Tobacco Control/Financial Analysis

The SmokingPaST Framework: Illustrating the Impact of Quit Attempts, Quit Methods, and New Smokers on Smoking Prevalence, Years of Life Saved, Medical Costs Saved, Programming Costs, Cost Effectiveness, and Return on Investment

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Abstract

Purpose. *Describe the specifications of the Smoking Prevalence, Savings, and Treatment (SmokingPaST) Framework and show how it can illustrate the impact of quit attempts, quit method, number of new smokers, smoking rates of immigrants and emigrants, and death rates of smokers and nonsmokers on future smoking prevalence rates, program costs, years of life saved, medical costs saved, cost effectiveness of programs, and return on investment (ROI).*

Framework Specifications. *Mathematical relationships among factors in SmokingPaST are described. Input variables include baseline smoking rates among current adults, new adults, immigrants, and emigrants; population counts for these groups; annual quit attempts; and distribution of quit methods. Assumption variables include success rate by quit method, death rates of smokers and nonsmokers, annual medical costs of smoking, costs per person for four tobacco treatment methods, age distribution of quitters, and distribution of medical cost funding by source. Output variables include year-end adult smoking rates, successful quitters, years of life saved by quitting, medical costs saved by quitting and by not hiring smokers, total costs of smoking treatment programs, cost per quitter, cost per life-year saved, distribution of medical cost savings from quitting, and ROI of treatment costs.*

Applications. *The Framework was applied at the employer, county, state, and national levels.*

Conclusions. *The SmokingPaST Framework provides a conceptually simple framework that can be applied to any population. It illustrates that significant drops in smoking rates can be achieved and significant savings in medical costs can be captured by employers as well as state and federal governments through tobacco treatment and prevention programs. Savings are especially important for reducing state and federal government deficits and enhancing job competitiveness. (Am J Health Promot 2011;26[1]:e11–e23.)*

Key Words: Tobacco Control, Quitting, Medical Costs, Funding Medical Costs, Prevention Research. Manuscript format: conceptual framework; Research purpose: descriptive; Study design: nonexperimental; Outcome measure: behavioral, mortality, medical costs; Setting: workplace, local community, state/national; Health focus: smoking prevention, tobacco treatment; Strategy: N/A; Target population age: youth, adults; Target population circumstances: all

INTRODUCTION

Forty years of effort cut the percentage of cigarette users in the United States in half, from approximately 42% to 21%.[1] This change may represent the greatest public health achievement in the United States in the past half century. Nevertheless, tobacco use remains the number one cause of death in the United States, killing more than 400,000 people each year.[2] Of equal concern, declines in smoking rates have stalled, dropping 2 percentage points between 2001 and 2006,[3] but only 0.3 percentage points between 2004 and 2009.[4] Part of the cause of the stall is reduced investment in tobacco prevention and treatment. Most states diverted the lion's share of the $246 billion secured through the Master Settlement Agreement (MSA) to efforts other than tobacco control. The Campaign for Tobacco-Free Kids estimates that only 3% of the funds have gone to tobacco prevention and treatment and that only three states are funding programs even at the minimum level recommended by the Centers for Disease Control and Prevention (CDC).[5] The cause of inadequate investments in tobacco prevention and treatment may be that public health advocates have not been successful in articulating the health and financial returns of investing in tobacco prevention and treatment efforts and explaining them to policy makers in relevant language.

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Table 1
SmokingPaST Framework: Input, Assumption, and Output Variables*

Input Variables	Assumption Variables	Output Variables
Population counts	Health factors	Health outcomes
Current adults	Death rates of smokers	Year-end adult smoking rates
New adults (high school seniors)	Death rates of nonsmokers	Successful quitters
Immigrants	Treatment factors	Years of life saved by quitting
Emigrants	Age distribution of quitters	Treatment costs
Baseline adult smoking rates	Success rate by quit method	Total costs of quit smoking treatment programs
Current adults	Costs of quit smoking treatments per person	Cost per quitter
New adults (high school seniors)	Medical costs	Cost per life year saved
Immigrants	Annual medical costs of smoking	Medical cost outcomes
Emigrants	Distribution of medical cost funding by source	Medical costs saved by quitting
Efforts to quit		Medical costs saved by not hiring smokers
Annual quit attempts		ROI medical costs saved vs. treatment costs
Distribution of quit methods used		Distribution of medical cost savings from quitting

* ROI indicates return on investment; and SmokingPaST, Smoking Prevalence, Savings, and Treatment.

Given this situation, we asked ourselves what we would need to do to drastically reduce the adult smoking rate in our community of Cuyahoga County, Ohio. We realized that future smoking rates could be explained by three factors: number of smokers attempting to quit, success rates of quitters, and number of new adult smokers entering the community. Realizing this, we developed a mathematical framework to illustrate this relationship and used the framework to determine the combinations of quit attempts, successful quit rate, and reductions in new smokers necessary to reduce smoking rates in future years. Subsequently, we realized that we could expand the framework to illustrate the impact of quitting on years of life saved, cost of treatment programs, medical costs saved, return on investment (ROI) of treatment programs, and savings by payer. We also realized that the framework could be adapted to illustrate these relationships for groups of any size, including employers, states, and nations.

We call it the Smoking Prevalence, Savings, and Treatment (SmokingPaST) Framework. After developing the Framework we discovered models[6,7] that had been developed to explain some of the relationships in SmokingPaST. These models used sophisticated math with the primary intention of predicting future smoking rates. They seem to have been designed for use primarily by scientists. The purpose of our framework is not to predict future smoking rates but to illustrate the impact of motivating more people to attempt to quit, engaging them in more successful quit methods, and reducing the number of new smokers entering the community. It functions effectively to test ''what if?'' scenarios. The applications described here include assumptions about the values of key variables that we feel are reasonable, but the framework was developed in such a way that users can choose their own values for those variables. This framework is also unique because it includes mechanisms to estimate impact on years of life saved, medical cost savings, and ROI. Because it uses simple arithmetic formulae presented in spreadsheet format, we hope that it will be relatively easy for practitioners to manipulate. The spreadsheet will be entered in the public domain so all can use it.

The purpose of this article is to describe the mathematical specifications of the SmokingPaST framework and to illustrate how it can be used to inform decisions at the national, state, county, or organization level.

Specifications of the SmokingPaST Framework

The SmokingPaST Framework was developed to illustrate the impact of quit attempts, quit methods, and new smokers on three major output areas: (1) health improvements, including future smoking rates, number of successful quitters, and years of life saved by quitting; (2) treatment costs, including total costs for treatment programs, cost per quitter, and cost per year of life saved; and (3) medical cost savings, including medical costs saved by smokers who quit, savings from not hiring smokers, distribution of savings by payer, and ROI on treatment costs. The input, assumption, and output variables are listed in Table 1. Input variables are specific to each population considered, whereas values of assumption variables are assumed to be constant across multiple populations. We developed this mathematical framework to allow users to insert values on quit rates, quit methods, number of new smokers, and other input values that are relevant to the populations they are studying and to insert their preferred values for success methods by treatment approach, costs by treatment approach, medical costs of smoking, and other assumption values. Users can insert their own values on a working spreadsheet of the mathematical framework that is available at http://www.HealthPromotionJournal.com/SmokingPaST.html. For each of the assumption variables, we selected values that we felt were reasonable based on current literature or our own

experience. Values of assumption variables are described below, organized under the major output variables they influence.

