$2,934,219
Lost Business Revenue	\$324,752	\$352,516	\$352,516	\$661,280
Benefit/Cost Ratio	1.18	0.88	1.41	1.70

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$18,388,752	\$19,667,624	\$19,667,624	\$33,890,128
Costs of Cessation Program	\$14,876,840	\$19,821,485	\$13,738,421	\$17,625,246
Lost Tax Revenue	\$2,037,082	\$2,178,754	\$2,178,754	\$3,754,304
Lost Business Revenue	\$459,094	\$491,022	\$491,022	\$846,102
Benefit/Cost Ratio	1.06	0.87	1.20	1.52

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$17,032,031	\$22,463,199	\$22,463,199	\$52,952,892
Costs of Cessation Program	\$9,262,938	\$14,207,583	\$8,124,519	\$12,011,344
Lost Tax Revenue	\$1,886,786	\$2,488,444	\$2,488,444	\$5,866,052
Lost Business Revenue	\$425,222	\$560,817	\$560,817	\$1,322,023
Benefit/Cost Ratio	1.47	1.30	2.01	2.76

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$23,016,671	\$29,262,515	\$29,262,515	\$64,325,661
Costs of Cessation Program	\$14,876,840	\$19,821,485	\$13,738,421	\$17,625,246
Lost Tax Revenue	\$2,549,757	\$3,241,663	\$3,241,663	\$7,125,913
Lost Business Revenue	\$574,635	\$730,569	\$730,569	\$1,605,956
Benefit/Cost Ratio	1.28	1.23	1.65	2.44

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for New York

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in New York the annual direct costs to the economy attributable to smoking were in excess of \$20.6 billion, including workplace productivity losses of \$3.9 billion, premature death losses of approximately \$6.9 billion, and direct medical expenditures of \$9.8 billion. While the retail price of a pack of cigarettes in New York is on average \$7.89, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$36.24 per pack of cigarettes. The ratio of benefits to cost varies from \$0.91 to \$2.73 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range.. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

Table 1: Baseline data on smokers and smoking in New York.

Variable	Total
Resident Smokers in NY ¹	2,994,052
Visiting Smokers in NY ²	204,952
Total Smokers	3,199,004
Total Packs Sold to Residents	568,859,807
Total Packs Sold to Visitors	38,940,193
Total Packs Sold ³	607,800,000
Average Packs Per Resident Smoker Per Year	190

¹ Data from the Behavioral Risk Factor Surveillance System, New York Calculated Variable Data Report, 2005. Retrieved on October 5, 2009 from:

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

² Data from <http://thebeat.iloveny.com/industry/wp-content/uploads/2009/03/year-in-review-2008-2009.pdf>, Year in Review 2008-2009.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$4,370,165,254	\$14.43	\$2,741.72
Women	\$2,516,494,024	\$9.46	\$1,797.37
Combined	\$6,886,659,279	\$12.11	\$2,300.11
Workplace Productivity²			
Current Smokers ³	\$2,653,546,943	\$4.66	\$886.27
Former Smokers ⁴	\$1,248,567,079	\$2.19	\$417.02
Combined	\$3,902,114,022	\$6.86	\$1,303.29
Total Productivity Losses	\$10,788,773,301	\$18.97	\$3,603.40

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in New York. Total expenditures per pack for both medical care and productivity losses are \$36.25 per pack.

Cost Component ¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$1,243,968,239	\$2.19	\$415.48
Hospital Care	\$5,007,365,824	\$8.80	\$1,672.44
Rx	\$1,564,953,228	\$2.75	\$522.69
Nursing Home	\$1,172,503,657	\$2.06	\$391.61
Other Care ²	\$830,927,178	\$1.46	\$277.53
Total	\$9,819,718,126	\$17.26	\$3,279.74
Neonatal Expenditures	\$8,750,776	\$0.02	\$2.92
Total Expenditures	\$9,828,468,903	\$17.28	\$3,282.66

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$4.06
Federal Tax ²	\$1.01
State Tax ²	\$2.75
State Sales Tax ³	\$0.30
Distributor & Retailer Mark-ups ¹	\$1.47
Final Retail Price	\$7.89

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
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Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$119,323,274	\$143,654,680	\$143,654,680	\$307,299,843
Costs of Cessation Program	\$69,162,601	\$106,082,256	\$60,662,488	\$89,683,834
Lost Tax Revenue	\$13,378,392	\$16,106,402	\$16,106,402	\$34,454,115
Lost Business Revenue	\$4,837,301	\$5,823,683	\$5,823,683	\$12,457,769
Benefit/Cost Ratio	1.37	1.12	1.74	2.25

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$164,436,525	\$192,417,641	\$192,417,641	\$380,609,579
Costs of Cessation Program	\$111,079,329	\$147,998,984	\$102,579,216	\$131,600,562
Lost Tax Revenue	\$18,436,440	\$21,573,651	\$21,573,651	\$42,673,521
Lost Business Revenue	\$6,666,168	\$7,800,507	\$7,800,507	\$15,429,706
Benefit/Cost Ratio	1.21	1.08	1.46	2.01

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$103,212,789	\$112,036,688	\$112,036,688	\$210,168,414
Costs of Cessation Program	\$69,162,601	\$106,082,256	\$60,662,488	\$89,683,834
Lost Tax Revenue	\$11,572,103	\$12,561,428	\$12,561,428	\$23,563,848
Lost Business Revenue	\$4,184,191	\$4,541,907	\$4,541,907	\$8,520,114
Benefit/Cost Ratio	1.22	0.91	1.44	1.73

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$145,909,467	\$156,056,950	\$156,056,950	\$268,908,435
Costs of Cessation Program	\$111,079,329	\$147,998,984	\$102,579,216	\$131,600,562
Lost Tax Revenue	\$16,359,207	\$17,496,931	\$17,496,931	\$30,149,713
Lost Business Revenue	\$5,915,091	\$6,326,464	\$6,326,464	\$10,901,402
Benefit/Cost Ratio	1.09	0.91	1.23	1.56

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$135,144,277	\$178,239,037	\$178,239,037	\$420,165,999
Costs of Cessation Program	\$69,162,601	\$106,082,256	\$60,662,488	\$89,683,834
Lost Tax Revenue	\$15,152,225	\$19,983,962	\$19,983,962	\$47,108,543
Lost Business Revenue	\$5,478,676	\$7,225,714	\$7,225,714	\$17,033,302
Benefit/Cost Ratio	1.51	1.34	2.03	2.73

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$182,630,679	\$232,189,653	\$232,189,653	\$510,405,658
Costs of Cessation Program	\$111,079,329	\$147,998,984	\$102,579,216	\$131,600,562
Lost Tax Revenue	\$20,476,348	\$26,032,845	\$26,032,845	\$57,226,112
Lost Business Revenue	\$7,403,749	\$9,412,843	\$9,412,843	\$20,691,569
Benefit/Cost Ratio	1.31	1.27	1.68	2.44

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Ohio

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April 30, 2010

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Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Ohio the annual direct costs to the economy attributable to smoking were in excess of \$13.8 billion, including workplace productivity losses of \$2.9 billion, premature death losses of \$5.7 billion, and direct medical expenditures of \$5.2 billion. While the retail price of a pack of cigarettes in Ohio is on average \$5.33, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$20.88 per pack of cigarettes. The ratio of benefits to cost varies from \$0.95 to \$2.88 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in OH ¹	1,934,247
Visiting Smokers in OH ²	227,827
Total Smokers	2,162,074
Total Packs Sold to Residents	664,080,576
Total Packs Sold to Visitors	78,219,424
Total Packs Sold ³	742,300,000
Average Packs Per Resident Smoker Per Year	343

¹ Data from the Behavioral Risk Factor Surveillance System, Ohio Calculated Variable Data Report, 2005. Retrieved on October 12, 2009 from:

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

² Data from <http://www.ohiotravel.org/pages/statistics.html>, Fast Facts About Ohio Tourism.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$3,689,496,934	\$11.84	\$4,064.93
Women	\$2,029,974,307	\$5.76	\$1,977.37
Combined	\$5,719,471,241	\$8.61	\$2,956.95
Workplace Productivity²			
Current Smokers ³	\$1,979,303,687	\$2.98	\$1,023.29
Former Smokers ⁴	\$931,317,017	\$1.40	\$481.49
Combined	\$2,910,620,704	\$4.38	\$1,504.78
Total Productivity Losses	\$8,630,091,945	\$13.00	\$4,461.73

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Ohio. Total expenditures per pack for both medical care and productivity losses are \$20.89 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$731,603,521	\$1.10	\$378.24
Hospital Care	\$2,726,555,508	\$4.11	\$1,409.62
Rx	\$784,899,142	\$1.18	\$405.79
Nursing Home	\$623,801,016	\$0.94	\$322.50
Other Care ²	\$364,590,497	\$0.55	\$188.49
Total	\$5,229,027,156	\$7.87	\$2,703.39
Neonatal Expenditures	\$10,001,979	\$0.02	\$5.17
Total Expenditures	\$5,239,029,135	\$7.89	\$2,708.56

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.54
Federal Tax ²	\$1.01
State Tax ²	\$1.25
State Sales Tax ³	\$0.28
Distributor & Retailer Mark-ups ¹	\$0.43
Final Retail Price	\$5.33

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$80,268,201	\$96,635,822	\$96,635,822	\$206,719,148
Costs of Cessation Program	\$44,681,106	\$68,532,305	\$39,189,778	\$57,938,435
Lost Tax Revenue	\$9,754,364	\$11,743,393	\$11,743,393	\$25,120,955
Lost Business Revenue	\$1,670,243	\$2,010,825	\$2,010,825	\$4,301,469
Benefit/Cost Ratio	1.43	1.17	1.83	2.37

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$110,615,671	\$129,438,435	\$129,438,435	\$256,034,260
Costs of Cessation Program	\$71,760,564	\$95,611,763	\$66,269,236	\$85,017,893
Lost Tax Revenue	\$13,442,254	\$15,729,637	\$15,729,637	\$31,113,833
Lost Business Revenue	\$2,301,721	\$2,693,390	\$2,693,390	\$5,327,631
Benefit/Cost Ratio	1.26	1.14	1.53	2.11

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$69,430,754	\$75,366,549	\$75,366,549	\$141,379,295
Costs of Cessation Program	\$44,681,106	\$68,532,305	\$39,189,778	\$57,938,435
Lost Tax Revenue	\$8,437,374	\$9,158,705	\$9,158,705	\$17,180,715
Lost Business Revenue	\$1,444,734	\$1,568,248	\$1,568,248	\$2,941,859
Benefit/Cost Ratio	1.27	0.95	1.51	1.81

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$98,152,607	\$104,978,771	\$104,978,771	\$180,893,430
Costs of Cessation Program	\$71,760,564	\$95,611,763	\$66,269,236	\$85,017,893
Lost Tax Revenue	\$11,927,715	\$12,757,246	\$12,757,246	\$21,982,558
Lost Business Revenue	\$2,042,386	\$2,184,427	\$2,184,427	\$3,764,080
Benefit/Cost Ratio	1.14	0.95	1.29	1.63

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$90,910,915	\$119,900,555	\$119,900,555	\$282,643,675
Costs of Cessation Program	\$44,681,106	\$68,532,305	\$39,189,778	\$57,938,435
Lost Tax Revenue	\$11,047,690	\$14,570,573	\$14,570,573	\$34,347,466
Lost Business Revenue	\$1,891,699	\$2,494,924	\$2,494,924	\$5,881,327
Benefit/Cost Ratio	1.58	1.40	2.13	2.88

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$122,854,792	\$156,192,879	\$156,192,879	\$343,347,466
Costs of Cessation Program	\$71,760,564	\$95,611,763	\$66,269,236	\$85,017,893
Lost Tax Revenue	\$14,929,578	\$18,980,894	\$18,980,894	\$41,724,321
Lost Business Revenue	\$2,556,396	\$3,250,104	\$3,250,104	\$7,144,468
Benefit/Cost Ratio	1.38	1.33	1.76	2.56

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Oklahoma

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Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Oklahoma the annual direct costs to the economy attributable to smoking were in excess of \$4.3 billion, including workplace productivity losses of \$903 million, premature death losses of \$2.1 billion, and direct medical expenditures of \$1.3 billion. While the retail price of a pack of cigarettes in Oklahoma is on average \$4.91, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$14.18 per pack of cigarettes. The ratio of benefits to cost varies from \$0.85 to \$2.47 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in OK ¹	665,561
Visiting Smokers in OK ²	17,983
Total Smokers	683,544
Total Packs Sold to Residents	305,544,452
Total Packs Sold to Visitors	8,255,548
Total Packs Sold ³	313,800,000
Average Packs Per Resident Smoker Per Year	459

