

Cost-Effectiveness Analysis of The Real Cost Campaign's Effect on Smoking Prevention



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Introduction: A previous study found that the Food and Drug Administration's The Real Cost national tobacco education campaign was associated with preventing approximately 350,000 U.S. youth from initiating smoking between 2014 and 2016. This study translates the reduction in smoking initiation into monetary terms by examining the cost effectiveness of the campaign.

Methods: The cost effectiveness of The Real Cost was assessed by measuring efficiency in two ways: (1) estimating the cost per quality-adjusted life year saved and (2) estimating the total monetary return on investment by comparing the cost savings associated with the campaign to campaign expenditures. Analyses were conducted in 2017.

Results: The Real Cost averted an estimated 175,941 youth from becoming established smokers between 2014 and 2016. Campaign expenditures totaled \$246,915,233. The cost per quality-adjusted life year saved of the campaign was \$1,337. When considering the costs of smoking, the averted established smokers represent >\$31 billion in cost savings (\$1.3 billion when only external costs considered). The overall return on investment of the campaign was \$128 in cost savings for every \$1 spent (\$4 for every \$1 spent when only external costs considered). These conclusions were robust to sensitivity analyses surrounding the parameters.

Conclusions: Campaign expenditures were cost efficient. The cost savings resulting from The Real Cost represent a large reduction in the financial burden to individuals, their families, and society as a result of tobacco. Public health campaigns, like The Real Cost, that reduce tobacco-related morbidity and mortality for a generation of U.S. youth also provide substantial cost savings.

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INTRODUCTION

Prior research has shown that mass media campaigns to reduce tobacco use can promote cessation and decrease initiation among youth.^{1,2} Several economic evaluations of media campaigns have found tobacco-focused mass media campaigns to be cost effective.^{3–6} Given a changing environment (e.g., declining smoking rates, rise of social media, and changes in accessing media), campaigns may differ in effectiveness and costs. It is increasingly important that federal funds to improve public health are cost effective, and guidelines have set an acceptable threshold for costs savings related to health interventions aimed to reduce mortality and morbidity.^{7–9} Assessing the cost utility and return

on investment (ROI) of public health expenditures allows stakeholders and policy makers to determine whether the economic investment in the campaign can be justified by the public health outcomes and provides insight into the potential cost savings of these outcomes.

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Since February 2014, the Food and Drug Administration has conducted a national tobacco public education campaign designed to prevent the initiation of cigarette smoking among youth aged 12 to 17 years who have never smoked but are susceptible to smoking (susceptible nonsmokers) and to discourage further smoking among youth who have experimented with smoking in the past (experimenters). The Real Cost has appeared on national TV, radio, the Internet, and out-of-home displays, as well as in magazines and movie theaters. The central theme of the campaign is: “Every cigarette costs you something.” In the first 3 years of advertising, campaign themes focused on the cosmetic effects of smoking, loss of control caused by addiction, and the dangerous mix of toxic chemicals in cigarette smoke.

A nationally representative longitudinal study of U.S. youth examined campaign awareness levels and evaluated the effect of The Real Cost on smoking-related beliefs and behaviors. After 8 months of advertising, more than 90% of the campaign’s target audience (susceptible nonsmokers and experimenters) reported ad awareness, and most surveyed youth considered advertisements to be effective based on assessments of perceived effectiveness.¹⁰ After 14 months on air, agreement with the eight campaign-targeted beliefs increased 11.5% from baseline measurement, and campaign exposure was associated with increased odds of agreeing with campaign-targeted beliefs.¹¹

In January 2017, Farrelly et al.¹² published the results of a model examining the effect of campaign exposure on smoking initiation. Among youth who reported never having smoked a cigarette in the baseline survey, high campaign exposure was associated with a 30% decrease in the risk for smoking initiation (AOR=0.70, 95% CI=0.55, 0.91). Exposure to The Real Cost was associated with preventing an estimated 348,398 U.S. youth aged 11 to 18 years from initiating smoking during February 2014–March 2016 (95% CI=331,825, 365,168).

This study assesses the cost effectiveness of The Real Cost by measuring efficiency in two ways: (1) examining the cost utility of the campaign by estimating the cost per quality-adjusted life year (QALY) saved and (2) examining the total ROI for the campaign. Both methods are based on the results of the smoking initiation model.¹² The QALY framework is one of several standard approaches that have been used to calculate the cost effectiveness of similar public health interventions^{3–5,13} and assists in comparing The Real Cost with other health interventions. In addition, the cost savings, or benefits, associated with The Real Cost are quantified using methodology from Sloan and colleagues¹⁴ and compared with campaign costs to calculate the ROI for the campaign.