Health Improvements

Year-End Smoking Rates (Output Variable). The year-end smoking rate for each year was calculated by estimating the number of smokers and nonsmokers at the end of the year, adding them together to get the total population, and dividing the number of smokers into the total population. This basic formula estimates the smoking rate for as many years as desired. The applications in this article include 12 years. The basic formula for calculating future smoking rates is shown below. The subformulae for inputs and outputs and the value of constants are described after the basic formula below.

smoking rate at year end = (smokers at year end)/(nonsmokers at year end + smokers at year end)

Smokers and Nonsmokers (Input Variable). The number of smokers at the end of the year was calculated by adding the number of smokers at the end of the previous year to the number of smokers who had just become adults and immigrants who were smokers and then subtracting emigrant smokers who left, successful quitters, and smokers who died. The same calculation was made for nonsmokers in the adult population. Formulae are shown below. Note: immigrants are people who enter a community and emigrants are people who leave. At the national level, these are people who come from or go to different nations. At the state or community level, they include people moving to and from other states as well as other nations. At the employer level, they are employees who join the organization and those who leave.

smokers at year end = smokers at end of previous year + (new adult smokers + immigrant smokers) − (emigrant smokers + successful quitters + smoker deaths)
nonsmokers at year end = nonsmokers at end of previous year + (successful quitters + new adult nonsmokers + immigrant nonsmokers) − (emigrant nonsmokers + nonsmoker deaths)

New Adult Smokers (Input Variable). The number of new adult smokers will be specific to each population examined. In the applications, we used a proxy measure of smoking rates among high school seniors as reported by the Behavioral Risk Factor Surveillance System (BRFSS).[8] To estimate the number of new smokers, we multiplied smoking rates of high school seniors by the number of high school seniors. This method assumes that all new smokers are high school students who become part of the adult population when they leave high school. A weakness of this approach is that it does not include youth who are not enrolled in high school. Another option would have been to use smoking rates of college-aged young adults as a proxy measure of smoking rates of new adults because many smokers initiate smoking in college rather than high school. We choose not to use this approach because many young adults do not attend college and young adults of college age are included in BRFSS counts of adults. Users may choose to use smoking rates of college-aged adults in their application of SmokingPaST.

new adult smokers = high school seniors × smoking rate of high school seniors

Immigrant and Emigrant Smokers and Nonsmokers (Input Variable). Estimates of the numbers of immigrants and emigrants or their smoking rates can be entered by users for each population examined. The applications show how these features can be used.

immigrant smokers = immigrants × smoking rate specific to immigrant population
emigrant smokers = emigrants × smoking rate specific to emigrant population

Death Rates of Smokers and Nonsmokers (Assumption Variable). We were unable to find established population death rates for smokers or nonsmokers at the population level. We therefore derived death rates for smokers and nonsmokers by combining what the literature reports on overall death rates in the population, relative death rates of smokers and nonsmokers, and smoking prevalence. The 2005 age-adjusted death rates for the overall U.S. population is 825.9 per 100,000[9]; 2005 smoking prevalence was 20.9%,[10] and Doll et al.[11] reported that the death rate of smokers is approximately twice that of nonsmokers. This resulted in a derived death rate for smokers of 1366.2 deaths per 100,000 lives and a rate for nonsmokers of 683.1 per 100,000. These values were used in the national, state, and community applications of the Framework. We also derived a death rate for smokers and nonsmokers for the age group of 25 to 64 years to use in the organization-level illustration. We did this by averaging the death rates for age groups 25 to 34, 35 to 44, 45 to 54, and 55 to 64 years and then using the same methodology as described earlier to derive rates for smokers and nonsmokers. The derived death rate for smokers in the 25 to 64 years age group was 670.2, and the rate for nonsmokers was 335.1.

Successful Quitters (Output Variable). Successful quitters for each year were calculated by multiplying quit attempts each year by the portion of quitters using each of four quit methods by the success rates for that method and summing the total.

successful quitters = total quit attempts × ([portion quitting cold turkey × cold turkey success rate] + [portion quitting with medication only × medication only success rate] + [portion quitting with behavior therapy only × behavior therapy only success rate] + [portion quitting with behavior therapy plus medication × behavior therapy plus medication success rate])

Adult Population (Input Variable). Adult population estimates were drawn from U.S. Census Bureau reports for each of the populations, including Cuyahoga County,[12] Ohio,[13] and the nation.[14]

Current Smoking Rates, Quit Attempts, and Quit Methods (Input Variables). Current smoking rates, quit attempts, and quit methods were drawn from the BRFSS for each population.[8] The specific data source varied for each population. The strength of the BRFSS is that it provides standard periodic measures of smoking rates, quit attempts, quit methods, and other

variables for the nation, all 50 states, and some counties and cities. The weaknesses include lack of values for many years; small samples for some states, many counties, and many cities; and underrepresentation of populations without telephones.

Success by Quit Method (Assumption Variable). We estimated likely quit rates for each of the basic quit methods from the literature.

Cold Turkey. We used the estimate from Hughes et al.[15] of 5% success rates for people quitting cold turkey (i.e., on their own with no formal training).

Behavioral Therapy. The 2008 Update of the Clinical Practice Guideline on Treating Tobacco Use and Dependence (2008 Update) reported findings of a series of meta-analyses of 6-month quit rates for a wide range of behavioral therapy, medication therapy, and combined approaches. Quit rates ranged from 14.4% for 1 to 3 minutes of counseling to 25.5% for 300 minutes[16] and from 12.4% for one session to 24.7% for 8 or more sessions.[17] Rates were 12.3% for self-help programs, 13.1% for proactive telephone counseling, 13.9% for group counseling, and 16.8% for individual counseling.[18] The mean quit rate for the four methods was 14%. Based on these findings, we choose a 10% quit rate for this analysis to account for relapse after 6 months. A 10% quit rate allows for relapse rates of 28% for the behavioral methods, a rate that is consistent with our experiences.

Medication Therapy. The 2008 Update reported meta-analyses of 6-month quit rates for 12 different forms and doses of medication treatment, including nicotine replacement therapy (NRT; e.g., gum, patch, spray), depression therapy (bupropion), and nicotine receptor therapy (varenicline), with rates ranging from 19% for 6 to 14 weeks of nicotine gum to 33.2% for 2 mg/day varenicline.[19] The mean quit rate for all of these approaches was 25%. We choose a 20% quit rate for this analysis to account for relapse after 6 months. A 20% quit rate allows for relapse rates of 25% for the behavioral methods, a rate that is consistent with our experiences.

Combination Behavioral and Medication Therapy. The meta-analyses in the 2008 Update reported that medication plus counseling was 1.4 times more effective than medication alone.[20] We multiplied the 20% postrelapse rate used for medication only by 1.4 to yield an estimate of a 28% postrelapse quit rate for the combination behavior therapy plus medication approach. Users may choose to use other values for quit rates.