¹ Data from the Behavioral Risk Factor Surveillance System, Oklahoma Calculated Variable Data Report, 2005. Retrieved on October 12, 2009 from:

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

² Data from <http://www.travelok.com/industry/pdf/2008-FINAL-OT-J134.pdf>, 2008 Annual Report.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,361,265,090	\$8.68	\$3,983.98
Women	\$753,403,064	\$5.07	\$2,326.21
Combined	\$2,114,668,154	\$6.92	\$3,177.27
Workplace Productivity²			
Current Smokers ³	\$614,145,198	\$2.01	\$922.75
Former Smokers ⁴	\$288,972,267	\$0.95	\$434.18
Combined	\$903,117,466	\$2.96	\$1,356.93
Total Productivity Losses	\$3,017,785,620	\$9.88	\$4,534.20

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in Oklahoma. Total expenditures per pack for both medical care and productivity losses are \$14.18 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$199,858,578	\$0.65	\$300.29
Hospital Care	\$683,152,957	\$2.24	\$1,026.43
Rx	\$220,450,068	\$0.72	\$331.22
Nursing Home	\$105,379,977	\$0.34	\$158.33
Other Care ²	\$102,957,449	\$0.34	\$154.69
Total	\$1,311,799,029	\$4.29	\$1,970.97
Neonatal Expenditures	\$3,227,177	\$0.01	\$4.85
Total Expenditures	\$1,315,026,206	\$4.30	\$1,975.82

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.04
Federal Tax ²	\$1.01
State Tax ²	\$1.03
State Sales Tax ³	\$0.00
Distributor & Retailer Mark-ups ¹	\$0.51
Final Retail Price	\$4.91

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
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Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$25,076,355	\$30,189,716	\$30,189,716	\$64,580,528
Costs of Cessation Program	\$15,374,459	\$23,581,492	\$13,484,931	\$19,936,214
Lost Tax Revenue	\$3,607,440	\$4,343,039	\$4,343,039	\$9,290,441
Lost Business Revenue	\$896,561	\$1,079,381	\$1,079,381	\$2,308,964
Benefit/Cost Ratio	1.26	1.04	1.60	2.05

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$34,557,120	\$40,437,485	\$40,437,485	\$79,986,919
Costs of Cessation Program	\$24,692,313	\$32,899,346	\$22,802,785	\$29,254,068
Lost Tax Revenue	\$4,971,326	\$5,817,265	\$5,817,265	\$11,506,777
Lost Business Revenue	\$1,235,529	\$1,445,772	\$1,445,772	\$2,859,793
Benefit/Cost Ratio	1.12	1.01	1.34	1.83

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$21,690,660	\$23,545,044	\$23,545,044	\$44,167,895
Costs of Cessation Program	\$15,374,459	\$23,581,492	\$13,484,931	\$19,936,214
Lost Tax Revenue	\$3,120,380	\$3,387,149	\$3,387,149	\$6,353,916
Lost Business Revenue	\$775,512	\$841,812	\$841,812	\$1,579,146
Benefit/Cost Ratio	1.13	0.85	1.33	1.58

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$30,663,571	\$32,796,113	\$32,796,113	\$56,512,391
Costs of Cessation Program	\$24,692,313	\$32,899,346	\$22,802,785	\$29,254,068
Lost Tax Revenue	\$4,411,207	\$4,717,991	\$4,717,991	\$8,129,773
Lost Business Revenue	\$1,096,322	\$1,172,568	\$1,172,568	\$2,020,502
Benefit/Cost Ratio	1.02	0.85	1.14	1.43

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$28,401,215	\$37,457,784	\$37,457,784	\$88,299,890
Costs of Cessation Program	\$15,374,459	\$23,581,492	\$13,484,931	\$19,936,214
Lost Tax Revenue	\$4,085,749	\$5,388,611	\$5,388,611	\$12,702,667
Lost Business Revenue	\$1,015,436	\$1,339,238	\$1,339,238	\$3,157,008
Benefit/Cost Ratio	1.39	1.24	1.85	2.47

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$38,380,709	\$48,795,763	\$48,795,763	\$107,264,185
Costs of Cessation Program	\$24,692,313	\$32,899,346	\$22,802,785	\$29,254,068
Lost Tax Revenue	\$5,521,381	\$7,019,673	\$7,019,673	\$15,430,837
Lost Business Revenue	\$1,372,235	\$1,744,607	\$1,744,607	\$3,835,044
Benefit/Cost Ratio	1.22	1.17	1.55	2.21

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Oregon

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Oregon the annual direct costs to the economy attributable to smoking were in excess of \$3.3 billion, including workplace productivity losses of approximately \$800 million, premature death losses of \$1.3 billion, and direct medical expenditures of \$1.2 billion. While the retail price of a pack of cigarettes in Oregon is on average \$5.08, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$18.83 per pack of cigarettes. The ratio of benefits to cost varies from \$0.89 to \$2.73 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in OR ¹	509,762
Visiting Smokers in OR ²	28,032
Total Smokers	537,794
Total Packs Sold to Residents	179,053,719
Total Packs Sold to Visitors	9,846,281
Total Packs Sold ³	188,900,000
Average Packs Per Resident Smoker Per Year	351

¹ Data from the Behavioral Risk Factor Surveillance System, Oregon Calculated Variable Data Report, 2005. Retrieved on October 12, 2009 from:

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

² Data from

<http://industry.traveloregon.com/upload/otc/departments/tourismdevelopment/impactoregon08.pdf>, Impact Oregon.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$843,892,476	\$8.62	\$3,029.21
Women	\$472,571,973	\$5.82	\$2,044.22
Combined	\$1,316,464,449	\$7.35	\$2,582.51
Workplace Productivity²			
Current Smokers ³	\$543,461,066	\$3.04	\$1,066.11
Former Smokers ⁴	\$255,713,432	\$1.43	\$501.63
Combined	\$799,174,498	\$4.46	\$1,567.74
Total Productivity Losses	\$2,115,638,948	\$11.82	\$4,150.25

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Oregon. Total expenditures per pack for both medical care and productivity losses are \$18.84 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$234,985,237	\$1.31	\$460.97
Hospital Care	\$655,293,883	\$3.66	\$1,285.49
Rx	\$148,985,485	\$0.83	\$292.26
Nursing Home	\$79,943,431	\$0.45	\$156.83
Other Care ²	\$135,661,580	\$0.76	\$266.13
Total	\$1,254,869,616	\$7.01	\$2,461.68
Neonatal Expenditures	\$1,947,461	\$0.01	\$3.82
Total Expenditures	\$1,256,817,077	\$7.02	\$2,465.50

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.19
Federal Tax ²	\$1.01
State Tax ²	\$1.18
State Sales Tax ³	\$0.00
Distributor & Retailer Mark-ups ¹	\$0.53
Final Retail Price	\$5.08

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$19,518,250	\$23,498,249	\$23,498,249	\$50,266,432
Costs of Cessation Program	\$11,775,502	\$18,061,377	\$10,328,288	\$15,269,411
Lost Tax Revenue	\$2,269,457	\$2,732,226	\$2,732,226	\$5,844,660
Lost Business Revenue	\$546,843	\$658,351	\$658,351	\$1,408,316
Benefit/Cost Ratio	1.34	1.10	1.71	2.23

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$26,897,630	\$31,474,628	\$31,474,628	\$62,258,039
Costs of Cessation Program	\$18,912,170	\$25,198,045	\$17,464,956	\$22,406,079
Lost Tax Revenue	\$3,127,485	\$3,659,669	\$3,659,669	\$7,238,967
Lost Business Revenue	\$753,592	\$881,826	\$881,826	\$1,744,286
Benefit/Cost Ratio	1.18	1.06	1.43	1.98

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$16,882,985	\$18,326,350	\$18,326,350	\$34,378,203
Costs of Cessation Program	\$11,775,502	\$18,061,377	\$10,328,288	\$15,269,411
Lost Tax Revenue	\$1,963,046	\$2,130,871	\$2,130,871	\$3,997,278
Lost Business Revenue	\$473,011	\$513,450	\$513,450	\$963,175
Benefit/Cost Ratio	1.19	0.89	1.41	1.70

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$23,867,075	\$25,526,945	\$25,526,945	\$43,986,575
Costs of Cessation Program	\$18,912,170	\$25,198,045	\$17,464,956	\$22,406,079
Lost Tax Revenue	\$2,775,111	\$2,968,110	\$2,968,110	\$5,114,478
Lost Business Revenue	\$668,685	\$715,189	\$715,189	\$1,232,373
Benefit/Cost Ratio	1.07	0.88	1.21	1.53

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$22,106,164	\$29,155,370	\$29,155,370	\$68,728,462
Costs of Cessation Program	\$11,775,502	\$18,061,377	\$10,328,288	\$15,269,411
Lost Tax Revenue	\$2,570,364	\$3,390,000	\$3,390,000	\$7,991,307
Lost Business Revenue	\$619,349	\$816,847	\$816,847	\$1,925,568
Benefit/Cost Ratio	1.48	1.31	2.01	2.73

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$29,873,730	\$37,980,317	\$37,980,317	\$83,489,374
Costs of Cessation Program	\$18,912,170	\$25,198,045	\$17,464,956	\$22,406,079
Lost Tax Revenue	\$3,473,527	\$4,416,109	\$4,416,109	\$9,707,611
Lost Business Revenue	\$836,973	\$1,064,096	\$1,064,096	\$2,339,125
Benefit/Cost Ratio	1.29	1.24	1.66	2.42

Adjusted for inflation to 2009

PENNS^TATE



Potential Costs and Benefits of Smoking Cessation for Pennsylvania

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Pennsylvania the annual direct costs to the economy attributable to smoking were in excess of \$14.2 billion, including workplace productivity losses of \$3.1 billion, premature death losses of approximately \$5.4 billion, and direct medical expenditures of approximately \$5.7 billion. While the retail price of a pack of cigarettes in Pennsylvania is on average \$5.74, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$20.16 per pack of cigarettes. The ratio of benefits to cost varies from \$0.83 to \$2.49 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had a break-even benefits to costs ratio across the range of treatment effectiveness percentages. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range and an approximate break even at the mid-point of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in PA ¹	2,265,582
Visiting Smokers in PA ²	185,118
Total Smokers	2,450,700
Total Packs Sold to Residents	706,012,572
Total Packs Sold to Visitors	57,687,428
Total Packs Sold ³	763,700,000
Average Packs Per Resident Smoker Per Year	312

¹ Data from the Behavioral Risk Factor Surveillance System, Pennsylvania Calculated Variable Data Report, 2005. Retrieved on October 12, 2009 from:

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

² Data from <http://www.visitpa.com/2008annualreport/statistics/leading-travel/index.aspx>, 2008 Pennsylvania Tourism Story.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$3,476,335,288	\$9.77	\$3,044.42
Women	\$1,918,798,939	\$5.48	\$1,707.55
Combined	\$5,395,134,227	\$7.64	\$2,381.35
Workplace Productivity²			
Current Smokers ³	\$2,144,063,339	\$3.04	\$946.36
Former Smokers ⁴	\$1,008,840,981	\$1.43	\$445.29
Combined	\$3,152,904,320	\$4.47	\$1,391.65
Total Productivity Losses	\$8,548,038,547	\$12.11	\$3,773.00

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

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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 \$20.17 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$806,701,896	\$1.14	\$356.07
Hospital Care	\$2,894,921,219	\$4.10	\$1,277.78
Rx	\$899,969,233	\$1.27	\$397.24
Nursing Home	\$664,983,995	\$0.94	\$293.52
Other Care ²	\$410,618,533	\$0.58	\$181.24
Total	\$5,677,194,876	\$8.04	\$2,505.84
Neonatal Expenditures	\$11,290,529	\$0.02	\$4.98
Total Expenditures	\$5,688,485,405	\$8.06	\$2,510.83

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.93
Federal Tax ²	\$1.01
State Tax ²	\$1.60
State Sales Tax ³	\$0.32
Distributor & Retailer Mark-ups ¹	\$0.44
Final Retail Price	\$5.74

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

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². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$82,394,562	\$99,195,773	\$99,195,773	\$212,195,285
Costs of Cessation Program	\$52,334,944	\$80,271,836	\$45,902,957	\$67,863,243
Lost Tax Revenue	\$11,992,005	\$14,437,315	\$14,437,315	\$30,883,676
Lost Business Revenue	\$1,817,985	\$2,188,694	\$2,188,694	\$4,681,959
Benefit/Cost Ratio	1.25	1.02	1.59	2.05