METHODS

Study Sample

The cost per QALY saved was estimated from a campaign perspective using the following key parameters: campaign costs, estimated number of smokers averted between 2014 and 2016 as a result of the campaign, and number of QALYs saved per prevented smoker. This methodology is comparable to previous studies on cost utility for youth prevention.^{3,13}

The ROI analysis used three key parameters: campaign costs, estimated number of smokers averted, and cost savings per averted smoker. The cost savings were calculated using the framework documented in *The Price of Smoking*¹⁴ to estimate a comprehensive measure of the smoking-related costs averted as a result of the reduction in smoking initiation. The ROI analysis compares the benefits, or cost savings, of the campaign with the costs associated with its implementation. This method estimates the dollar value of the campaign’s benefits for each dollar spent.

Campaign costs and resulting outcomes for the two analyses are compared with what would have happened in the absence of the campaign. Univariate sensitivity analyses were conducted for individual parameters for both cost per QALY and ROI analyses to account for the impact of uncertainty on the conclusions of each analysis. All analyses were conducted in 2017.

Measures

Table 1 presents the costs associated with implementing The Real Cost.^a These costs include the media contract for planning and development, media purchase, partnerships, outreach, and administration. The cost of the contract awarded to RTI International to evaluate the campaign was also included. No costs were included for campaign exposure, as viewing advertisements introduced no additional time burden beyond one’s usual media viewing habits. Campaign costs were aggregated over time to generate gross implementation costs for the study period. Costs for 2016 reflect partial costs for the year (January–March) to reflect the timing of the study.

The first estimate established was the number of averted established adult smokers attributable to The Real Cost. The starting value for this estimate was the number of youth averted from initiating smoking, based on the estimate from Farrelly et al.¹² (N=348,398, 95% CI=331,825, 365,168). Not all those who initiate smoking as an adolescent go on to become established smokers. Gruber and Zinman,¹⁵ using National Health Interview Survey data, found that about 50.5% of youth who try smoking between the ages 12 and 17 years will become established smokers when aged ≥28 years. This estimate most closely reflects the age range for the analyses. Thus, the number of averted established adult smokers is 175,941 (348,398 × 0.505).

Quantifiable metrics of an intervention’s health outcomes are LYs and QALYs saved. QALYs account for the morbidity and mortality of health outcomes. Here, they represent a combined measure of quantity of LYs lost and quality-of-life losses resulting from smoking-related illnesses. To estimate the LYs and QALYs saved, research by Wang and colleagues¹³ was used. Wang and colleagues estimated LYs lost for three smoker types (former smokers, light smokers, and heavy smokers) using National Health Interview Survey–adjusted

^aThese costs were provided by Food and Drug Administration Center for Tobacco Products.

Table 1. Cost Elements of The Real Cost 2013–2016

Variable	Actual expenses (\$)				Total
	FY2013	FY2014	FY2015	FY2016 ^a	
Strategy planning and research	3,661,466	164,227	2,558,150	491,099	6,874,942
Creative development	5,356,446	12,494,574	6,446,464	1,537,518	25,835,002
Media buying	562,472	85,659,350	84,284,681	12,847,167	183,353,670
Digital media	1,605,209	4,762,952	6,192,044	1,533,772	14,093,977
Media outreach	86,073	468,597	125,702	16,842	697,214
Partnerships	51,258	315,284	343,623	158,249	868,414
Administration	851,340	724,660	809,582	211,900	2,597,482
Evaluation	—	—	—	—	12,594,532
Grand total	12,174,264	104,589,644	100,760,245	16,796,547	246,915,233

^aCosts for 2016 reflect partial-year costs for January–March 2016.
FY, fiscal year.

life tables for smokers aged 25 to 29 years.¹⁶ The life expectancy for a never smoker is 2 years longer than a former smoker, 3.5 years longer than a light smoker, and 14.2 years longer than a heavy smoker. Future LYs lost were discounted to their present value using a 3% annual discount rate¹⁷ and weighted to account for the relative proportion of each smoker type for individuals aged 25 to 29 years. The study also found that the weighted average of discounted LYs saved for each smoker was 0.67 and report an estimate of 1.05 QALYs saved per smoker (1 LY=1.57 QALYs, $1.57 \times 0.67=1.05$ QALYs saved per smoker). The conversion value for LYs to QALYs for smokers aged 25 to 29 years was derived by Wang and colleagues using published data from Cromwell et al.¹⁸ The values of 0.67 LYs and 1.05 QALYs saved per smoker were the final values used in the cost per QALY analysis.