Years of Life Saved (Output Variable). Estimates of years of life saved were calculated by multiplying the number of people in each age group who quit by the years of life expected to be saved for each age group and then summing the years saved. The basic formula for calculating life years saved is shown below. The subformulas for inputs and outputs and the constants are described after the basic formula.

Years of Life Saved by Age of Quitting (Assumption Variable). Findings from Doll et al.[11] were used in the basic framework. In a 50-year longitudinal study of 34,439 physicians in the United Kingdom, the researchers found that smokers had a life span 10 years shorter than nonsmokers; however, the 10 years could be regained if a person quit by age 34 years, 9 years by age 44, 6 years by age 54, and 3 years by 64. Another option would be to use the estimate by CDC that smokers lose 14 years of life and then derive likely years of life saved for each age group.[21] We chose to use the values from Doll et al.[11] because they were more conservative and because we did not have a reliable strategy to estimate years of life saved by quitting at each age cut point for the CDC data. Users can choose to use other values.

years of life saved = sum for the years examined (number of successful quitters <34 years × 10 years) + (number of successful quitters 35–44 years × 9 years) + (number of successful quitters 45–54 years × 6 years) + (number of successful quitters 54–64 years × 3 years).

Age Distribution of Quitters (Assumption Variable). The age distribution of successful quitters was based on our own experience in a campaign in Cuyahoga County, Ohio, that stimulated 10,625 quit attempts over a 6-month period.[22] In that campaign, 23.7% quit attempters were less than 34 years, 24.8% were 35 to 44 years, 31.1% were 45 to 54 years, 20.4% were 55 to 64 years, and none were 65 years or older. We used these values in our applications of the Framework. Users can insert their own estimates for age distribution of quitters in the populations.

Treatment Costs

Treatment costs were estimated through out own experience in providing treatment programs to patients in a clinical setting. Users can insert their own values for the cost of each type of treatment.

Cold Turkey. The cost of cold turkey quit attempts was assumed to be zero, and the cost per successful quit was zero.

Behavioral Therapy. For behavioral treatment only, we assumed that one-fourth of smokers would use each of the four primary quit methods (self-help materials, telephone counseling, group counseling, and individual counseling). Self-help materials were assumed to cost $10/participant. Telephone counseling was assumed to cost $150/participant for three 30-minute sessions at a cost of $50/hour for the counselor. Group counseling was estimated to cost $250/participant for treatment that included a $10 book and six 1-hour group sessions. Individual counseling was estimated to cost $410/participant for treatment that included a $10 book and four 45-minute sessions at a cost of $50/hour for the counselor. The average cost of these behavioral therapy methods is $205 ([$10 + $150 + $250 + $410]/4 = $205). Assuming a 10% quit rate, the cost per successful quit is $2050 ($205/10% = $2050).

Medication Therapy. For pharmacology treatment only, we assumed that one-third of smokers would use each of the pharmacology treatments (NRT, bupropion, varenicline). NRT costs $150 for 3 months of medication, bupropion costs $75 for 3 months plus an additional $30 for NRT to compliment the bupropion, and varenicline costs

$330 for 3 months, for an average cost of $195. Assuming a 20% quit rate, the cost per successful quit through this mix of pharmacology treatments was $975 ($195/20% = $975).

Combined Behavioral and Medication Therapy. The combination of behavioral and medication therapy was estimated to cost $205 + $195 = $400. Assuming a 28% quit rate, the cost per quit was $1429 ($400/28% = $1429).

Cost per Year of Life Saved (Output Variable). The overall cost per year of life saved was calculated by dividing projected years of life saved by treatment costs. Cost per successful quit was estimated by multiplying the cost of each treatment by the success rate for that treatment.

cost per year of life saved = (years of life saved)/(cost of treatment)
cost per successful treatment = (cost of treatment) × (success rate of treatment)

Medical Cost Savings

Medical Costs Avoided by Quitting Smoking (Output Variable). Medical costs avoided by successful quits were estimated by multiplying the number of successful quits by the difference in smoking costs for smokers and nonsmokers, factoring in years after quitting required to reach the medical cost of nonsmokers for smokers with and without chronic conditions. We did not estimate medical cost savings for smokers who died or emigrated from the population. The basic formula for calculating medical cost saved is shown below. The subformulas for inputs and outputs and the constants are described after the basic formula.

Medical Cost of Smoking Per Smoker (Assumption Variable). The CDC concluded that annual medical costs for smokers were $1623 higher than for those nonsmokers in 1998.[21] We chose to use this value because it is the most widely cited estimate of the cost of annual smoking per smoker. We recognize that it probably underestimates the cost because of the increase in overall medical costs since 1998, but we did not have a valid method to extrapolate this value to a 2011 estimate. Users may choose to use other values.

Medical Cost Savings From Not Hiring Smokers (Assumption Variable). For employers who decided to not hire smokers, we assumed savings of $1623 for each smoker not hired for each year considered multiplied by the smoking rate in the population from which new employees are normally hired. The total savings from this group equaled the additional number of never-smokers multiplied by $1623 and summed for all years in the illustration.

Medical Cost Savings for Quitters (Assumption Variable). Medical costs avoided by quitting were based on a study by Musich et al.[23] of 20,332 employees of General Motors on the change in medical costs after quitting smoking. Musich et al.[23] found that medical costs for smokers dropped to costs of nonsmokers after 5 years for those with no chronic conditions and after 10 years for those with chronic conditions. For simplicity, we assumed that medical costs decreased in a linear fashion by year. Therefore, for quitters with chronic disease, we assumed their medical costs decreased $162/year for 10 years ($1623/10 = $162) until they reached the cost of nonsmokers in the 10th year. For quitters with no chronic disease, we assumed their medical costs decreased $325/year for 5 years ($1623/5 = $325) until they reached the cost of nonsmokers in the fifth year. Users can insert their own assumptions on medical cost savings for smokers who quit. For this estimate, we assumed that 50% of smokers have chronic conditions and 50% do not. This distribution is consistent with estimates by the federal government that 54% of people with employment-based insurance have preexisting medical conditions.[24] Users can insert their own assumptions on this distribution. Differences in medical costs were calculated for 10 years. Because of space limitations, only 3 years of the formula for calculating cost savings is shown below. The full formula and spreadsheet can be seen on the Web site (http://www.HealthPromotionJournal.com/SmokingPaST.html).

total medical cost savings = sum for the years examined (savings for quitters + savings from new smokers prevented)
savings from quitters in year 1 = (total quitters in year 1 × portion of quitters in year 1 with chronic disease × $162.30) + (total quitters in year 1 × portion of quitters in year 1 with no chronic disease × $326.60)
savings from quitters in year 2 = savings from quitters in year 1 + (total quitters in year 2 × portion of quitters in year 2 with chronic disease × $162.30 + total quitters in year 2 × portion of quitters in year 2 with no chronic disease × $326.60)
savings from quitters in year 3 = savings from quitters in year 1 +savings from quitters in year 2 + (total quitters in year 3 × portion of quitters in year 3 with chronic disease × $162.30) + (total quitters in year 3 × portion of quitters in year 3 with no chronic disease × $326.60)

This pattern continues for each additional year.