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$113,545,958	\$132,867,351	\$132,867,351	\$262,816,789
Costs of Cessation Program	\$84,053,092	\$111,989,984	\$77,621,105	\$99,581,391
Lost Tax Revenue	\$16,525,893	\$19,337,999	\$19,337,999	\$38,251,314
Lost Business Revenue	\$2,505,322	\$2,931,637	\$2,931,637	\$5,798,891
Benefit/Cost Ratio	1.10	0.99	1.33	1.83

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$71,270,024	\$77,363,062	\$77,363,062	\$145,124,533
Costs of Cessation Program	\$52,334,944	\$80,271,836	\$45,902,957	\$67,863,243
Lost Tax Revenue	\$10,372,899	\$11,259,702	\$11,259,702	\$21,121,954
Lost Business Revenue	\$1,572,529	\$1,706,968	\$1,706,968	\$3,202,084
Benefit/Cost Ratio	1.11	0.83	1.31	1.57

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$100,752,739	\$107,759,733	\$107,759,733	\$185,685,425
Costs of Cessation Program	\$84,053,092	\$111,989,984	\$77,621,105	\$99,581,391
Lost Tax Revenue	\$14,663,921	\$15,683,745	\$15,683,745	\$27,025,334
Lost Business Revenue	\$2,223,047	\$2,377,652	\$2,377,652	\$4,097,035
Benefit/Cost Ratio	1.00	0.83	1.13	1.42

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$93,319,209	\$123,076,806	\$123,076,806	\$290,131,107
Costs of Cessation Program	\$52,334,944	\$80,271,836	\$45,902,957	\$67,863,243
Lost Tax Revenue	\$13,582,018	\$17,913,047	\$17,913,047	\$42,226,740
Lost Business Revenue	\$2,059,031	\$2,715,614	\$2,715,614	\$6,401,565
Benefit/Cost Ratio	1.37	1.22	1.85	2.49

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$126,109,302	\$160,330,539	\$160,330,539	\$352,442,985
Costs of Cessation Program	\$84,053,092	\$111,989,984	\$77,621,105	\$99,581,391
Lost Tax Revenue	\$18,354,408	\$23,335,092	\$23,335,092	\$51,295,838
Lost Business Revenue	\$2,782,524	\$3,537,595	\$3,537,595	\$7,776,438
Benefit/Cost Ratio	1.20	1.15	1.53	2.22

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Puerto Rico

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April 30, 2010

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Puerto Rico the annual direct costs to the economy attributable to smoking were in excess of \$2.4 billion, including workplace productivity losses of \$520 million, premature death losses of \$1.1 billion, and direct medical expenditures of \$921 million. While the retail price of a pack of cigarettes in Puerto Rico is on average \$6.62, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$23.30 per pack of cigarettes. The ratio of benefits to cost varies from \$0.85 to \$2.46 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had a break-even benefits to costs ratio across the range of treatment effectiveness percentages. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range and an approximate break even at the mid-point of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

Table 1: Baseline data on smokers and smoking in Puerto Rico.

Variable	Total
Resident Smokers in PR ¹	372,601
Visiting Smokers in PR ²	8,232
Total Smokers	380,833
Total Packs Sold to Residents	105,315,414
Total Packs Sold to Visitors	2,326,862
Total Packs Sold ³	107,642,276
Average Packs Per Resident Smoker Per Year	283

¹ Data from the Behavioral Risk Factor Surveillance System, Puerto Rico Calculated Variable Data Report, 2005. Retrieved on December 14, 2009 from:

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

² Data from

http://www.gotopuertorico.com/pressRoom/mediaResources/tourist_economic_indicators.htm, Tourism Activity Statistics in Fiscal Years.

³ Data calculated from Tobacco Taxes Collected from <http://www.gdb-pur.com/economy/documents/AE2008-T27.pdf>, Commonwealth Government Net Recurrent Revenues.

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	Per Pack	Per Smoker
Premature Death			
Men ²	\$761,144,803	\$7.23	\$3,161.10
Women ²	\$250,519,721	\$2.38	\$1,900.53
Combined	\$1,011,664,524	\$9.61	\$2,715.14
Workplace Productivity³			
Current Smokers ⁴	\$353,874,387	\$3.36	\$949.74
Former Smokers ⁵	\$166,507,667	\$1.58	\$446.88
Combined	\$520,382,054	\$4.94	\$1,396.62
Total Productivity Losses	\$1,532,046,578	\$14.55	\$4,111.76

Adjusted for inflation to 2009

¹. Data from SAMMEC M. MCH SAMMEC - Medical Economics Report. Washington, D.C.: CDC; 2008 for the United States on average

². Gender ratios from the Puerto Rico Calculated Variable Data Report, 2005. Retrieved on December 14, 2009 from:
http://apps.nccd.cdc.gov/s_broker/htmsql.exe/weat/freq_analysis.hsqli?survey_year=2005.

³. Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

⁴. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁵. Per Bunn et al. 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 Puerto Rico. Total expenditures per pack for both medical care and productivity losses are \$13.30 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$149,252,394	\$1.42	\$400.57
Hospital Care	\$466,895,546	\$4.43	\$1,253.07
Rx	\$148,427,795	\$1.41	\$398.36
Nursing Home	\$81,424,343	\$0.77	\$218.53
Other Care ³	\$73,964,600	\$0.70	\$198.51
Total	\$919,964,678	\$8.74	\$2,469.03
Neonatal Expenditures	\$1,424,379	\$0.01	\$3.82
Total Expenditures	\$921,389,057	\$8.75	\$2,472.86

Adjusted for inflation to 2009

¹ Data use Per Smoker Costs from U.S. National Report and the Behavioral Risk Factor Surveillance System, Puerto Rico Calculated Variable Data Report, 2005. Retrieved on December 14, 2009 from:

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

² Data from SAMMEC M. MCH SAMMEC - Medical Economics Report. Washington, D.C.: CDC; 2008 for the United States on average

³ Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$3.58
Federal Tax ¹	\$1.01
State Tax ²	\$2.23
State Sales Tax ³	\$0.34
Distributor & Retailer Mark-ups ¹	\$0.67
Final Retail Price	\$6.62

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.ncsl.org/IssuesResearch/Health/StateCigaretteExciseTaxes/tabid/14349/Default.aspx#Facts>, State Cigarette Excise Tax Rates.

³ Data from http://www.hacienda.gobierno.pr/ivu/aplicacion_06_05.htm, Application of Sales and Use Tax.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$14,199,376	\$17,094,794	\$17,094,794	\$36,568,440
Costs of Cessation Program	\$8,607,083	\$13,201,626	\$7,549,269	\$11,160,890
Lost Tax Revenue	\$2,185,087	\$2,630,651	\$2,630,651	\$5,627,375
Lost Business Revenue	\$409,935	\$493,525	\$493,525	\$1,055,728
Benefit/Cost Ratio	1.27	1.05	1.60	2.05

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$19,567,817	\$22,897,548	\$22,897,548	\$45,292,241
Costs of Cessation Program	\$13,823,497	\$18,418,040	\$12,765,683	\$16,377,304
Lost Tax Revenue	\$3,011,215	\$3,523,615	\$3,523,615	\$6,969,847
Lost Business Revenue	\$564,921	\$661,050	\$661,050	\$1,307,583
Benefit/Cost Ratio	1.12	1.01	1.35	1.84

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$12,282,241	\$13,332,278	\$13,332,278	\$25,009,876
Costs of Cessation Program	\$8,607,083	\$13,201,626	\$7,549,269	\$11,160,890
Lost Tax Revenue	\$1,890,066	\$2,051,652	\$2,051,652	\$3,848,673
Lost Business Revenue	\$354,587	\$384,902	\$384,902	\$722,033
Benefit/Cost Ratio	1.13	0.85	1.34	1.59

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$17,363,112	\$18,570,655	\$18,570,655	\$31,999,893
Costs of Cessation Program	\$13,823,497	\$18,418,040	\$12,765,683	\$16,377,304
Lost Tax Revenue	\$2,671,942	\$2,857,766	\$2,857,766	\$4,924,339
Lost Business Revenue	\$501,272	\$536,133	\$536,133	\$923,834
Benefit/Cost Ratio	1.02	0.85	1.15	1.44

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$16,082,063	\$21,210,306	\$21,210,306	\$49,999,424
Costs of Cessation Program	\$8,607,083	\$13,201,626	\$7,549,269	\$11,160,890
Lost Tax Revenue	\$2,474,806	\$3,263,971	\$3,263,971	\$7,694,217
Lost Business Revenue	\$464,288	\$612,340	\$612,340	\$1,443,479
Benefit/Cost Ratio	1.39	1.24	1.86	2.46
Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$21,732,907	\$27,630,386	\$27,630,386	\$60,737,873
Costs of Cessation Program	\$13,823,497	\$18,418,040	\$12,765,683	\$16,377,304
Lost Tax Revenue	\$3,344,393	\$4,251,933	\$4,251,933	\$9,346,715
Lost Business Revenue	\$627,427	\$797,687	\$797,687	\$1,753,497
Benefit/Cost Ratio	1.22	1.18	1.55	2.21

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for Rhode Island

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Rhode Island the annual direct costs to the economy attributable to smoking were in excess of \$1.2 billion, including workplace productivity losses of \$232 million, premature death losses of \$433 million, and direct medical expenditures of \$595 million. While the retail price of a pack of cigarettes in Rhode Island is on average \$8.12, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$31.20 per pack of cigarettes. The ratio of benefits to cost varies from \$0.95 to \$2.64 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range though it was very close to the breakeven point. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

Table 1: Baseline data on smokers and smoking in Rhode Island.

Variable	Total
Resident Smokers in RI ¹	166,999
Visiting Smokers in RI ²	23,444
Total Smokers	190,443
Total Packs Sold to Residents	40,425,006
Total Packs Sold to Visitors	5,674,994
Total Packs Sold ³	46,100,000
Average Packs Per Resident Smoker Per Year	242

¹ Data from the Behavioral Risk Factor Surveillance System, Rhode Island Calculated Variable Data Report, 2005. Retrieved on October 12, 2009 from:

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

² Data from

<http://www.visitrhodeisland.com/admin/brscms/myuserfiles/Global%20Insight%20Report.pdf>, Rhode Island Tourism: Strength in a Difficult Time.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$285,958,855	\$15.20	\$3,678.92
Women	\$147,312,757	\$6.82	\$1,650.19
Combined	\$433,271,611	\$10.72	\$2,594.46
Workplace Productivity²			
Current Smokers ³	\$158,332,202	\$3.92	\$948.10
Former Smokers ⁴	\$74,499,671	\$1.84	\$446.11
Combined	\$232,831,873	\$5.76	\$1,394.21
Total Productivity Losses	\$666,103,485	\$16.48	\$3,988.67

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Rhode Island. Total expenditures per pack for both medical care and productivity losses are \$31.21 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$69,042,054	\$1.71	\$413.43
Hospital Care	\$310,083,612	\$7.67	\$1,856.80
Rx	\$106,591,242	\$2.64	\$638.27
Nursing Home	\$61,774,470	\$1.53	\$369.91
Other Care ²	\$47,239,300	\$1.17	\$282.87
Total	\$594,730,677	\$14.71	\$3,561.28
Neonatal Expenditures	\$573,766	\$0.01	\$3.44
Total Expenditures	\$595,304,443	\$14.73	\$3,564.72

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$5.00
Federal Tax ²	\$1.01
State Tax ²	\$3.46
State Sales Tax ³	\$0.53
Distributor & Retailer Mark-ups ¹	\$0.76
Final Retail Price	\$8.12

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$7,300,459	\$8,789,107	\$8,789,107	\$18,801,276
Costs of Cessation Program	\$3,857,677	\$5,916,942	\$3,383,567	\$5,002,288
Lost Tax Revenue	\$1,170,022	\$1,408,603	\$1,408,603	\$3,013,221
Lost Business Revenue	\$176,719	\$212,754	\$212,754	\$455,113
Benefit/Cost Ratio	1.40	1.17	1.76	2.22

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$10,060,586	\$11,772,532	\$11,772,532	\$23,286,526
Costs of Cessation Program	\$6,195,663	\$8,254,928	\$5,721,553	\$7,340,274
Lost Tax Revenue	\$1,612,378	\$1,886,747	\$1,886,747	\$3,732,058
Lost Business Revenue	\$243,532	\$284,972	\$284,972	\$563,686
Benefit/Cost Ratio	1.25	1.13	1.49	2.00

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,314,784	\$6,854,649	\$6,854,649	\$12,858,563
Costs of Cessation Program	\$3,857,677	\$5,916,942	\$3,383,567	\$5,002,288
Lost Tax Revenue	\$1,012,051	\$1,098,573	\$1,098,573	\$2,060,801
Lost Business Revenue	\$152,859	\$165,927	\$165,927	\$311,261
Benefit/Cost Ratio	1.26	0.95	1.47	1.74