The total cost savings per smoker are a combination of (1) private, (2) quasi-external, and (3) external costs. The private costs of smoking are the costs incurred directly by the smoker. The quasi-external costs reflect the costs to an average smoker's spouse or children because of secondhand smoke. The external costs of smoking include the costs not borne by the smoker or their family and instead incurred by society. Together, these direct and indirect costs represent the cost burden of smoking to society. The costs were rigorously calculated by Sloan and colleagues¹⁴ using a life-cycle or longitudinal approach. This approach is particularly well suited to this analysis as it documents all costs accrued over an average smoker's lifetime and addresses the question, "If we

could influence a person not to smoke, what would be the savings over the individual's lifetime?"^{14,19}

To calculate the present-day value of all costs, the estimates from Sloan and colleagues were adapted to this study by applying a 3% discount rate to further discount values to the average age of prevented smokers. Because the costs occur in the future, their present-day value is lower for an individual aged 15.5 years than for an individual aged 24 years. Additionally, the values were updated to 2016 dollars using the Consumer Price Index (CPI) medical component for medical costs and the CPI less medical care for other cost categories, in keeping with similar research.²⁰

RESULTS

Table 2 presents results from the cost–utility analysis. Campaign costs between 2013 and March 2016 totaled \$246,915,233 (Table 1). From the estimated number of youth prevented from initiating smoking ($n=348,398$) and the corresponding adjustment of the likelihood of being an established smoker at age ≥ 28 years (50.5%), the campaign resulted in an estimated 175,941 fewer established smokers ($0.505 \times 348,398$) aged ≥ 28 years (95% CI=167,572, 184,410). Using the values of 0.67 LYs lost per smoker and 1.05 QALYs lost per smoker, the

Table 2. Input Parameter Values and Cost-Utility Analysis of The Real Cost

Parameter	Parameter definition	Total
C	Gross campaign costs (\$)	246,915,233.75
A	Established smokers averted	175,941
Q	QALYs saved per established smoker	1.05
LY	LYs per established smoker	0.67
Results		
(A*Q)	QALYs saved	184,738
(A*LY)	LYs saved	117,880
C/(A*Q)	Cost per QALY saved (excluding medical care costs saved) (\$)	1,336.57
C/(A*LY)	Cost per LY saved (excluding medical care costs saved) (\$)	2,094.62

LY, life year; QALY, quality-adjusted life year.

estimates for costs per LY saved and QALY saved were \$2,095 and \$1,337, respectively. Sensitivity analyses were conducted around the cost per QALY analysis parameters and main findings were robust to variation in these parameters (Appendix A, available online).

Table 3 summarizes the adapted values for each cost type incurred by an average smoker; the private costs, quasi-external costs, and external costs. The last column in Table 3 represents the total costs of smoking. These values account for the increase in CPI between year 2000 U.S. dollars and year 2016 U.S. dollars using a multiplier of 1.777 for the medical care cost CPI and 1.359 for the CPI less medical care costs. The net present value for a smoker aged 15.5 years (the mean age of averted smokers) was estimated by multiplying each value by 0.777 (calculated from: $1/[1.03]^{8.5}$) to adjust for the 8.5 years of additional discounting from the original values for an individual aged 24 years. The next sections provide an overview of calculations for the three cost components (Table 3; for more detail on each cost, see Sloan and colleagues¹⁴).

The present value of the private costs to a smoker aged 15.5 years in 2016 is \$149,573. The private costs

include the present-day value of all future expenditures on cigarettes over the course of the smoker's life^{14,23} (Table 3). Their sum is the total present-day value of a smoker's expenditures on cigarettes, >\$14,000 in 2016 dollars. This figure does not account for additional cigarettes smoked between the ages of 15.5 and 24 years.

The largest private costs of smoking are the smoker's mortality and disability. The WHO recommends that the premature death and loss of LYs should be valued when considering the economic impact of smoking.¹⁹ The mortality costs are based on a value of \$100,000 per LY, the lowest of three LY values typically employed in valuations of LYs saved.¹⁷ The private medical care costs are the present-day value of the increase in out-of-pocket insurance payments and taxes funding public insurance programs, such as Medicaid.

The other private costs accounted for include the reduction in Social Security taxable earnings and the reduction in Social Security and defined benefit pension contributions.