ROI (Output Variable). ROI was calculated by dividing the total medical cost savings by the total treatment costs during the 12-year period examined.

ROI = (medical cost savings/treatment costs)

Distribution of Savings by Funder (Output Variable) and Ratio of Medical Cost Funding by Source (Assumption Variable). For populations at the county, state, and national levels, medical cost savings recovered from quitting smoking are assumed to reduce annual medical costs for the funders of care. As such, costs savings are assumed to be in direct proportion to relative spending levels of these funders.[25] Distribution of spending by major funders is shown in Table 2.

Medical Care Funding Sources

For employer populations, all savings are assumed to be recovered by the employer because most employers who provide health insurance pay 70% to 80% of the full cost. In reality, some savings at the organization level may be passed on to households through higher wages or reduced health plan

Table 2
Medical Care Funding Sources

Employers		40.0%
Private business employers	25.00%	
Federal employer	9.19%	
State and local government employer	5.82%	
Households		31.11%
Federal aid and other federal spending		13.67%
State Medicaid and local aid		11.48%
Other private revenues		3.47%
Total		100%

premiums, but sorting that relative distribution is beyond the scope of this analysis. Users can insert their own values on the distribution of cost savings.

Applications: County, State, National, and Employer Levels

The SmokingPaST Framework illustrates the impact of any of the input variables on any of the output variables for any population. For example, it illustrates the impact of existing levels of quit attempts, quit method, and smoking rates on future smoking rates, treatment program costs, years of life saved, medical costs saved, cost effectiveness of programs, and ROI. It can also be used to show how different degrees of changes in the inputs result in changes in the outputs (e.g., how increasing numbers of quit attempts and numbers of people using the most effective quit methods and reducing numbers of new smokers can reduce future smoking rates). From another perspective, it can be used to show the specific level of changes that must occur in the number of quit attempts and number of people using the most effective quit methods and/or reducing the number of new smokers to achieve a desired smoking rate by a specific year. Additionally, it can be used to show which strategies produce the greatest reduction in future smoking rates, save the most money, are the most cost effective, or produce the greatest ROI. In the sections following, SmokingPaST is applied to community-, state-, national-, and organization-level populations to illustrate several of these applications. Values of inputs and assumption variables are specified in each illustration.

Community Application: Cuyahoga County, Ohio. The community-level application of SmokingPaST illustrates the impact of existing levels of quit attempts, existing quit methods, and existing smoking rates on future smoking rates, program costs, years of life saved, medical costs saved, cost effectiveness of programs, and ROI. It also illustrates the impact of improving quit attempts, quit methods, and new smokers by 10%. Values from Cuyahoga County, Ohio, were used in this illustration. Cuyahoga County is located in northeast Ohio and includes the city of Cleveland. It has approximately 1.3 million people, including approximately 1.0 million adults. The most recent published statistics related to smoking were collected in 2006 and are shown below.[26]

Adult smoking rate at the beginning of 2007 (based on 2006 end of year data): 18.8%
Smoking rate of high school seniors: 22.5%
Portion of smokers attempting to quit annually: 53.5%
Quit method: cold turkey, 70%; medication therapy only, 27%; behavioral therapy only, 2%; behavioral plus medication therapy: 1%

For the purposes of this analysis, we assumed the following.

Adult immigrants per year: 75,000
Adult emigrants per year: 50,000
Smoking rate of immigrants: 22.1% (same as state of Ohio in 2007)
Smoking rate of emigrants: 18.8% (same as Cuyahoga County in 2007)

If these factors held steady, smoking prevalence at the end of 2018 would be projected to drop from the 2007 rate of 18.8% to 14.2% in 2019 (Table 3). If smoking rates dropped to this level, 823,626 years of life and $715,616,573 in medical costs would be projected to be saved. A total of $75,342,577 would need to be spent on quit smoking treatments during the 12-year period, but the cost per quitter would be only $648, the cost per life-year saved would be only $91, and the ROI would be $9.50 in medical cost savings for every dollar invested in smoking cessation programs. Table 3 shows the actual output of the Framework that relates to smoking rates. The top of Table 3 shows values for nonsmokers, including the annual number of nonsmokers at the beginning of the year, nonsmoking rate at the beginning of the year, new nonsmoking adults entering the population (including new adults and immigrants) and those leaving (including emigrants and deaths), nonsmokers at the end of the year, and net change in the number of nonsmokers. Similar values are shown for smokers at the bottom of Table 3, with final smoking prevalence rates shown in the last column. Because of space limitations, applications for other population levels show only the final smoking prevalence rate at the end of the 12-year period.

If all of the input factors were improved by just 10% (i.e., if smoking rates of high school seniors dropped to 20.3%, quit attempts increased to 58.9%, and smokers quitting cold turkey dropped from 70% to 63%, and all of the 7% shifted from cold turkey to using a combination of behavioral plus medication therapy [increasing this number to 8%], then 2018 smoking prevalence would drop to 12.7% and years of life saved would increase to 994,298). Total treatment program costs, costs per quitter, and cost per year of life saved would increase because fewer people would be using the zero-cost cold turkey methods and more would use the most expensive combined behavioral plus medication therapy approach. However, medical costs saved would also increase substantially, and ROI would still be very high. Program costs, medical cost savings, cost per quitter, cost per year of life saved, and ROI on medical cost savings are shown in Table 4.

Table 3
Smoking Rates in Cuyahoga County Assuming No Change in Quit Attempts, Quit Method, or Number of New Smokers

Non Smokers

Year	Total Adult Population	Beginning Nonsmokers	Beginning Nonsmoking Rate	New Adults	Immigrants	Emigrants	Deaths	Ending Non-smokers	Change
2007	1,000,000	812,000	81.2%	14,264	57,675	40,600	5761	847,089	35,089
2008	1,035,020	847,089	81.8%	14,264	57,675	40,921	5998	881,615	34,527
2009	1,069,803	881,615	82.4%	14,264	57,675	41,205	6232	915,638	34,022
2010	1,104,348	915,638	82.9%	14,264	57,675	41,456	6463	949,204	33,566
2011	1,138,656	949,204	83.4%	14,264	57,675	41,681	6691	982,354	33,150
2012	1,172,726	982,354	83.8%	14,264	57,675	41,883	6916	1,015,122	32,768
2013	1,206,558	1,015,122	84.1%	14,264	57,675	42,067	7138	1,047,536	32,415
2014	1,240,153	1,047,536	84.5%	14,264	57,675	42,234	7359	1,079,622	32,086
2015	1,273,512	1,079,622	84.8%	14,264	57,675	42,388	7577	1,111,399	31,777
2016	1,306,635	1,111,399	85.1%	14,264	57,675	42,529	7793	1,142,885	31,486
2017	1,339,524	1,142,885	85.3%	14,264	57,675	42,660	8007	1,174,095	31,210
2018	1,372,180	1,174,095	85.6%	14,264	57,675	42,782	8219	1,205,043	30,947