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$8,927,060	\$9,547,905	\$9,547,905	\$16,452,406
Costs of Cessation Program	\$6,195,663	\$8,254,928	\$5,721,553	\$7,340,274
Lost Tax Revenue	\$1,430,712	\$1,530,213	\$1,530,213	\$2,636,775
Lost Business Revenue	\$216,093	\$231,122	\$231,122	\$398,255
Benefit/Cost Ratio	1.14	0.95	1.28	1.59

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$8,268,422	\$10,905,054	\$10,905,054	\$25,706,674
Costs of Cessation Program	\$3,857,677	\$5,916,942	\$3,383,567	\$5,002,288
Lost Tax Revenue	\$1,325,154	\$1,747,719	\$1,747,719	\$4,119,928
Lost Business Revenue	\$200,150	\$263,973	\$263,973	\$622,269
Benefit/Cost Ratio	1.54	1.38	2.02	2.64

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$11,173,744	\$14,205,870	\$14,205,870	\$31,227,733
Costs of Cessation Program	\$6,195,663	\$8,254,928	\$5,721,553	\$7,340,274
Lost Tax Revenue	\$1,790,781	\$2,276,730	\$2,276,730	\$5,004,770
Lost Business Revenue	\$270,477	\$343,875	\$343,875	\$755,915
Benefit/Cost Ratio	1.35	1.31	1.70	2.38

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for South Carolina

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April 30, 2010

Acknowledgements

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in South Carolina the annual direct costs to the economy attributable to smoking were in excess of \$4.9 billion, including workplace productivity losses of \$1 billion, premature death losses of \$2.3 billion, and direct medical expenditures of \$1.6 billion. While the retail price of a pack of cigarettes in South Carolina is on average \$4.19, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$13.27 per pack of cigarettes. The ratio of benefits to cost varies from \$0.93 to \$2.85 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range though it is very close to the breakeven point. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

Table 1: Baseline data on smokers and smoking in South Carolina.

Variable	Total
Resident Smokers in SC ¹	714,273
Visiting Smokers in SC ²	38,776
Total Smokers	753,049
Total Packs Sold to Residents	372,668,991
Total Packs Sold to Visitors	20,231,009
Total Packs Sold ³	392,900,000
Average Packs Per Resident Smoker Per Year	522

¹ Data from the Behavioral Risk Factor Surveillance System, South Carolina Calculated Variable Data Report, 2005. Retrieved on October 19, 2009 from:

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

² Data from

<http://www.scprt.com/files/Tourism%20and%20Recreation%20Development/Microsoft%20PowerPoint%20-%20Tourism%20Development%20in%20SC.pdf>, Tourism Development in SC.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,594,222,289	\$7.96	\$4,153.90
Women	\$727,685,881	\$4.22	\$2,201.89
Combined	\$2,321,908,170	\$6.23	\$3,250.73
Workplace Productivity²			
Current Smokers ³	\$688,438,224	\$1.85	\$963.83
Former Smokers ⁴	\$323,929,187	\$0.87	\$453.51
Combined	\$1,012,367,411	\$2.72	\$1,417.34
Total Productivity Losses	\$3,334,275,581	\$8.95	\$4,668.07

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 South Carolina. Total expenditures per pack for both medical care and productivity losses are \$13.28 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$233,773,973	\$0.63	\$327.29
Hospital Care	\$872,110,158	\$2.34	\$1,220.98
Rx	\$290,703,386	\$0.78	\$406.99
Nursing Home	\$105,379,977	\$0.28	\$147.53
Other Care ²	\$106,591,242	\$0.29	\$149.23
Total	\$1,608,558,736	\$4.32	\$2,252.02
Neonatal Expenditures	\$3,434,705	\$0.01	\$4.81
Total Expenditures	\$1,611,993,441	\$4.33	\$2,256.83

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.32
Federal Tax ²	\$1.01
State Tax ²	\$0.07
State Sales Tax ³	\$0.24
Distributor & Retailer Mark-ups ¹	\$0.52
Final Retail Price	\$4.19

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$28,626,768	\$34,464,100	\$34,464,100	\$73,724,103
Costs of Cessation Program	\$16,499,706	\$25,307,407	\$14,471,885	\$21,395,333
Lost Tax Revenue	\$2,841,395	\$3,420,788	\$3,420,788	\$7,317,602
Lost Business Revenue	\$1,115,842	\$1,343,375	\$1,343,375	\$2,873,690
Benefit/Cost Ratio	1.40	1.15	1.79	2.33

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$39,449,859	\$46,162,790	\$46,162,790	\$91,311,794
Costs of Cessation Program	\$26,499,528	\$35,307,229	\$24,471,707	\$31,395,155
Lost Tax Revenue	\$3,915,658	\$4,581,960	\$4,581,960	\$9,063,296
Lost Business Revenue	\$1,537,715	\$1,799,378	\$1,799,378	\$3,559,240
Benefit/Cost Ratio	1.23	1.11	1.50	2.07

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$24,761,712	\$26,878,648	\$26,878,648	\$50,421,366
Costs of Cessation Program	\$16,499,706	\$25,307,407	\$14,471,885	\$21,395,333
Lost Tax Revenue	\$2,457,763	\$2,667,882	\$2,667,882	\$5,004,652
Lost Business Revenue	\$965,186	\$1,047,702	\$1,047,702	\$1,965,373
Benefit/Cost Ratio	1.24	0.93	1.48	1.78

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$35,005,044	\$37,439,520	\$37,439,520	\$64,513,646
Costs of Cessation Program	\$26,499,528	\$35,307,229	\$24,471,707	\$31,395,155
Lost Tax Revenue	\$3,474,481	\$3,716,118	\$3,716,118	\$6,403,403
Lost Business Revenue	\$1,364,461	\$1,459,354	\$1,459,354	\$2,514,676
Benefit/Cost Ratio	1.12	0.92	1.26	1.60

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$32,422,375	\$42,761,210	\$42,761,210	\$100,801,749
Costs of Cessation Program	\$16,499,706	\$25,307,407	\$14,471,885	\$21,395,333
Lost Tax Revenue	\$3,218,134	\$4,244,331	\$4,244,331	\$10,005,236
Lost Business Revenue	\$1,263,791	\$1,666,788	\$1,666,788	\$3,929,149
Benefit/Cost Ratio	1.55	1.37	2.10	2.85

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$43,814,806	\$55,704,467	\$55,704,467	\$122,451,086
Costs of Cessation Program	\$26,499,528	\$35,307,229	\$24,471,707	\$31,395,155
Lost Tax Revenue	\$4,348,907	\$5,529,034	\$5,529,034	\$12,154,075
Lost Business Revenue	\$1,707,856	\$2,171,303	\$2,171,303	\$4,773,018
Benefit/Cost Ratio	1.35	1.30	1.73	2.53

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for South Dakota

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in South Dakota the annual direct costs to the economy attributable to smoking were in excess of \$790 million, including workplace productivity losses of \$193 million, premature death losses of \$262 million, and direct medical expenditures of \$334 million. While the retail price of a pack of cigarettes in South Dakota is on average \$5.58, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$21.26 per pack of cigarettes. The ratio of benefits to cost varies from \$0.92 to \$2.76 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range, though it is close to breakeven. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

Table 1: Baseline data on smokers and smoking in South Dakota.

Variable	Total
Resident Smokers in SD ¹	113,525
Visiting Smokers in SD ²	6,766
Total Smokers	120,291
Total Packs Sold to Residents	37,183,988
Total Packs Sold to Visitors	2,216,012
Total Packs Sold ³	39,400,000
Average Packs Per Resident Smoker Per Year	328

¹ Data from the Behavioral Risk Factor Surveillance System, South Dakota Calculated Variable Data Report, 2005. Retrieved on October 19, 2009 from:

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

² Data from personal communication, Office of Tourism.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$180,404,152	\$9.57	\$3,133.05
Women	\$81,990,840	\$4.47	\$1,465.59
Combined	\$262,394,992	\$7.06	\$2,311.34
Workplace Productivity²			
Current Smokers ³	\$131,527,131	\$3.54	\$1,158.57
Former Smokers ⁴	\$61,887,145	\$1.66	\$545.14
Combined	\$193,414,276	\$5.20	\$1,703.72
Total Productivity Losses	\$455,809,268	\$12.26	\$4,015.06

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in South Dakota. Total expenditures per pack for both medical care and productivity losses are \$21.27 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$44,816,772	\$1.21	\$394.77
Hospital Care	\$198,647,314	\$5.34	\$1,749.81
Rx	\$35,126,659	\$0.94	\$309.42
Nursing Home	\$35,126,659	\$0.94	\$309.42
Other Care ²	\$20,591,490	\$0.55	\$181.38
Total	\$334,308,894	\$8.99	\$2,944.80
Neonatal Expenditures	\$536,801	\$0.01	\$4.73
Total Expenditures	\$334,845,695	\$9.01	\$2,949.53

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.75
Federal Tax ²	\$1.01
State Tax ²	\$1.53
State Sales Tax ³	\$0.21
Distributor & Retailer Mark-ups ¹	\$0.47
Final Retail Price	\$5.58

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$4,575,953	\$5,509,044	\$5,509,044	\$11,784,706
Costs of Cessation Program	\$2,622,428	\$4,022,304	\$2,300,130	\$3,400,528
Lost Tax Revenue	\$592,799	\$713,678	\$713,678	\$1,526,668
Lost Business Revenue	\$100,202	\$120,635	\$120,635	\$258,057
Benefit/Cost Ratio	1.38	1.13	1.76	2.27

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,306,011	\$7,379,065	\$7,379,065	\$14,596,077
Costs of Cessation Program	\$4,211,778	\$5,611,654	\$3,889,480	\$4,989,878
Lost Tax Revenue	\$816,922	\$955,932	\$955,932	\$1,890,871
Lost Business Revenue	\$138,086	\$161,584	\$161,584	\$319,619
Benefit/Cost Ratio	1.22	1.10	1.47	2.03

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$3,958,129	\$4,296,519	\$4,296,519	\$8,059,793
Costs of Cessation Program	\$2,622,428	\$4,022,304	\$2,300,130	\$3,400,528
Lost Tax Revenue	\$512,762	\$556,599	\$556,599	\$1,044,118
Lost Business Revenue	\$86,674	\$94,083	\$94,083	\$176,490
Benefit/Cost Ratio	1.23	0.92	1.46	1.74

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,595,513	\$5,984,661	\$5,984,661	\$10,312,426
Costs of Cessation Program	\$4,211,778	\$5,611,654	\$3,889,480	\$4,989,878
Lost Tax Revenue	\$724,879	\$775,292	\$775,292	\$1,335,939
Lost Business Revenue	\$122,528	\$131,050	\$131,050	\$225,817
Benefit/Cost Ratio	1.11	0.92	1.25	1.57

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,182,676	\$6,835,326	\$6,835,326	\$16,113,034
Costs of Cessation Program	\$2,622,428	\$4,022,304	\$2,300,130	\$3,400,528
Lost Tax Revenue	\$671,398	\$885,493	\$885,493	\$2,087,388
Lost Business Revenue	\$113,488	\$149,677	\$149,677	\$352,837
Benefit/Cost Ratio	1.52	1.35	2.05	2.76

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$7,003,742	\$8,904,290	\$8,904,290	\$19,573,654
Costs of Cessation Program	\$4,211,778	\$5,611,654	\$3,889,480	\$4,989,878
Lost Tax Revenue	\$907,311	\$1,153,520	\$1,153,520	\$2,535,699
Lost Business Revenue	\$153,365	\$194,983	\$194,983	\$428,616
Benefit/Cost Ratio	1.33	1.28	1.70	2.46

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Tennessee

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April 30, 2010

Acknowledgements

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Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Tennessee the annual direct costs to the economy attributable to smoking were in excess of \$7.9 billion, including workplace productivity losses of \$1.6 billion, premature death losses of \$3.6 billion, and direct medical expenditures of \$2.6 billion. While the retail price of a pack of cigarettes in Tennessee is on average \$4.84, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$20.32 per pack of cigarettes. The ratio of benefits to cost varies from \$0.90 to \$2.90 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had a break-even benefits to costs ratio across the range of treatment effectiveness percentages. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range and just over breakeven at the mid-point of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in TN ¹	1,199,048
Visiting Smokers in TN ²	115,831
Total Smokers	1,314,879
Total Packs Sold to Residents	390,296,420
Total Packs Sold to Visitors	37,703,580
Total Packs Sold ³	428,000,000
Average Packs Per Resident Smoker Per Year	326