The quasi-external costs reflect the costs to an average smoker's spouse or children because of secondhand

Table 3. Lifetime Cost of Smoking for a Smoker Aged 15.5 Years (Male and Female Weighted Average)

Cost component ^{a,b}	Private cost (smoker) ^c	Quasi-external cost (smoker's family)	External cost (rest of society)	Total costs (society as a whole)
Cost of cigarettes	10,673.03	0.00	0.00	10,673.03
Federal excise taxes on tobacco	1,609.60	0.00	(1,609.60)	0.00
State excise taxes on tobacco	1,815.94	0.00	(1,815.94)	0.00
Mortality cost ^d	92,363.77	0.00	0.00	92,363.77
Disability cost	15,455.61	0.00	0.00	15,455.61
Medical care cost of smoker	1,439.43	0.00	2,854.85	4,294.28
Loss in smoker's earnings	23,468.51	0.00	0.00	23,468.51
Lost income taxes on earnings	0.00	0.00	4,693.53	4,693.53
Work loss (sick leave/ absenteeism)	0.00	0.00	3,464.07	3,464.07
Other productivity losses	0.00	0.00	1,064.22	1,064.22
SSI outlays and benefits	4,628.46	(776.55)	(3,851.92)	0.00
Private pension outlays	6,260.33	(547.95)	(5,712.38)	0.00
Life insurance outlays	(8,141.33)	0.00	8,141.33	0.00
Spouse mortality cost (SHS) ^d	0.00	23,677.42	0.00	23,677.42
Spouse disability cost (SHS)	0.00	1,104.46	0.00	1,104.46
Infant deaths (SHS)	0.00	645.55	0.00	645.55
Medical expenditures (SHS)	0.00	744.87	0.00	744.87
Totals	149,573.35	24,847.81	7,228.18	181,649.34

Note: Values are in U.S. dollars.

^aThe original values for Table 3 come from Tables 11.1, 11.2, and 11.3 in Sloan et al.¹⁴ (pp. 252–255). All values have been updated to reflect discounting to age 15.5 years and the increase in the Consumer Price Index between 2000 and 2016.

^bValues in parentheses reflect negative numbers or cost savings of smoking.

^cThe cost for each smoker is calculated by Sloan et al. and is the weighted average for males and females based on 514,733 female and 678,554 male smokers aged 24 years.

^dSloan et al. estimate mortality costs based on a value of \$100,000 per LY, a conservative LY value employed in valuations of LYs saved.^{17,21,22} The costs of smoking can be calculated using alternate values for a LY or excluding the monetary costs of mortality. Changing this value will yield higher or lower values for the costs of smoking accordingly.

SHS, secondhand smoke; SSI, Supplemental Security Income.

Table 4. The Return on Investment for The Real Cost

Cost type	Costs averted (per smoker)	Costs averted (all smokers)	Return on investment
Private costs of smoking	149,573.35	26,316,084,772.35	105.58
Quasi-external costs of smoking	24,847.81	4,371,748,539.21	16.71
External costs of smoking	7,228.18	1,271,733,217.38	4.15
Total costs of smoking	181,649.34	31,959,566,528.94	128.44

Note: Values are in U.S. dollars.

smoke. These values account for increased morbidity and mortality of a spouse, infant deaths, and medical expenditures resulting from secondhand smoke. The costs also account for a reduction in private pension payouts and Social Security that result from the increased mortality for the smoker's spouse. The present-day value of the quasi-external costs of a smoker aged 15.5 years is \$24,848 in 2016 U.S. dollars.

The external costs of smoking are the smallest of the three types of smoking costs and represent the costs not borne by the smoker or their family. The main costs are increases in medical care costs borne by nonsmokers, productivity losses and losses because of sick leave, a loss of taxes as a result of lower Social Security taxable income, and an increase in life insurance payments not fully subsidized by a smoker's life insurance premiums. These costs are partially offset by reductions in the payouts or outlays to smokers for Social Security and defined benefit pensions. The increase in taxes negates the payment of taxes by smokers and results in a net neutral amount for the total tax costs. The present-day value of the external costs of a smoker aged 15.5 years is \$7,228 in 2016 U.S. dollars.

The aggregate costs for each smoker total \$181,649. Every adolescent aged 15.5 years averted from smoking in 2016 represents >\$180,000 in present-value costs savings.

To quantify the ROI, the total present-day value for the cost per smoker documented in Table 3, \$181,649.34, was multiplied by the number of averted established smokers ($n=175,941$). The total value represents >\$31 billion in cost savings (\$31,959,566,529) attributable to The Real Cost (Table 4). When considering only external costs, the total cost savings are \$1.4 billion.

Table 4 presents the ROI, calculated by dividing the costs saved (net costs of the campaign) by the costs of implementing the campaign, \$246,915,233. Every \$1 spent on The Real Cost resulted in a present-day cost savings of \$128. When considering external costs only, every \$1 spent resulted in a cost savings of \$4. Sensitivity analyses were conducted around the parameters for the ROI analyses (Appendix A, available online).