Smokers

Year	Beginning Smokers	New Adults	Immigrants	Quitters	Emigrants	Deaths	Ending Smokers	Change	Year-End Smoking Prevalence
2007	188,000	4141	17,325	9510	9400	2625	187,931	69	18.2%
2008	187,931	4141	17,325	9507	9079	2624	188,187	256	17.6%
2009	188,187	4141	17,325	9520	8795	2628	188,711	523	17.1%
2010	188,711	4141	17,325	9546	8544	2635	189,453	742	16.6%
2011	189,453	4141	17,325	9582	8319	2645	190,372	920	16.2%
2012	190,372	4141	17,325	9628	8117	2657	191,437	1064	15.9%
2013	191,437	4141	17,325	9681	7933	2672	192,617	1180	15.5%
2014	192,617	4141	17,325	9739	7766	2688	193,890	1273	15.2%
2015	193,890	4141	17,325	9802	7612	2706	195,237	1346	14.9%
2016	195,237	4141	17,325	9869	7471	2724	196,639	1403	14.7%
2017	196,639	4141	17,325	9938	7340	2743	198,084	1445	14.4%
2018	198,084	4141	17,325	10,010	7218	2763	199,560	1476	14.2%

State Application: State of Ohio. The state of Ohio is used to illustrate applications at the state level, with 2007 as the baseline year, based on the most recent data available.[27] This illustration assumed the following.

Adult smoking rate in the beginning of 2007 (based on 2006 end of year data): 22.3%
Smoking rate of high school seniors: 22.5%
Portion of smokers attempting to quit annually: 52.8%
Quit method: cold turkey, 70%; medication therapy only, 27%; behavioral therapy only, 2%; behavioral plus medication therapy: 1%

For the purposes of this analysis, we assumed the following.

Adult immigrants per year: 662,123
Adult emigrants per year: 662,123
Smoking rate of immigrants: 23.1% (same as the state of Ohio in 2006)
Smoking rate of emigrants: 23.1% (same as the state of Ohio in 2006)

Note that immigration and emigration values are the same because we did not have specific data on these values for the state of Ohio. Using the same values canceled this factor for the analysis.

Table 5 shows the projected smoking prevalence rate in 2018, assuming continuation of current values and assuming 10% improvement in quit attempts, smoking rate among new adults, and quit method. It also shows years of life saved, program costs, medical cost savings, cost per quitter, cost per life-year saved, and ROI on medical costs. The new analysis added at the state level was distribution of medical cost savings by major funders of medical care. This analysis assumed that cost savings would be captured in direct proportion to the amount spent by each of the major funders: employers, households, federal aid, state Medicaid, and other sources. The portion paid by each of the primary funders was specified earlier.[25] This analysis may help state governments make more informed decisions about spending on state-level tobacco prevention and treatment programs. For example, if smoking rates in Ohio were reduced from 22.5% in 2007 to 14.8% in 2018, $6,670,424,303 would be saved in medical costs over 12 years for an average annual savings of

Table 4
County Level (Cuyahoga County, Ohio): Impact of 10% Improvement in Quit Attempts, Quit Method, and New Smokers on Smoking Rate, Life-Years Saved, and Medical Costs Saved at County Level*

	Current Scenario	10% Improvement
Adult smoking rate 2008	18.5%	18.5%
Adult smoking rate 2018	15.7%	12.7%
Projected years of life saved	823,626	994,298
Program costs	$75,342,577	$113,410,688
Projected medical costs saved	$715,616,573	$883,937,410
Cost/quitter	$648	$808
Cost/year of life saved	$91	$114
ROI on medical cost savings	9.50	7.79

* ROI indicates return on investment.

$555,868,692. Program costs would be $656,750,138, for an annual average cost of $54,729,178. Savings to the state-funded Medicaid program would be projected to be $765,658,732 total, or $63,804,894 per year. Therefore, medical care cost savings to the state Medicaid program would exceed the cost of providing tobacco treatment to the entire population of those attempting to quit in the entire state by 17%. Furthermore, these programming costs would be only 6% of the $336,600,000 Ohio would have received from the MSA each year[28] with the tobacco industry if the Ohio state legislature had not securitized and sold that revenue stream.[29] The state of Ohio would realize additional savings on medical care costs in its role as an employer. Like most other states, the Ohio state government is the largest employer in the state. Finally, if employers in the state saved money on medical costs, their profits would increase and state income tax revenues paid to the state would increase as well. Given these multiple flows of savings and revenue, and abundant sources of income from MSA, it is fiscally responsible for state governments to fund a significant portion of treatment programs to help their residents quit smoking.

Table 5
State Level (State of Ohio): Impact of 10% Improvement in Quit Attempts, Quit Method, and New Smokers on Smoking Rate, Life Years Saved, and Medical Costs Saved at State Level*

	Current Scenario	10% Improvement
Adult smoking rate 2007	22.5%	22.5%
Adult smoking rate 2018	15.0%	13.4%
Projected years of life saved	7,179,430	8,681,841
Program costs	$656,750,138	$990,259,954
Projected medical costs saved	$6,670,424,303	$8,248,986,324
Distribution of savings (not discounted)		
Employers	$2,686,759,929	$3,322,584,127
Households	$2,074,775,723	$2,565,773,298
Federal aid	$911,870,036	$1,127,664,916
State Medicaid	$765,658,732	$946,852,573
Other	$231,359,883	$286,111,411
Cost/quitter	$648	$808
Cost/year of life saved	$91	$114
ROI on medical cost savings	$10.16	$8.33

* ROI indicates return on investment.

National Application. SmokingPaST produces a similar result when applied at the national level. If the assumptions below held and national smoking rates dropped to 12.8% by 2019, 153,653,492 years of life would be saved, $144,160,510,627 would be saved in medical costs, and only $14,055,704,554 would need to be spent on treatment costs (data not shown in table form to save space). National-level analysis assumed the following.[30]

Adult smoking rate in 2008 (based on 2007 end of year data): 19.7%
Smoking rate of high school seniors: 22.5%
Portion of smokers attempting to quit annually: 46.8%
Quit method: cold turkey, 70%; medication therapy only, 27%; behavioral therapy only, 2%; behavioral plus medication therapy, 1%
Adult population: 229,945,137
Population of high school seniors: 4,378,709
Immigrant population: 1,130,818
Emigrant population: 48,000
Smoking rate of immigrants: 30.01% (because of the high smoking rates of the countries from which immigrants come)
Smoking rate of emigrants: 22.5% (same as smoking rate of new adults)

A new analysis was added to the national-level data to show the relative impact of different levels of the population making quit attempts using the combined behavioral and medication therapy quit method. Table 6 shows smoking rates in 2019 resulting from all the combinations of portions of smokers attempting to quit (0% to 100% in 10% increments) and portions of quitters using the most effective method to quit (behavioral plus medication therapy; 0% to 100% in 10% increments). To simplify the illustration, this analysis assumed that new smokers entering the adult population remained constant at 22.5% of high school seniors and that all those who attempted to quit used the combined behavioral and medication therapy approach or they quit cold turkey (i.e., none of them used only behavioral or only medication therapy