¹ Data from the Behavioral Risk Factor Surveillance System, Tennessee Calculated Variable Data Report, 2005. Retrieved on October 19, 2009 from:

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

² Data from <http://www.tnvacation.com/media/industry/TennesseeTravelBarometer2008.pdf>, 2007 Visitor Profile.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$2,358,413,532	\$11.52	\$3,750.39
Women	\$1,258,218,051	\$6.78	\$2,206.62
Combined	\$3,616,631,583	\$9.27	\$3,016.25
Workplace Productivity²			
Current Smokers ³	\$1,144,605,624	\$2.93	\$954.60
Former Smokers ⁴	\$538,568,539	\$1.38	\$449.16
Combined	\$1,683,174,164	\$4.31	\$1,403.76
Total Productivity Losses	\$5,299,805,747	\$13.58	\$4,420.01

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Tennessee. Total expenditures per pack for both medical care and productivity losses are \$20.32 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$453,012,777	\$1.16	\$377.81
Hospital Care	\$1,275,461,106	\$3.27	\$1,063.73
Rx	\$512,364,718	\$1.31	\$427.31
Nursing Home	\$202,281,106	\$0.52	\$168.70
Other Care ²	\$180,478,352	\$0.46	\$150.52
Total	\$2,623,598,059	\$6.72	\$2,188.07
Neonatal Expenditures	\$6,057,035	\$0.02	\$5.05
Total Expenditures	\$2,629,655,094	\$6.74	\$2,193.12

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.95
Federal Tax ²	\$1.01
State Tax ²	\$0.62
State Sales Tax ³	\$0.32
Distributor & Retailer Mark-ups ¹	\$0.54
Final Retail Price	\$4.84

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$45,892,133	\$55,250,074	\$55,250,074	\$118,188,555
Costs of Cessation Program	\$27,698,009	\$42,483,470	\$24,293,912	\$35,916,284
Lost Tax Revenue	\$4,397,776	\$5,294,534	\$5,294,534	\$11,325,837
Lost Business Revenue	\$1,215,367	\$1,463,194	\$1,463,194	\$3,130,002
Benefit/Cost Ratio	1.38	1.12	1.78	2.35

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$63,242,842	\$74,004,473	\$74,004,473	\$146,383,727
Costs of Cessation Program	\$44,484,681	\$59,270,142	\$41,080,584	\$52,702,956
Lost Tax Revenue	\$6,060,469	\$7,091,741	\$7,091,741	\$14,027,739
Lost Business Revenue	\$1,674,868	\$1,959,869	\$1,959,869	\$3,876,698
Benefit/Cost Ratio	1.21	1.08	1.48	2.07

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$39,695,987	\$43,089,688	\$43,089,688	\$80,831,480
Costs of Cessation Program	\$27,698,009	\$42,483,470	\$24,293,912	\$35,916,284
Lost Tax Revenue	\$3,804,008	\$4,129,222	\$4,129,222	\$7,745,963
Lost Business Revenue	\$1,051,274	\$1,141,149	\$1,141,149	\$2,140,670
Benefit/Cost Ratio	1.22	0.90	1.46	1.76

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$56,117,273	\$60,020,029	\$60,020,029	\$103,423,091
Costs of Cessation Program	\$44,484,681	\$59,270,142	\$41,080,584	\$52,702,956
Lost Tax Revenue	\$5,377,636	\$5,751,632	\$5,751,632	\$9,910,884
Lost Business Revenue	\$1,486,161	\$1,589,518	\$1,589,518	\$2,738,966
Benefit/Cost Ratio	1.09	0.90	1.24	1.58

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$51,976,945	\$68,551,335	\$68,551,335	\$161,597,259
Costs of Cessation Program	\$27,698,009	\$42,483,470	\$24,293,912	\$35,916,284
Lost Tax Revenue	\$4,980,875	\$6,569,174	\$6,569,174	\$15,485,629
Lost Business Revenue	\$1,376,512	\$1,815,453	\$1,815,453	\$4,279,600
Benefit/Cost Ratio	1.53	1.35	2.10	2.90

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$70,240,375	\$89,300,923	\$89,300,923	\$196,303,736
Costs of Cessation Program	\$44,484,681	\$59,270,142	\$41,080,584	\$52,702,956
Lost Tax Revenue	\$6,731,033	\$8,557,577	\$8,557,577	\$18,811,500
Lost Business Revenue	\$1,860,184	\$2,364,967	\$2,364,967	\$5,198,736
Benefit/Cost Ratio	1.32	1.27	1.72	2.56

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for Texas

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Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Texas the annual direct costs to the economy attributable to smoking were in excess of \$20.4 billion, including workplace productivity losses of \$4.9 billion, premature death losses of approximately \$7.9 billion, and direct medical expenditures of \$7.5 billion. While the retail price of a pack of cigarettes in Texas is on average \$5.52, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$21.00 per pack of cigarettes. The ratio of benefits to cost varies from \$0.84 to \$2.61 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had a break-even benefits to costs ratio across the range of treatment effectiveness percentages. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range and just at breakeven at the mid-point of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in TX ¹	3,236,711
Visiting Smokers in TX ²	261,188
Total Smokers	3,497,899
Total Packs Sold to Residents	971,503,947
Total Packs Sold to Visitors	78,396,053
Total Packs Sold ³	1,049,900,000
Average Packs Per Resident Smoker Per Year	300

¹ Data from the Behavioral Risk Factor Surveillance System, Texas Calculated Variable Data Report, 2005. Retrieved on October 19, 2009 from:

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

² Data from <http://travel.state.tx.us/getattachment/a859a906-cf91-4c3c-8029-524bd18bd2ea/2007-Visitor-Profile.aspx>, 2007 Non-Resident Overnight Leisure Visitor Profile.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$5,352,729,950	\$9.67	\$2,903.52
Women	\$2,538,394,061	\$6.07	\$1,822.02
Combined	\$7,891,124,011	\$8.12	\$2,438.01
Workplace Productivity²			
Current Smokers ³	\$3,354,133,179	\$3.45	\$1,036.28
Former Smokers ⁴	\$1,578,212,241	\$1.62	\$487.60
Combined	\$4,932,345,420	\$5.08	\$1,523.88
Total Productivity Losses	\$12,823,469,431	\$13.20	\$3,961.88

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in Texas. Total expenditures per pack for both medical care and productivity losses are \$21.00 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$1,259,714,673	\$1.30	\$389.20
Hospital Care	\$4,165,537,269	\$4.29	\$1,286.97
Rx	\$1,062,278,623	\$1.09	\$328.20
Nursing Home	\$461,491,625	\$0.48	\$142.58
Other Care ²	\$623,801,016	\$0.64	\$192.73
Total	\$7,571,611,941	\$7.79	\$2,339.29
Neonatal Expenditures	\$10,566,550	\$0.01	\$3.26
Total Expenditures	\$7,582,178,491	\$7.80	\$2,342.56

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$2.74
Federal Tax ²	\$1.01
State Tax ²	\$1.41
State Sales Tax ³	\$0.32
Distributor & Retailer Mark-ups ¹	\$0.41
Final Retail Price	\$5.52

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$118,098,662	\$142,180,355	\$142,180,355	\$304,146,032
Costs of Cessation Program	\$74,768,024	\$114,679,907	\$65,579,002	\$96,952,441
Lost Tax Revenue	\$15,431,647	\$18,578,339	\$18,578,339	\$39,741,975
Lost Business Revenue	\$2,327,095	\$2,801,616	\$2,801,616	\$5,993,096
Benefit/Cost Ratio	1.28	1.04	1.64	2.13

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$162,748,917	\$190,442,863	\$190,442,863	\$376,703,392
Costs of Cessation Program	\$120,081,978	\$159,993,861	\$110,892,956	\$142,266,395
Lost Tax Revenue	\$21,265,980	\$24,884,676	\$24,884,676	\$49,222,858
Lost Business Revenue	\$3,206,913	\$3,752,613	\$3,752,613	\$7,422,815
Benefit/Cost Ratio	1.13	1.01	1.36	1.89

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$102,153,519	\$110,886,858	\$110,886,858	\$208,011,460
Costs of Cessation Program	\$74,768,024	\$114,679,907	\$65,579,002	\$96,952,441
Lost Tax Revenue	\$13,348,136	\$14,489,299	\$14,489,299	\$27,180,320
Lost Business Revenue	\$2,012,901	\$2,184,989	\$2,184,989	\$4,098,796
Benefit/Cost Ratio	1.13	0.84	1.35	1.62

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$144,412,002	\$154,455,342	\$154,455,342	\$266,148,634
Costs of Cessation Program	\$120,081,978	\$159,993,861	\$110,892,956	\$142,266,395
Lost Tax Revenue	\$18,869,943	\$20,182,280	\$20,182,280	\$34,776,954
Lost Business Revenue	\$2,845,590	\$3,043,491	\$3,043,491	\$5,244,370
Benefit/Cost Ratio	1.02	0.84	1.15	1.46

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$133,757,295	\$176,409,774	\$176,409,774	\$415,853,845
Costs of Cessation Program	\$74,768,024	\$114,679,907	\$65,579,002	\$96,952,441
Lost Tax Revenue	\$17,477,720	\$23,051,009	\$23,051,009	\$54,338,546
Lost Business Revenue	\$2,635,643	\$3,476,096	\$3,476,096	\$8,194,261
Benefit/Cost Ratio	1.41	1.25	1.92	2.61

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$180,756,344	\$229,806,696	\$229,806,696	\$505,167,377
Costs of Cessation Program	\$120,081,978	\$159,993,861	\$110,892,956	\$142,266,395
Lost Tax Revenue	\$23,618,964	\$30,028,247	\$30,028,247	\$66,008,915
Lost Business Revenue	\$3,561,744	\$4,528,264	\$4,528,264	\$9,954,155
Benefit/Cost Ratio	1.23	1.18	1.58	2.31

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for Utah

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April 30, 2010

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Utah the annual direct costs to the economy attributable to smoking were in excess of \$1.1 billion, including workplace productivity losses of \$ 337 million, premature death losses of \$353 million, and direct medical expenditures of \$448 million. While the retail price of a pack of cigarettes in Utah is on average \$4.81, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$16.75 per pack of cigarettes. The ratio of benefits to cost varies from \$0.81 to \$2.56 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had a break-even benefits to costs ratio across the range of treatment effectiveness percentages. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range and an approximate breakeven at the mid-point of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in UT ¹	189,257
Visiting Smokers in UT ²	41,268
Total Smokers	230,525
Total Packs Sold to Residents	67,977,331
Total Packs Sold to Visitors	14,822,669
Total Packs Sold ³	82,800,000
Average Packs Per Resident Smoker Per Year	359

¹ Data from the Behavioral Risk Factor Surveillance System, Utah Calculated Variable Data Report, 2005. Retrieved on October 12, 2009 from:

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

² Data from

http://travel.utah.gov/research_and_planning/documents/YE2005UtahVisitorProfileReport_PublicVersion_Final.pdf, 2005 Visitor Profile.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$245,391,032	\$6.09	\$2,187.57
Women	\$107,980,595	\$3.90	\$1,400.87
Combined	\$353,371,627	\$5.20	\$1,867.15
Workplace Productivity²			
Current Smokers ³	\$229,306,593	\$3.37	\$1,211.61
Former Smokers ⁴	\$107,895,081	\$1.59	\$570.10
Combined	\$337,201,675	\$4.96	\$1,781.71
Total Productivity Losses	\$690,573,302	\$10.16	\$3,648.87

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Utah. Total expenditures per pack for both medical care and productivity losses are \$16.75 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$65,408,262	\$0.96	\$345.61
Hospital Care	\$242,252,822	\$3.56	\$1,280.02
Rx	\$71,464,582	\$1.05	\$377.61
Nursing Home	\$23,014,018	\$0.34	\$121.60
Other Care ²	\$44,816,772	\$0.66	\$236.80
Total	\$446,956,456	\$6.58	\$2,361.64
Neonatal Expenditures	\$1,083,011	\$0.02	\$5.72
Total Expenditures	\$448,039,467	\$6.59	\$2,367.36

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.92
Federal Tax ²	\$1.01
State Tax ²	\$0.70
State Sales Tax ³	\$0.21
Distributor & Retailer Mark-ups ¹	\$0.53
Final Retail Price	\$4.81

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$6,589,776	\$7,933,508	\$7,933,508	\$16,971,015
Costs of Cessation Program	\$4,371,837	\$6,705,565	\$3,834,536	\$5,669,004
Lost Tax Revenue	\$754,788	\$908,698	\$908,698	\$1,943,847
Lost Business Revenue	\$207,608	\$249,942	\$249,942	\$534,664
Benefit/Cost Ratio	1.24	1.01	1.59	2.08