Even when considering external costs only, the number of prevented smokers would need to be <10% of the original estimate before the campaign no longer had a positive ROI.

DISCUSSION

The cost per QALY saved for The Real Cost, \$1,337, is consistent with a similar study on the cost utility of a public education campaign to prevent youth cigarette initiation.³ Holtgrave et al.³ estimated a similar cost per QALY saved \$1,818 for the truth campaign from the campaign perspective (\$2,425 in 2016 dollars). Other campaigns targeting adult tobacco cessation found a cost per QALY saved of \$268⁴ and \$37,355.^{5,b} Comparisons should be interpreted with caution because of differing methodologies in the analyses and differing populations for each campaign. The Real Cost is well under the \$50,000 to \$109,000 threshold range for the cost per QALY recommended value in the U.S.^{7–9} Preventing an adolescent aged 15.5 years from smoking was estimated to save more than \$180,000 per smoker. The averted smokers attributable to the campaign result in an overall ROI of \$128 for every \$1 spent. Some previous studies have estimated the costs of smoking for external costs only.²⁴ When considering external costs only, the campaign was still cost saving and the ROI was \$4 for every \$1 spent. Although these findings apply to the U.S., they compare favorably with a systematic review of ROIs for public health interventions in high-income countries, where the median ROI for national public health interventions was 27.2 to 1.²⁵

Limitations

The analyses are subject to a number of limitations. First, the number of youth prevented from initiating smoking is subject to estimation error due to any limitations or uncertainty of the associated model.¹² Second, although QALYs saved and LYs saved values are consistent with

^bThis study looked at costs from a societal perspective for adults. Villanti and colleagues⁵ included costs for cessation services and medication. After excluding the costs of cessation services and medication, the cost per QALY saved was \$9,550.

previous research, they are based on dated life tables. If the relationship between smoking and longevity has changed since these life tables were estimated, the results could change. Third, the costs of smoking are from Sloan and colleagues¹⁴ and share limitations documented in that study. In adapting the costs for this study, there are additional limitations. The first is specific to the cost calculations associated with smokers aged 15.5 to 24 years. The analysis does not account for any costs of smoking for this age range, which would increase the private costs of smoking. The analysis also potentially undercounts smokers' earnings, lost income taxes on earnings, and work loss because of sick days or other productivity losses. These are minor omissions overall, but would nonetheless result in larger cost savings attributable to the campaign. In addition, the data used to estimate progression from initiation to established smoking are from 1992 and 1995, respectively.¹⁵ The authors know of no extant literature that indicates how smoking progression may have changed in recent years as a result of recent declines in smoking prevalence. If fewer youth try a cigarette but those who experiment are more likely to become established smokers, the estimates understate the cost savings of the campaign and overstate the cost per QALY saved. Alternately, if the decline in prevalence means that youth are less likely to become established smokers even after experimentation, the numbers may overstate the cost savings and understate the cost per QALY saved for the campaign.

Sensitivity analyses were performed to account for the potential uncertainty around the estimates (Appendix A, available online). The results showed that these conclusions are robust to variations in the estimated number of smokers averted. If the number of smokers averted as estimated in Farrelly et al.¹² was lower than 348,398, or if the percentage of youth who become established smokers is lower than 50.5%, the campaign would still meet the recommended QALY cost threshold and result in a smaller but positive ROI. The results also showed the conclusions are robust to the changes in the QALY per averted smokers. This analysis used a conservative cost per QALY saved estimate compared with others in the literature; using an unpublished value estimated from more recent data resulted in a cost per QALY saved of \$404 (compared with \$1,337).

CONCLUSIONS

The cost effectiveness of The Real Cost has several policy implications. The resulting cost savings for the reduction in youth smoking amounts to more than \$31 billion. This value represents a large reduction in the financial burden to individuals, their families, and

society as a result of tobacco use. These findings indicate that expenditures on the campaign were cost saving and efficient, and that these results are robust to variations in the analysis specifications. The cost per QALY saved for this campaign, which is in line with the cost-saving calculations of past tobacco-related mass media efforts, is also in keeping with the cost per QALY saved for other major prevention interventions.⁶ Public health campaigns like The Real Cost reduce the burden of tobacco-related morbidity and mortality for a generation of U.S. youth. The findings suggest that these interventions not only markedly improve public health outcomes, but they also provide substantial cost savings.

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SUPPLEMENTAL MATERIAL

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