Table 6
Population Prevalence of Smokers at the End of 2019, Given Portions of Smokers Attempting to Quit and Portion of Attempts Using a Combination of Behavioral and Medication Therapy

Portion of Population Attempting to Quit, %	Portion of Quit Attempts Using Combination of Behavioral and Medication Therapy, %										
	0	10	20	30	40	50	60	70	80	90	100
0	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2
10	19.2	18.7	18.3	17.8	17.4	17.0	16.6	16.2	15.8	15.4	15.1
20	18.2	17.3	16.5	15.7	15.0	14.3	13.6	13.0	12.4	11.8	11.3
30	17.3	16.1	14.9	13.9	12.9	12.0	11.2	10.4	9.7	9.1	8.4
40	16.4	14.9	13.5	12.3	11.2	10.1	9.2	8.4	7.7	7.0	6.4
50	15.5	13.8	12.2	10.9	9.6	8.6	7.6	6.8	6.1	5.4	4.9
60	14.8	12.8	11.1	9.6	8.3	7.3	6.3	5.5	4.8	4.2	3.7
70	14.0	11.8	10.0	8.5	7.2	6.2	5.3	4.5	3.9	3.4	2.9
80	13.3	11.0	9.1	7.5	6.3	5.2	4.4	3.7	3.2	2.7	2.3
90	12.6	10.2	8.2	6.7	5.5	4.5	3.7	3.1	2.6	2.2	1.9
100	12.0	9.4	7.5	5.9	4.8	3.8	3.1	2.6	2.2	1.8	1.6

in their quit attempt). Smoking rates in the nation would reach 4.9% if 50% of the smokers attempted to quit (the current rate is 46.8%) and 100% of them used the combined behavioral and medication therapy approach. If 100% of smokers attempted to quit and all of them used the combined approach, the rate would drop to 1.6%. Note that the smoking prevalence rate will never reach zero as long as new smokers continue to enter the population. In this illustration, 1.3 million new adult smokers enter the population each year. This represents approximately .5% of the existing adult population.

Employer-Level Application. The SmokingPaST Framework can be used at the employer or organization level, but some of the labels would change. For example, new adults entering the population would be called ''newly hired employees,'' emigrants would be called ''employees leaving the organization,'' and the immigrants factor would not be used (i.e., its value would be zero). Also, the population mortality rates for smokers and nonsmokers would be replaced with smoking rates for 25- to 64-year-olds to reflect the absence of youth and seniors in working populations. Six scenarios are presented. The first four scenarios assumed that there was no net change in the size of the workforce over time. The number of newly hired employees equaled the number who left for other jobs plus the number who died. These first four scenarios reflect four strategies an employer might use to reduce smoking rates. In the fifth scenario, the workforce was assumed to grow 5% per year (i.e., from 40,000 in 2010 to 68,414 in 2021). In the sixth scenario, the workforce was assumed to decline 5% per year (i.e., from 40,000 in 2010 to 22,752 in 2021). The turnover rate in all cases was assumed to be 3.8%, the average turnover rate in the United States for the period of 2000 to 2010.[31] As such, new employees were hired to offset turnover in all scenarios, even when the total workforce size was decreasing. Input values for the basic example are shown below. We assumed the baseline smoking rates for the existing employees were the same as those in Cuyahoga County and the rate of newly hired employees was the same as that in the state of Ohio.

Baseline smoking rate of existing employees: 18.8%
Smoking rate of newly hired employees: 22.3%
Baseline employee population: 40,000
New employees hired per year: 4000
Annual turnover rate: 3.8%
Portion of smokers attempting to quit annually: 58.9% (same as Cuyahoga County)
Quit method: cold turkey, 70%; medication therapy only, 27%; behavioral therapy only, 2%; behavioral plus medication therapy: 1%

Scenario 1: No Change in Workforce Size, Strategy 1: No Change in Approach. In the first scenario, the quit attempts and quit methods continued to reflect those seen in the county in the baseline year. Smoking rates would reach 12.2% by 2021, and significant savings would be seen in life-years and medical care costs. This scenario is shown in the second column of Table 7.

Scenario 2: No Change in Workforce Size, Strategy 2: Use Combined Quit Method. Given the already high rate of 53.5% of current smokers attempting to quit each year, it may be difficult to motivate more people to try to quit. However, it might be possible to motivate more quitters to use the most effective quit methods (i.e., a combination of behavioral and medication therapy). This might be done through aggressive marketing and by covering all treatment costs. This scenario is shown in the third column of Table 7. It assumed that 50% of attempts were cold turkey and 50% used the combined behavioral and medication therapy approach. The 2021 smoking rate would drop substantially to 8.6%, and years of life saved and medical costs saved would increase. Cost per quitter and per life-year saved would increase because more smokers would be quitting using the more expensive combined behavioral and medication therapy approach, but the costs would still be very low. The ROI would drop but would still be very attractive.

Scenario 3: No Workforce Growth, Strategy 3: Stop Hiring Smokers. An

Table 7
Employer Level: Impact of Four Strategies to Reduce Smoking Prevalence, Assuming No Change in Workforce Size, Growth of Workforce, and Decline of Workforce*

	No Change in Workforce Size Scenario 1 No Change in Approach	No Change in Workforce Size Scenario 2 Use Combined Quit Method	No Change in Workforce Size Scenario 3 Stop Hiring Smokers
Employee smoking rate 2010	18.8%	18.8%	18.8%
Employee smoking rate 2021	12.2%	8.6%	5.6%
Projected years of life saved	27,171	40,792	19,374
Program costs	$2,485,523	$6,983,768	$2,044,378
Medical costs saved			
Smokers quitting	$25,985,773	$41,544,709	$21,315,161
Not hiring smokers			$48,599,932
Cost/quitter	$648	$1212	$648
Cost/tear of life saved	$91	$171	$91
ROI on medical cost savings (for each dollar invested in treatment)	$10.45	$5.95	$12.03

* Assumes smoking rate of high school seniors remained constant at 22.5% and all quit methods were either cold turkey or combined behavioral plus medication therapy approach.

alternative strategy might be to make no additional efforts to motivate employees to use more effective quit methods but to stop hiring smokers. As shown in the fourth column of Table 7, this would result in a much lower 2021 smoking rate, 5.6%, and produce more than $48 million in savings from medical costs avoided because smokers were not hired (the number of smokers not hired averages 892 per year given the 3.8% turnover rate; data are not shown in the table). These savings would be in addition to the more than $21 million saved by smokers quitting. The savings for quitters would be lower than that for scenarios 1 and 2 because there would be fewer smokers in the workforce to quit. This approach would produce the best ROI because fewer programs would need to be offered to help smokers quit.