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$9,081,211	\$10,626,503	\$10,626,503	\$21,019,636
Costs of Cessation Program	\$7,021,435	\$9,355,163	\$6,484,134	\$8,318,602
Lost Tax Revenue	\$1,040,155	\$1,217,151	\$1,217,151	\$2,407,573
Lost Business Revenue	\$286,099	\$334,783	\$334,783	\$662,214
Benefit/Cost Ratio	1.09	0.97	1.32	1.85

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,700,054	\$6,187,365	\$6,187,365	\$11,606,811
Costs of Cessation Program	\$4,371,837	\$6,705,565	\$3,834,536	\$5,669,004
Lost Tax Revenue	\$652,880	\$708,696	\$708,696	\$1,329,435
Lost Business Revenue	\$179,578	\$194,930	\$194,930	\$365,667
Benefit/Cost Ratio	1.10	0.81	1.31	1.58

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$8,058,031	\$8,618,439	\$8,618,439	\$14,850,802
Costs of Cessation Program	\$7,021,435	\$9,355,163	\$6,484,134	\$8,318,602
Lost Tax Revenue	\$922,961	\$987,149	\$987,149	\$1,700,999
Lost Business Revenue	\$253,865	\$271,520	\$271,520	\$467,868
Benefit/Cost Ratio	0.98	0.81	1.11	1.42

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$7,463,510	\$9,843,472	\$9,843,472	\$23,204,188
Costs of Cessation Program	\$4,371,837	\$6,705,565	\$3,834,536	\$5,669,004
Lost Tax Revenue	\$854,865	\$1,127,464	\$1,127,464	\$2,657,790
Lost Business Revenue	\$235,134	\$310,114	\$310,114	\$731,037
Benefit/Cost Ratio	1.37	1.21	1.87	2.56

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$10,086,006	\$12,822,962	\$12,822,962	\$28,187,785
Costs of Cessation Program	\$7,021,435	\$9,355,163	\$6,484,134	\$8,318,602
Lost Tax Revenue	\$1,155,243	\$1,468,732	\$1,468,732	\$3,228,607
Lost Business Revenue	\$317,755	\$403,982	\$403,982	\$888,043
Benefit/Cost Ratio	1.19	1.14	1.53	2.27

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for Virginia

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Virginia the annual direct costs to the economy attributable to smoking were in excess of \$7.4 billion, including workplace productivity losses of \$1.9 billion, premature death losses of \$2.8 billion, and direct medical expenditures of \$2.6 billion. While the retail price of a pack of cigarettes in Virginia is on average \$4.59, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$13.87 per pack of cigarettes. The ratio of benefits to cost varies from \$0.85 to \$2.56 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had a break-even benefits to costs ratio across the range of treatment effectiveness percentages. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range and was just at breakeven at the mid-point of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in VA ¹	1,172,174
Visiting Smokers in VA ²	60,800
Total Smokers	1,232,974
Total Packs Sold to Residents	539,515,444
Total Packs Sold to Visitors	27,984,556
Total Packs Sold ³	567,500,000
Average Packs Per Resident Smoker Per Year	460

¹ Data from the Behavioral Risk Factor Surveillance System, Virginia Calculated Variable Data Report, 2005. Retrieved on October 26, 2009 from:

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

² Data estimated from like states in surrounding geographic area. No data sources were available from the state.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,880,164,108	\$6.86	\$3,157.46
Women	\$977,305,189	\$3.68	\$1,694.63
Combined	\$2,857,469,297	\$5.30	\$2,437.75
Workplace Productivity²			
Current Smokers ³	\$1,326,917,727	\$2.46	\$1,132.01
Former Smokers ⁴	\$624,351,416	\$1.16	\$532.64
Combined	\$1,951,269,142	\$3.62	\$1,664.66
Total Productivity Losses	\$4,808,738,439	\$8.91	\$4,102.41

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in Virginia. Total expenditures per pack for both medical care and productivity losses are \$13.86 per pack.

Cost Component ¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$421,519,910	\$0.78	\$359.61
Hospital Care	\$1,372,362,235	\$2.54	\$1,170.78
Rx	\$472,393,002	\$0.88	\$403.01
Nursing Home	\$208,337,427	\$0.39	\$177.74
Other Care ²	\$192,590,993	\$0.36	\$164.30
Total	\$2,668,414,831	\$4.95	\$2,276.47
Neonatal Expenditures	\$3,832,467	\$0.01	\$3.27
Total Expenditures	\$2,672,247,298	\$4.95	\$2,279.74

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.53
Federal Tax ²	\$1.01
State Tax ²	\$0.30
State Sales Tax ³	\$0.22
Distributor & Retailer Mark-ups ¹	\$0.70
Final Retail Price	\$4.59

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
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Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

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Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$43,296,562	\$52,125,236	\$52,125,236	\$111,504,037
Costs of Cessation Program	\$27,077,219	\$41,531,297	\$23,749,417	\$35,111,300
Lost Tax Revenue	\$4,773,121	\$5,746,417	\$5,746,417	\$12,292,484
Lost Business Revenue	\$2,196,961	\$2,644,947	\$2,644,947	\$5,657,955
Benefit/Cost Ratio	1.27	1.04	1.62	2.10

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$59,665,948	\$69,818,922	\$69,818,922	\$138,104,544
Costs of Cessation Program	\$43,487,655	\$57,941,733	\$40,159,853	\$51,521,736
Lost Tax Revenue	\$6,577,724	\$7,697,013	\$7,697,013	\$15,224,991
Lost Business Revenue	\$3,027,579	\$3,542,762	\$3,542,762	\$7,007,722
Benefit/Cost Ratio	1.12	1.01	1.36	1.87

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$37,450,858	\$40,652,618	\$40,652,618	\$76,259,807
Costs of Cessation Program	\$27,077,219	\$41,531,297	\$23,749,417	\$35,111,300
Lost Tax Revenue	\$4,128,676	\$4,481,646	\$4,481,646	\$8,407,072
Lost Business Revenue	\$1,900,337	\$2,062,801	\$2,062,801	\$3,869,587
Benefit/Cost Ratio	1.13	0.85	1.34	1.61

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$52,943,387	\$56,625,411	\$56,625,411	\$97,573,679
Costs of Cessation Program	\$43,487,655	\$57,941,733	\$40,159,853	\$51,521,736
Lost Tax Revenue	\$5,836,612	\$6,242,527	\$6,242,527	\$10,756,767
Lost Business Revenue	\$2,686,461	\$2,873,295	\$2,873,295	\$4,951,099
Benefit/Cost Ratio	1.02	0.84	1.15	1.45

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$49,037,228	\$64,674,202	\$64,674,202	\$152,457,628
Costs of Cessation Program	\$27,077,219	\$41,531,297	\$23,749,417	\$35,111,300
Lost Tax Revenue	\$5,405,987	\$7,129,846	\$7,129,846	\$16,807,311
Lost Business Revenue	\$2,488,255	\$3,281,708	\$3,281,708	\$7,736,028
Benefit/Cost Ratio	1.40	1.25	1.89	2.56

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$66,267,714	\$84,250,234	\$84,250,234	\$185,201,173
Costs of Cessation Program	\$43,487,655	\$57,941,733	\$40,159,853	\$51,521,736
Lost Tax Revenue	\$7,305,519	\$9,287,957	\$9,287,957	\$20,417,041
Lost Business Revenue	\$3,362,566	\$4,275,038	\$4,275,038	\$9,397,506
Benefit/Cost Ratio	1.22	1.18	1.57	2.28

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Vermont

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April 30, 2010

Acknowledgements

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Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Vermont the annual direct costs to the economy attributable to smoking were in excess of \$652 million, including workplace productivity losses of \$138 million, premature death losses of approximately \$221 million, and direct medical expenditures of \$293 million. While the retail price of a pack of cigarettes in Vermont is on average \$6.54, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$24.52 per pack of cigarettes. The ratio of benefits to cost varies from \$0.90 to \$2.62 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in VT ¹	93,670
Visiting Smokers in VT ²	18,908
Total Smokers	112,578
Total Packs Sold to Residents	26,625,338
Total Packs Sold to Visitors	5,374,662
Total Packs Sold ³	32,000,000
Average Packs Per Resident Smoker Per Year	284

¹ Data from the Behavioral Risk Factor Surveillance System, Vermont Calculated Variable Data Report, 2005. Retrieved on October 26, 2009 from:

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

² Data from http://www.uvm.edu/tourismresearch/publications/2007_Tourism_Factsheet.pdf, The Vermont Travel and Tourism Industry 2007.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$148,258,809	\$10.22	\$2,905.73
Women	\$72,737,015	\$6.00	\$1,705.56
Combined	\$220,995,824	\$8.30	\$2,359.30
Workplace Productivity²			
Current Smokers ³	\$94,058,478	\$3.53	\$1,004.15
Former Smokers ⁴	\$44,257,110	\$1.66	\$472.48
Combined	\$138,315,588	\$5.19	\$1,476.63
Total Productivity Losses	\$359,311,412	\$13.50	\$3,835.93

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Vermont. Total expenditures per pack for both medical care and productivity losses are \$24.53 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$43,605,508	\$1.64	\$465.52
Hospital Care	\$155,041,806	\$5.82	\$1,655.19
Rx	\$42,394,244	\$1.59	\$452.59
Nursing Home	\$23,014,018	\$0.86	\$245.69
Other Care ²	\$29,070,339	\$1.09	\$310.35
Total	\$293,125,914	\$11.01	\$3,129.35
Neonatal Expenditures	\$440,854	\$0.02	\$4.71
Total Expenditures	\$293,566,768	\$11.03	\$3,134.05

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$3.62
Federal Tax ²	\$1.01
State Tax ²	\$2.24
State Sales Tax ³	\$0.37
Distributor & Retailer Mark-ups ¹	\$0.56
Final Retail Price	\$6.54

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$3,778,564	\$4,549,057	\$4,549,057	\$9,731,144
Costs of Cessation Program	\$2,163,777	\$3,318,822	\$1,897,848	\$2,805,791
Lost Tax Revenue	\$557,836	\$671,586	\$671,586	\$1,436,627
Lost Business Revenue	\$86,099	\$103,656	\$103,656	\$221,736
Benefit/Cost Ratio	1.35	1.11	1.70	2.18

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,207,147	\$6,093,215	\$6,093,215	\$12,052,615
Costs of Cessation Program	\$3,475,157	\$4,630,202	\$3,209,228	\$4,117,171
Lost Tax Revenue	\$768,741	\$899,553	\$899,553	\$1,779,350
Lost Business Revenue	\$118,651	\$138,841	\$138,841	\$274,633
Benefit/Cost Ratio	1.19	1.07	1.43	1.95

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$3,268,399	\$3,547,822	\$3,547,822	\$6,655,321
Costs of Cessation Program	\$2,163,777	\$3,318,822	\$1,897,848	\$2,805,791
Lost Tax Revenue	\$482,520	\$523,772	\$523,772	\$982,538
Lost Business Revenue	\$74,474	\$80,841	\$80,841	\$151,649
Benefit/Cost Ratio	1.20	0.90	1.42	1.69

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$4,620,458	\$4,941,795	\$4,941,795	\$8,515,419
Costs of Cessation Program	\$3,475,157	\$4,630,202	\$3,209,228	\$4,117,171
Lost Tax Revenue	\$682,127	\$729,566	\$729,566	\$1,257,147
Lost Business Revenue	\$105,283	\$112,605	\$112,605	\$194,034
Benefit/Cost Ratio	1.08	0.90	1.22	1.53

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$4,279,561	\$5,644,226	\$5,644,226	\$13,305,233
Costs of Cessation Program	\$2,163,777	\$3,318,822	\$1,897,848	\$2,805,791
Lost Tax Revenue	\$631,800	\$833,268	\$833,268	\$1,964,276
Lost Business Revenue	\$97,515	\$128,610	\$128,610	\$303,176
Benefit/Cost Ratio	1.48	1.32	1.97	2.62

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$5,783,295	\$7,352,659	\$7,352,659	\$16,162,817
Costs of Cessation Program	\$3,475,157	\$4,630,202	\$3,209,228	\$4,117,171
Lost Tax Revenue	\$853,799	\$1,085,487	\$1,085,487	\$2,386,147
Lost Business Revenue	\$131,779	\$167,539	\$167,539	\$368,289
Benefit/Cost Ratio	1.30	1.25	1.65	2.35

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Washington

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Washington the annual direct costs to the economy attributable to smoking were in excess of \$5.7 billion, including workplace productivity losses of \$1.3 billion, premature death losses of \$2 billion, and direct medical expenditures of \$2.3 billion. While the retail price of a pack of cigarettes in Washington is on average \$6.69, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$29.95 per pack of cigarettes. The ratio of benefits to cost varies from \$0.92 to \$2.80 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies, generic bupropion and varenicline showed substantial benefits to costs from the societal perspective across the sensitivity ranges used for treatment effectiveness. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range, though it was close to a breakeven position. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in WA ¹	825,626
Visiting Smokers in WA ²	69,023
Total Smokers	894,649
Total Packs Sold to Residents	190,660,715
Total Packs Sold to Visitors	15,939,285
Total Packs Sold ³	206,600,000
Average Packs Per Resident Smoker Per Year	231

¹ Data from the Behavioral Risk Factor Surveillance System, Washington Calculated Variable Data Report, 2005. Retrieved on October 26, 2009 from:

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

² Data from http://www.experiencewa.com/images/pdf/R_SOI%20Final.pdf, Washington State Tourism State of the Industry-January 2008.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,289,945,450	\$12.59	\$2,907.11
Women	\$766,280,962	\$8.69	\$2,006.47
Combined	\$2,056,226,413	\$10.78	\$2,490.51
Workplace Productivity²			
Current Smokers ³	\$884,835,559	\$4.64	\$1,071.71
Former Smokers ⁴	\$416,339,553	\$2.18	\$504.27
Combined	\$1,301,175,112	\$6.82	\$1,575.99
Total Productivity Losses	\$3,357,401,525	\$17.61	\$4,066.49

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Washington. Total expenditures per pack for both medical care and productivity losses are \$29.95 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$417,886,117	\$2.19	\$506.14
Hospital Care	\$1,219,742,957	\$6.40	\$1,477.36
Rx	\$313,717,404	\$1.65	\$379.98
Nursing Home	\$163,520,655	\$0.86	\$198.06
Other Care ²	\$234,985,237	\$1.23	\$284.61
Total	\$2,349,852,370	\$12.32	\$2,846.15
Neonatal Expenditures	\$3,242,606	\$0.02	\$3.93
Total Expenditures	\$2,353,094,976	\$12.34	\$2,850.07

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$3.44
Federal Tax ²	\$1.01
State Tax ²	\$2.03
State Sales Tax ³	\$0.41
Distributor & Retailer Mark-ups ¹	\$0.89
Final Retail Price	\$6.69

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
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Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$33,049,771	\$39,789,005	\$39,789,005	\$85,114,908
Costs of Cessation Program	\$19,071,961	\$29,252,755	\$16,728,008	\$24,730,801
Lost Tax Revenue	\$3,799,711	\$4,574,516	\$4,574,516	\$9,785,606
Lost Business Revenue	\$981,904	\$1,182,126	\$1,182,126	\$2,528,753
Benefit/Cost Ratio	1.39	1.14	1.77	2.30

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$45,545,092	\$53,295,211	\$53,295,211	\$105,420,000
Costs of Cessation Program	\$30,630,725	\$40,811,519	\$28,286,772	\$36,289,565
Lost Tax Revenue	\$5,236,290	\$6,127,316	\$6,127,316	\$12,120,069
Lost Business Revenue	\$1,353,139	\$1,583,394	\$1,583,394	\$3,132,014
Benefit/Cost Ratio	1.22	1.10	1.48	2.05

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$28,587,542	\$31,031,556	\$31,031,556	\$58,211,762
Costs of Cessation Program	\$19,071,961	\$29,252,755	\$16,728,008	\$24,730,801
Lost Tax Revenue	\$3,286,691	\$3,567,678	\$3,567,678	\$6,692,568
Lost Business Revenue	\$849,332	\$921,943	\$921,943	\$1,729,464
Benefit/Cost Ratio	1.23	0.92	1.46	1.76

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$40,413,528	\$43,224,145	\$43,224,145	\$74,481,381
Costs of Cessation Program	\$30,630,725	\$40,811,519	\$28,286,772	\$36,289,565
Lost Tax Revenue	\$4,646,317	\$4,969,452	\$4,969,452	\$8,563,076
Lost Business Revenue	\$1,200,681	\$1,284,184	\$1,284,184	\$2,212,832
Benefit/Cost Ratio	1.11	0.92	1.25	1.58

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$37,431,821	\$49,368,067	\$49,368,067	\$116,376,208
Costs of Cessation Program	\$19,071,961	\$29,252,755	\$16,728,008	\$24,730,801
Lost Tax Revenue	\$4,303,512	\$5,675,815	\$5,675,815	\$13,379,697
Lost Business Revenue	\$1,112,094	\$1,466,719	\$1,466,719	\$3,457,522
Benefit/Cost Ratio	1.53	1.36	2.07	2.80

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$50,584,450	\$64,311,133	\$64,311,133	\$141,370,495
Costs of Cessation Program	\$30,630,725	\$40,811,519	\$28,286,772	\$36,289,565
Lost Tax Revenue	\$5,815,661	\$7,393,809	\$7,393,809	\$16,253,274
Lost Business Revenue	\$1,502,857	\$1,910,675	\$1,910,675	\$4,200,099
Benefit/Cost Ratio	1.33	1.28	1.71	2.49

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Wisconsin

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Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Wisconsin the annual direct costs to the economy attributable to smoking were in excess of \$5.7 billion, including workplace productivity losses of \$1.4 billion, premature death losses of \$1.9 billion, and direct medical expenditures of \$2.3 billion. While the retail price of a pack of cigarettes in Wisconsin is on average \$6.81, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$16.24 per pack of cigarettes. The ratio of benefits to cost varies from \$0.80 to \$2.02 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had an approximately break-even benefits to costs ratio at the mid-point of the treatment effectiveness range. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the mid and low points of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in WI ¹	865,775
Visiting Smokers in WI ²	49,188
Total Smokers	914,963
Total Packs Sold to Residents	355,880,845
Total Packs Sold to Visitors	20,219,155
Total Packs Sold ³	376,100,000
Average Packs Per Resident Smoker Per Year	411

¹ Data from the Behavioral Risk Factor Surveillance System, Wisconsin Calculated Variable Data Report, 2005. Retrieved on October 26, 2009 from:

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

² Data from

<http://industry.travelwisconsin.com/~media/Files/Research/Economic%20Impact/2008/WI%202008%20State%20Report-HIGHLIGHTS.pdf>, The Economic Impact of Expenditures by Travelers on Wisconsin.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$1,314,598,466	\$7.06	\$2,901.85
Women	\$646,718,323	\$3.81	\$1,566.84
Combined	\$1,961,316,788	\$5.51	\$2,265.39
Workplace Productivity²			
Current Smokers ³	\$984,192,242	\$2.77	\$1,136.78
Former Smokers ⁴	\$463,089,616	\$1.30	\$534.88
Combined	\$1,447,281,858	\$4.07	\$1,671.66
Total Productivity Losses	\$3,408,598,646	\$9.58	\$3,937.05

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Wisconsin. Total expenditures per pack for both medical care and productivity losses are \$16.24 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$402,139,684	\$1.13	\$464.49
Hospital Care	\$1,237,911,919	\$3.48	\$1,429.83
Rx	\$333,097,630	\$0.94	\$384.74
Nursing Home	\$215,605,011	\$0.61	\$249.03
Other Care ²	\$179,267,088	\$0.50	\$207.06
Total	\$2,366,810,068	\$6.65	\$2,733.75
Neonatal Expenditures	\$3,609,734	\$0.01	\$4.17
Total Expenditures	\$2,370,419,802	\$6.66	\$2,737.92

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$3.85
Federal Tax ²	\$1.01
State Tax ²	\$2.52
State Sales Tax ³	\$0.32
Distributor & Retailer Mark-ups ¹	\$0.60
Final Retail Price	\$6.81

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$33,446,345	\$40,266,445	\$40,266,445	\$86,136,227
Costs of Cessation Program	\$19,999,403	\$30,675,274	\$17,541,467	\$25,933,424
Lost Tax Revenue	\$7,938,949	\$9,557,793	\$9,557,793	\$20,445,615
Lost Business Revenue	\$1,236,067	\$1,488,116	\$1,488,116	\$3,183,313
Benefit/Cost Ratio	1.15	0.97	1.41	1.74

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$46,091,601	\$53,934,716	\$53,934,716	\$106,684,966
Costs of Cessation Program	\$32,120,253	\$42,796,124	\$29,662,317	\$38,054,274
Lost Tax Revenue	\$10,940,474	\$12,802,144	\$12,802,144	\$25,323,140
Lost Business Revenue	\$1,703,395	\$1,993,250	\$1,993,250	\$3,942,727
Benefit/Cost Ratio	1.03	0.94	1.21	1.58

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$28,930,572	\$31,403,913	\$31,403,913	\$58,910,262
Costs of Cessation Program	\$19,999,403	\$30,675,274	\$17,541,467	\$25,933,424
Lost Tax Revenue	\$6,867,068	\$7,454,149	\$7,454,149	\$13,983,159
Lost Business Revenue	\$1,069,179	\$1,160,586	\$1,160,586	\$2,177,130
Benefit/Cost Ratio	1.04	0.80	1.20	1.40

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$40,898,462	\$43,742,805	\$43,742,805	\$75,375,106
Costs of Cessation Program	\$32,120,253	\$42,796,124	\$29,662,317	\$38,054,274
Lost Tax Revenue	\$9,707,811	\$10,382,955	\$10,382,955	\$17,891,315
Lost Business Revenue	\$1,511,473	\$1,616,591	\$1,616,591	\$2,785,617
Benefit/Cost Ratio	0.94	0.80	1.05	1.28

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$37,880,977	\$49,960,449	\$49,960,449	\$117,772,641
Costs of Cessation Program	\$19,999,403	\$30,675,274	\$17,541,467	\$25,933,424
Lost Tax Revenue	\$8,991,569	\$11,858,798	\$11,858,798	\$27,954,951
Lost Business Revenue	\$1,399,957	\$1,846,374	\$1,846,374	\$4,352,491
Benefit/Cost Ratio	1.25	1.13	1.60	2.02

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$51,191,428	\$65,082,821	\$65,082,821	\$143,066,841
Costs of Cessation Program	\$32,120,253	\$42,796,124	\$29,662,317	\$38,054,274
Lost Tax Revenue	\$12,150,987	\$15,448,300	\$15,448,300	\$33,958,877
Lost Business Revenue	\$1,891,867	\$2,405,248	\$2,405,248	\$5,287,282
Benefit/Cost Ratio	1.11	1.07	1.37	1.85

Adjusted for inflation to 2009

PENNS^{TATE}



Potential Costs and Benefits of Smoking Cessation for West Virginia

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April 30, 2010

Acknowledgements

This study was made possible by a grant from Pfizer Inc.

Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in West Virginia the annual direct costs to the economy attributable to smoking were in excess of \$2.4 billion, including workplace productivity losses of \$451 million, premature death losses of \$1.1 billion, and direct medical expenditures of \$861 million. While the retail price of a pack of cigarettes in West Virginia is on average \$4.60, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$13.04 per pack of cigarettes. The ratio of benefits to cost varies from \$0.85 to \$2.50 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had a break-even benefits to costs ratio across the range of treatment effectiveness percentages. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range and an approximate breakeven at the mid-point of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

Table 1: Baseline data on smokers and smoking in West Virginia.

Variable	Total
Resident Smokers in WV ¹	380,739
Visiting Smokers in WV ²	31,735
Total Smokers	412,474
Total Packs Sold to Residents	188,674,062
Total Packs Sold to Visitors	15,725,938
Total Packs Sold ³	204,400,000
Average Packs Per Resident Smoker Per Year	496

¹ Data from the Behavioral Risk Factor Surveillance System, West Virginia Calculated Variable Data Report, 2005. Retrieved on October 26, 2009 from:

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

² Data from <http://www.wvexecutive.com/featured/fall04/the-tourism-industry.php>, The Tourism Industry.

³ Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$745,977,744	\$8.01	\$3,967.23
Women	\$402,260,850	\$4.21	\$2,087.44
Combined	\$1,148,238,594	\$6.09	\$3,015.82
Workplace Productivity²			
Current Smokers ³	\$307,124,389	\$1.63	\$806.65
Former Smokers ⁴	\$144,510,502	\$0.77	\$379.55
Combined	\$451,634,891	\$2.39	\$1,186.21
Total Productivity Losses	\$1,599,873,485	\$8.48	\$4,202.02

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

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Table 3: Direct expenditures on medical care attributable to smoking and smoking-related events in West Virginia. Total expenditures per pack for both medical care and productivity losses are \$13.04 per pack.