Scenario 4: No Workforce Growth, Strategy 4: Stop Hiring Smokers and Use Combined Quit Method. A fourth strategy would be to stop hiring smokers and to motivate half of the remaining smokers who attempt to quit to use the best quit methods. This approach would produce a smoking rate of 3.4% by 2021 and save more than $48 million in medical costs by not hiring smokers, in addition to nearly $34 million saved by smokers who quit. (Note that the nearly $34 million in medical costs saved by smokers during the 12-year period does not reveal the trend in savings. Savings in the first year would be $161,262 and would increase to $5,345,627 in the 12th year and remain high in subsequent years. This pattern of savings would occur because of the 10-year delay in medical spending levels of quitters with chronic diseases returning to the spending levels of nonsmokers and the 5-year delay for those with no chronic diseases. The same trend applies for all medical cost savings in all scenarios for applications to all populations.) This scenario would result in the lowest overall smoking rate; greatest medical cost savings; and second highest years of life saved, program costs, and ROI. Years of life saved are lower in scenario 4 than 2 because not hiring smokers results in fewer smokers joining the organization and thus a smaller pool of smokers to engage in quit smoking attempts. This scenario is shown in the fifth column of Table 7.

Scenario 5: 5% Annual Workforce Growth, Strategy 4: Stop Hiring Smokers and Use Combined Quit Method. An employer with 5% annual workforce growth (e.g., from 40,000 employees in 2010 to 68,074 in 2021) that did not hire smokers and motivated half of the remaining smokers who attempt to quit to use the best quit method would achieve a smoking rate of 2.1% by 2021, save nearly $124 million in medical costs by not hiring smokers, save an additional $34 million from smokers who quit, and achieve similar ROI as Scenario 4. This scenario is shown in the sixth column of Table 7.

Scenario 6: 5% Annual Workforce Decline, Strategy 4: Stop Hiring Smokers and Use Combined Quit Method. An employer with a 5% annual workforce decline (e.g., from 40,000 employees in 2010 to 22,752 in 2021) that did not hire smokers and motivated half of the remaining smokers who attempt to quit to use the combined quit method would achieve a smoking rate of 5.3%, and save almost 28,000 life-years, with cost-effective program costs and an attractive ROI. However, medical costs saved by not hiring smokers would not be as high for a declining workforce as those for an expanding workforce because few new employees are hired when the workforce is declining. (Note that even though this employer would have a net loss of 5% of employees each year, an average of 93 new employees would need to be hired each year to offset the average of 1520 employees [3.8% of the workforce] who would quit or be fired each year and the average of 137 who would die each year.) This scenario is shown in the seventh column of Table 7.

Table 7, Extended

	No Change in Workforce Size Scenario 4 Stop Hiring Smokers and Use Combined Quit Method	5% Annual Workforce Growth Scenario 5 Stop Hiring Smokers and Use Combined Quit Method	5% Annual Workforce Decline Scenario 6 Stop Hiring Smokers and Use Combined Quit Method
Employee smoking rate 2010	18.8%	18.8%	18.8%
Employee smoking rate 2021	3.4%	2.1%	5.3%
Projected years of life saved	28,620	29,312	27,962
Program costs	$5,323,687	$5,018,308	$4,787,210
Medical costs saved			
Smokers quitting	$33,950,809	$34,287,885	$33,673,321
Not hiring smokers	$48,486,314	$123,985,215	$2,670,014
Cost/quitter	$1212	$1212	$1212
Cost/tear of life saved	$171	$171	$171
ROI on medical cost savings (for each dollar invested in treatment)	$6.93	$6.83	$7.03

Other Scenarios. An infinite number of scenarios could be generated, with different turnover and growth rates, different portions of the population using the combined quit method, and hiring or not hiring smokers, but additional scenarios are not shown here because of space limitations. The higher the turnover rate, the more new employees need to be hired, regardless of the growth or decline of the workforce. The more new employees hired, the greater the impact of not hiring smokers. For example, an employer with 40,000 employees, growing at a 5% annual rate with a 15% annual turnover that chose to not hire smokers and to provide the combined behavioral plus medication therapy approach to half of those who attempted to quit, would achieve a 2.2% smoking rate by 2016 and a 0.6% rate by 2021. In contrast, an employer with the same growth and turnover rate that continued to hire smokers and provided the same combined behavioral plus medication therapy approach to half of those who attempted to quit would achieve a smoking rate of 14.0% by 2016 and 12.7% by 2021. In general, not hiring smokers is the most effective strategy to reduce smoking prevalence and reduce medical care spending in organizations that are hiring new employees, either because of expansion of their workforce or high turnover rates.

DISCUSSION

The SmokingPaST Framework can be used to illustrate the impact of smoking quit attempts, quit method, new smokers, smoking rates of immigrants and emigrants, and death rates of smokers and nonsmokers on future smoking prevalence rates, treatment costs, years of life saved, medical costs saved, cost effectiveness of programs, and ROI. Applications of the SmokingPaST Framework shown here represent a small fraction of ways the Framework can be used, but several insights emerge from these applications. These insights are dependent on the assumptions used.

1. It is possible to significantly reduce future smoking rates. Increasing the portion of smokers who attempt to quit and the portion of smokers who use a combination of behavioral plus medication therapy significantly reduces future smoking rates and years of life saved for employers, counties, states, and the nation.
2. Treatment costs are low. Costs per quitter and per year of life saved are remarkably low.
3. ROIs are high. ROIs in treatment costs to help people quit smoking are far higher than businesses or governments normally experience.
4. Using the combined quit method has the greatest effect on reducing smoking prevalence for county, state, and national populations. Given the already high portion of the population that attempts to quit and the low portion that uses the combined behavioral plus medication therapy approach, the greatest impact may result from increasing the portion that uses behavior therapy plus medication. Most states provide telephone quitlines to their residents, and many of these have the capability to supply NRT. Participation rates can be increased through more visible marketing. For example, we were able to triple participation rates in our county with a marketing campaign and paying for NRT.
5. Cold turkey is the most cost-effective approach but is not very effective in helping people quit smoking.
6. Medication-only approaches as a broad category quadruple quit rates over that of cold turkey and are more cost effective than behavioral-only or the combined behavioral plus medication therapy approach.
7. Combined behavioral plus medication therapy approaches as a broad category have quit rates almost six times higher than that of cold turkey and are more cost effective than behavioral-only approaches as a broad category.
8. Not hiring smokers has the greatest impact for employers. For employers, the greatest progress in reducing tobacco prevalence rates and reduc-

ing medical costs is likely to come from not hiring smokers. A growing number of hospitals, medical insurance companies, and voluntary health organizations have stopped hiring smokers. The American Civil Liberties Union estimates that at least 6000 employers in the United Sates have implemented similar policies.[32] For existing employees who smoke, offering a combined behavioral plus medication therapy approach and paying for treatment is the most effective approach.

9. Employers and governments are being fiscally responsible when they pay for combined behavioral plus medication therapy treatment programs. Individuals who quit smoking receive the ultimate benefit in that they enhance their quality of life and add years of disability-free living. They also save thousands of dollars per year from the cigarettes they do not purchase. However, smokers see short-term costs when they weigh these decisions. When they compare the $5 to $10 cost of a pack of cigarettes to the several hundred dollar cost of treatment to help them quit, the treatment program seems very high. Given that the medical cost savings secured by employers and state and federal governments far exceeds the cost of treatment, it makes fiscal sense for these entities to cover the cost of the most effective treatment services.
10. America's job competitiveness increases as costs for medical care, absenteeism, and disability decrease and productivity increases.