Cost Component¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$116,281,354	\$0.62	\$305.41
Hospital Care	\$462,702,889	\$2.45	\$1,215.28
Rx	\$155,041,806	\$0.82	\$407.21
Nursing Home	\$65,408,262	\$0.35	\$171.79
Other Care ²	\$58,140,677	\$0.31	\$152.70
Total	\$858,786,253	\$4.55	\$2,255.58
Neonatal Expenditures	\$2,302,038	\$0.01	\$6.05
Total Expenditures	\$861,088,291	\$4.56	\$2,261.62

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.82
Federal Tax ²	\$1.01
State Tax ²	\$0.55
State Sales Tax ³	\$0.26
Distributor & Retailer Mark-ups ¹	\$0.42
Final Retail Price	\$4.60

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$14,242,934	\$17,147,234	\$17,147,234	\$36,680,617
Costs of Cessation Program	\$8,795,071	\$13,489,964	\$7,714,153	\$11,404,656
Lost Tax Revenue	\$1,988,023	\$2,393,405	\$2,393,405	\$5,119,867
Lost Business Revenue	\$463,239	\$557,699	\$557,699	\$1,193,006
Benefit/Cost Ratio	1.27	1.04	1.61	2.07

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$19,627,843	\$22,967,789	\$22,967,789	\$45,431,179
Costs of Cessation Program	\$14,125,417	\$18,820,310	\$13,044,499	\$16,735,002
Lost Tax Revenue	\$2,739,647	\$3,205,835	\$3,205,835	\$6,341,267
Lost Business Revenue	\$638,379	\$747,008	\$747,008	\$1,477,611
Benefit/Cost Ratio	1.12	1.01	1.35	1.85

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$12,319,918	\$13,373,176	\$13,373,176	\$25,086,596
Costs of Cessation Program	\$8,795,071	\$13,489,964	\$7,714,153	\$11,404,656
Lost Tax Revenue	\$1,719,610	\$1,866,623	\$1,866,623	\$3,501,578
Lost Business Revenue	\$400,695	\$434,951	\$434,951	\$815,921
Benefit/Cost Ratio	1.13	0.85	1.34	1.60

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$17,416,375	\$18,627,622	\$18,627,622	\$32,098,055
Costs of Cessation Program	\$14,125,417	\$18,820,310	\$13,044,499	\$16,735,002
Lost Tax Revenue	\$2,430,971	\$2,600,037	\$2,600,037	\$4,480,235
Lost Business Revenue	\$566,453	\$605,848	\$605,848	\$1,043,962
Benefit/Cost Ratio	1.02	0.85	1.15	1.44

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$16,131,396	\$21,275,370	\$21,275,370	\$50,152,802
Costs of Cessation Program	\$8,795,071	\$13,489,964	\$7,714,153	\$11,404,656
Lost Tax Revenue	\$2,251,614	\$2,969,608	\$2,969,608	\$7,000,310
Lost Business Revenue	\$524,660	\$691,964	\$691,964	\$1,631,178
Benefit/Cost Ratio	1.39	1.24	1.87	2.50

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$21,799,575	\$27,715,145	\$27,715,145	\$60,924,192
Costs of Cessation Program	\$14,125,417	\$18,820,310	\$13,044,499	\$16,735,002
Lost Tax Revenue	\$3,042,777	\$3,868,470	\$3,868,470	\$8,503,776
Lost Business Revenue	\$709,013	\$901,412	\$901,412	\$1,981,508
Benefit/Cost Ratio	1.22	1.17	1.56	2.24

Adjusted for inflation to 2009

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Potential Costs and Benefits of Smoking Cessation for Wyoming

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April 30, 2010

Acknowledgements

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Executive Summary

Background. Cigarette smoking is the single leading cause of preventable disease and preventable death in the United States (US), leading to more than 400,000 deaths annually. The CDC and the U.S. Department of Health and Human Services have both issued 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. However, access to these aids is limited since many payers do not cover these treatments. The objective of this study was to determine whether the cost of making such smoking cessation programs available at the state level could be justified by the benefits.

Methods. We performed a cost-benefit analysis of access to smoking cessation programs using a societal perspective using state specific data. 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. Benefits were estimated as reductions in medical expenditures, premature deaths and increased workplace productivity. Costs were estimated as direct 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. Other model parameters included how many smokers take advantage of the programs and the programs' effectiveness in helping smokers to quit. The cost-benefit model was parameterized using data from CDC, and various national surveys, including the Behavioral Risk Factors Surveillance Survey and the Current Population Survey.

Results. Results from our model suggested that in Wyoming the annual direct costs to the economy attributable to smoking were in excess of \$510 million, including workplace productivity losses of \$134 million, premature death losses of \$196 million, and direct medical expenditures of \$179 million. While the retail price of a pack of cigarettes in Wyoming is on average \$4.77, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately \$13.81 per pack of cigarettes. The ratio of benefits to cost varies from \$0.82 to \$2.44 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. Nicotine replacement therapies had a break-even benefits to costs ratio across the range of treatment effectiveness percentages. Generic bupropion and varenicline showed substantial benefits to costs from the societal perspective. Only brand name bupropion did not have a positive benefits to cost ratio at the low end of the range and an approximate breakeven at the mid-point of the range. Detailed results can be found in Tables 1-8, which are attached.

Conclusions. For most smoking cessation treatments, the benefits of smoking cessation programs statewide greatly outweigh the cost to implement them.

Tables

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

Variable	Total
Resident Smokers in WY ¹	81,597
Visiting Smokers in WY ²	9,666
Total Smokers	91,263
Total Packs Sold to Residents	36,925,845
Total Packs Sold to Visitors	4,374,155
Total Packs Sold ³	41,300,000
Average Packs Per Resident Smoker Per Year	453

¹ Data from the Behavioral Risk Factor Surveillance System, Wyoming Calculated Variable Data Report, 2005. Retrieved on October 26, 2009 from:

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

² Data from

http://www.wyomingbusiness.org/pdf/tourism/wyoming_2008_visitor_profile_report_02.19.09.pdf, Wyoming Tourism 2008 Visitor Profile Report.

³Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

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	Per Pack	Per Smoker
Premature Death¹			
Men	\$131,763,651	\$7.44	\$3,365.35
Women	\$64,383,814	\$3.35	\$1,516.95
Combined	\$196,147,465	\$5.31	\$2,403.86
Workplace Productivity²			
Current Smokers ³	\$91,294,481	\$2.47	\$1,118.85
Former Smokers ⁴	\$42,956,573	\$1.16	\$526.45
Combined	\$134,251,054	\$3.64	\$1,645.29
Total Productivity Losses	\$330,398,519	\$8.95	\$4,049.15

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Data from Bunn WB, 3rd, Stave GM, Downs KE, Alvir JM, Dirani R. Effect of smoking status on productivity loss. J Occup Environ Med 2006 Oct;48(10):1099-108.

³. Per Bunn et al. total cost per current smoker in the labor force is \$4430, with a net effect of lost productivity of \$1807.

⁴. Per Bunn et al. 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 Wyoming. Total expenditures per pack for both medical care and productivity losses are \$13.82 per pack.

Cost Component ¹	Total	Per Pack	Per Smoker
Adult Expenditures			
Ambulatory Care	\$25,436,546	\$0.69	\$311.73
Hospital Care	\$99,323,657	\$2.69	\$1,217.25
Rx	\$26,647,810	\$0.72	\$326.58
Nursing Home	\$13,323,905	\$0.36	\$163.29
Other Care ²	\$15,746,433	\$0.43	\$192.98
Total	\$179,267,088	\$4.85	\$2,196.98
Neonatal Expenditures	\$424,955	\$0.01	\$5.21
Total Expenditures	\$179,692,043	\$4.87	\$2,202.19

Adjusted for inflation to 2009

¹. SAMMEC. Adult Smoking-Attributable Mortality, Morbidity, and Economic Costs Calculator. Atlanta, GA: CDC; 2008.

². Other Care includes home health, nonprescription drugs, and nondurable medical products.

Table 4: Components of cigarette prices, including taxes, distributor markups, and retailer markups.

Component	Price
Factory Price ¹	\$2.36
Total Taxes	\$1.79
Federal Tax ²	\$1.01
State Tax ²	\$0.60
State Sales Tax ³	\$0.18
Distributor & Retailer Mark-ups ¹	\$0.62
Final Retail Price	\$4.77

Adjusted for inflation to 2009

¹ 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).

² Data from <http://www.tobaccofreekids.org/research/factsheets/pdf/0099.pdf>, Campaign for Tobacco Free Kids.

³ Data from <http://www.rjrt.com/StateMsaPayments.aspx>, State MSA Payments.

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

Treatment	With	
	Alone	Counseling
NRT	\$231	\$371
Bupropion (Brand)	\$354	\$494
Generic Bupropion	\$203	\$343
Varenicline	\$300	\$440

Source: Treatment costs are at national retail pricing from Drugstore.com (2009). Prices were adjusted to 2009 dollars.

Table 6: Marginal treatment effectiveness, including baseline values and ranges used in sensitivity analysis.

Treatment Option	Marginal Treatment Effectiveness		
	<i>Baseline</i>	<i>Low</i>	<i>High</i>
NRT ¹	5.8%	5.0%	6.6%
Bupropion (Brand) ²	7.0%	5.4%	8.6%
Generic Bupropion ²	7.0%	5.4%	8.6%
Varenicline ³	14.9%	10.2%	20.4%
NRT Plus Counseling	8.0%	7.1%	8.9%
Bupropion (Brand) Plus Counseling	9.3%	7.6%	11.3%
Generic Bupropion Plus Counseling	9.3%	7.6%	11.3%
Varenicline Plus Counseling	18.5%	13.0%	24.8%

¹. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev 2004(3):CD000146.

². Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev 2007(1):CD000031.

³. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev 2007(1):CD006103.

Table 7: Results of cost-benefit analysis at baseline marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$2,952,173	\$3,554,156	\$3,554,156	\$7,602,896
Costs of Cessation Program	\$1,884,891	\$2,891,063	\$1,653,237	\$2,444,157
Lost Tax Revenue	\$383,310	\$461,471	\$461,471	\$987,159
Lost Business Revenue	\$132,676	\$159,730	\$159,730	\$341,687
Benefit/Cost Ratio	1.23	1.01	1.56	2.02

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$4,068,319	\$4,760,599	\$4,760,599	\$9,416,650
Costs of Cessation Program	\$3,027,249	\$4,033,421	\$2,795,595	\$3,586,515
Lost Tax Revenue	\$528,230	\$618,116	\$618,116	\$1,222,657
Lost Business Revenue	\$182,837	\$213,949	\$213,949	\$423,200
Benefit/Cost Ratio	1.09	0.98	1.31	1.80

Adjusted for inflation to 2009

Table 8: Sensitivity analysis of cost-benefit analysis at low values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$2,553,584	\$2,771,896	\$2,771,896	\$5,199,770
Costs of Cessation Program	\$1,884,891	\$2,891,063	\$1,653,237	\$2,444,157
Lost Tax Revenue	\$331,557	\$359,903	\$359,903	\$675,138
Lost Business Revenue	\$114,762	\$124,574	\$124,574	\$233,686
Benefit/Cost Ratio	1.10	0.82	1.30	1.55

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$3,609,942	\$3,861,000	\$3,861,000	\$6,653,055
Costs of Cessation Program	\$3,027,249	\$4,033,421	\$2,795,595	\$3,586,515
Lost Tax Revenue	\$468,714	\$501,312	\$501,312	\$863,832
Lost Business Revenue	\$162,237	\$173,520	\$173,520	\$299,000
Benefit/Cost Ratio	0.99	0.82	1.11	1.40

Adjusted for inflation to 2009

Table 9: Sensitivity analysis of cost-benefit analysis at high values of marginal effectiveness

Costs/Benefits	No Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$3,343,600	\$4,409,807	\$4,409,807	\$10,395,314
Costs of Cessation Program	\$1,884,891	\$2,891,063	\$1,653,237	\$2,444,157
Lost Tax Revenue	\$434,133	\$572,569	\$572,569	\$1,349,727
Lost Business Revenue	\$150,267	\$198,184	\$198,184	\$467,183
Benefit/Cost Ratio	1.35	1.20	1.82	2.44

Costs/Benefits	Counseling			
	<i>NRT</i>	<i>Bupropion (Brand)</i>	<i>Generic Bupropion</i>	<i>Varenicline</i>
Medical Expenditures Avoided Plus Productivity Gains	\$4,518,460	\$5,744,597	\$5,744,597	\$12,627,931
Costs of Cessation Program	\$3,027,249	\$4,033,421	\$2,795,595	\$3,586,515
Lost Tax Revenue	\$586,676	\$745,878	\$745,878	\$1,639,609
Lost Business Revenue	\$203,067	\$258,172	\$258,172	\$567,520
Benefit/Cost Ratio	1.18	1.14	1.51	2.18

Adjusted for inflation to 2009