The strengths of SmokingPaST include a conceptual simplicity that will make it accessible to practitioners and policy makers who are not modeling experts, its use of input and assumption variables that can be populated with values from the literature, the broad scope of inputs and outputs that help to tell a more complete story, and flexibility that allows it to be applied to any population.

Despite its strengths, the SmokingPaST has several limitations, most related to its simplicity. These include limitations in structural scope, mathematical specifications, and assumptions used to populate the spreadsheet.

The structure of the overall Framework is limited in that program costs include only the cost of treatment once smokers have decided to attempt to quit and enroll in a program. Costs of motivating people to try to quit or enroll in programs are not included in the Framework. Smokers are motivated to quit by external marketing campaigns, increases in tobacco excise taxes, smoking bans, seeing others quit successfully, medical crises, and internal reflections. Some of these influences cost money to implement. People who are ready to quit enroll in programs through referrals from family, friends, and medical providers and in response to marketing campaigns. Supporting some of these referral sources costs money. If the cost of motivating smokers to attempt to quit and to enroll in programs was built into SmokingPaST, the total costs would be higher and the ROI would be lower. Another structural scope limitation is failure to account for the total societal savings of quitting smoking, including increased productivity gained by smokers not taking time from work for smoking breaks and increased state and federal income and payroll tax receipts gained by smokers working additional years of life. It also does not account for possible increased societal costs that might be incurred by former smokers who live longer because they quit smoking and therefore draw social security payments for additional years. Some of those costs might be offset because the former smoker has more productive years in which to work and pay taxes and fewer years of disability or retirement, but estimating that balance is beyond the scope of this article. A growing literature is showing that reducing lifestyle risk factors does delay disability, sometimes as much as 9 years.[33] The net result of some of these factors might be to delay medical payments and shift some of the burden of medical costs from employer, state Medicaid, and individually sponsored medical programs to the federal Medicare programs. Delaying medical costs is not as desirable as eliminating them, but it does produce a positive benefit. The extent of these shifts is also beyond the scope of this analysis.

The simplicity of the mathematical specifications also causes limitations. A more complex framework might have an age-adjusted death rate for smokers that would account for the fact that the population of smokers will get younger over time because the older smokers will die. We felt that more complex formulae on this factor would make the SmokingPaST Framework less intuitively understandable to practitioners and would require users to know the distribution of their populations of interest to use it. It would result in only minor differences in values of the outcome variables. For example, doubling the mortality rates for smokers and nonsmokers in the national example raised the smoking rate for 2021 only slightly over a 12-year period, from 13.1% to 13.5%, and cutting the rate in half reduced the smoking rate only slightly, to 12.5%. Another mathematical specification limitation of SmokingPaST is the assumption of constant levels of quit attempts, quit methods, new smokers, immigrants, and emigrants for all of the years in any analysis. A more complex formula would allow different assumptions in each of these variables for each year. To account for year to year changes in those values, SmokingPaST requires the user to insert baseline values for the first year, determine year-end smoking prevalence rates, place those year-end prevalence rates as the baseline rates in the next year, insert new assumptions for the other values in SmokingPaST, and repeat this process for each year of interest.

SmokingPaST is also limited by the quality of the data available for input and assumption variables. SmokingPaST was not developed to predict future smoking rates—it was developed to illustrate the impact of quit attempts, quit methods, and new smokers on prevalence rates and other factors. It functions effectively to test ''what if?'' scenarios. It will provide a glimpse of the future to the extent that input and assumption variables are accurate.

We are sharing the SmokingPaST Framework in spreadsheet form to make it easy for practitioners and policy makers to use it in helping to guide decisions about investments in tobacco prevention and treatment programs and encourage them to improve it by adding formulae for new output variables, correcting any gaps in

logic or errors in formulae, and suggesting better data sources for the assumption variables.

SO WHAT? Implications for Health Promotion Practitioners and Researchers

What is already known on this topic?

Population-level smoking prevalence and related medical costs are impacted by the number of quit attempts, quit methods, and number of new smokers, but it is difficult to link these variables.

What does this article add?

This article describes SmokingPaST, a framework that is conceptually simple and illustrates the impact of baseline smoking rates among adults, new adults, annual quit attempts, and quit methods on future adult smoking rates, number of successful quitters, years of life saved, medical costs saved by quitting and by not hiring smokers, costs of quit smoking treatment programs, cost per quitter, cost per life year saved, distribution of medical cost savings from quitting, and ROI of treatment costs. It can be used for any population including organizations, counties, states, and nations.

What are the implications for health promotion practice or research?

This framework can help guide policy makers in making decisions about how to invest funds in tobacco treatment efforts. Researchers are encouraged to help refine the framework.

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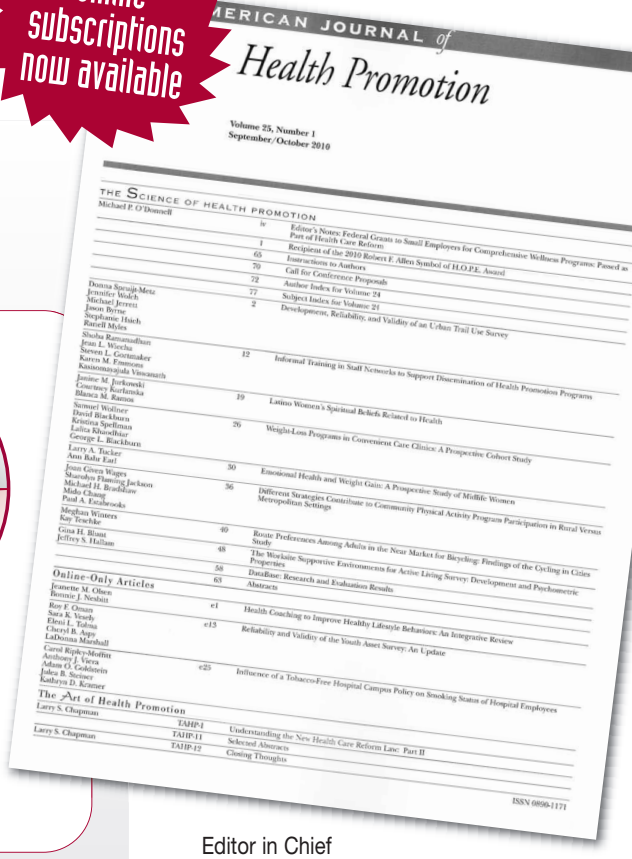

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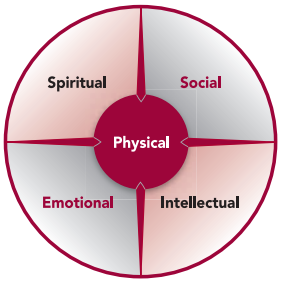
(O'Donnell, *American Journal of Health Promotion,* 2009, 24,1,iv)



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