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The Role of Public Policies in Reducing Smoking Prevalence: Results from the Michigan *SimSmoke* Tobacco Policy Simulation Model

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Abstract

Introduction—Michigan has implemented several of the tobacco control policies recommended by the World Health Organization MPOWER goals. We consider the effect of those policies and additional policies consistent with MPOWER goals on smoking prevalence and smoking-attributable deaths (SADs).

Methods—The *SimSmoke* tobacco control policy simulation model is used to examine the effect of past policies and a set of additional policies to meet the MPOWER goals. The model is adapted to Michigan using state population, smoking and policy data starting in 1993. SADs are estimated using standard attribution methods. Upon validating the model, *SimSmoke* is used to distinguish the effect of policies implemented since 1993 against a counterfactual with policies kept at their 1993 levels. The model is then used to project the effect of implementing stronger policies beginning in 2014.

Results—*SimSmoke* predicts smoking prevalence accurately between 1993 and 2010. Since 1993, a relative reduction in smoking rates of 22% by 2013 and of 30% by 2054 can be attributed to tobacco control policies. Of the 22% reduction, 44% is due to taxes, 28% to smoke-free air laws, 26% to cessation treatment policies, and 2% to youth access. Moreover, 234,000 smoking-attributable deaths are projected to be averted by 2054. With additional policies consistent with MPOWER goals, the model projects that, by 2054, smoking prevalence can be further reduced by 17% with 80,000 deaths averted relative to the absence of those policies.

Conclusions—*Michigan SimSmoke* shows that tobacco control policies, including cigarette taxes, smoke-free air laws and cessation treatment policies, have substantially reduced smoking

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and smoking-attributable deaths. Higher taxes, strong mass media campaigns and cessation treatment policies would further reduce smoking prevalence and smoking-attributable deaths.

INTRODUCTION

The World Health Organization Framework Convention on Tobacco Control (FCTC)¹ is the first international global health treaty set out to reduce the global burden of tobacco-associated mortality. To assist nations with implementing FCTC obligations, WHO introduced the MPOWER package of evidence-based FCTC tobacco control measures in 2008.² The MPOWER package includes: **M**onitoring tobacco use and tobacco control policies; **P**rotecting people from the dangers of tobacco smoke; **O**ffering help (e.g., treatments) to quit tobacco; **W**arning the public about the dangers of tobacco; **E**nforcing bans on tobacco advertising, promotion, and sponsorship; and **R**aising tobacco taxes. These measures are supported by substantial evidence of their impact for reducing smoking.³⁻⁷ Early leaders in tobacco control, such as Thailand,⁸ Ireland⁹ and Brazil,¹⁰ have markedly reduced smoking rates as a result of adopting MPOWER policies.

In the US, much of the tobacco control policies are set at a state level. States with low smoking rates typically have the most comprehensive tobacco control policies, as seen in Minnesota,¹¹ California,¹² Massachusetts^{13,14} and Arizona.^{15,16} Ranked thirty-first among US states, Michigan had an adult smoking prevalence of about 17.2% in 2010/11,¹⁷ higher than most of the states with the more comprehensive policies, but lower than many other states. In the last 20 years, Michigan has raised state cigarette taxes to \$2.00 (currently ranked 12th),¹⁷ instituted smoke-free air laws and media campaigns. However, Michigan has been ranked among the lowest in terms of tobacco control expenditures, below 4% of the CDC recommended amount.¹⁷

The purpose of this paper is to estimate the effect of these past policies in Michigan's smoking prevalence and smoking-attributable deaths, and project the effects of stronger policies consistent with MPOWER goals. We employ the *SimSmoke* tobacco control policy simulation model adapted to the state of Michigan.

METHODS

SimSmoke simultaneously considers a broader array of public policies than other models¹⁸ and has been validated in other states^{11,12,15,19} and countries.^{8-10,20,21} *SimSmoke*^{22,23} projects smoking prevalence and smoking-attributable deaths over time and estimates the effect of tobacco control policies on those rates. A discrete time, first-order Markov process is employed to project future population growth through fertility and deaths, and to project smoking rates through smoking initiation, cessation, and relapse.

SimSmoke begins in the baseline year 1993, with the population divided into current, never, and former smokers by age and gender. The baseline year was chosen because a large-scale survey was available for that year and policies were stable.

SimSmoke Population and Smoking Model

Michigan population data and US birth rates by age and gender were obtained for 1993.²⁴ Mortality rates²⁵ by age and gender were averaged from 1999 to 2005.

Smokers are defined as respondents who had smoked more than 100 cigarettes in their lifetime and were currently smoking either daily or on some days. Former smokers (distinguished by years quit) have smoked 100 lifetime cigarettes but were not currently smoking, and never smokers were those who had not smoked 100 cigarettes in their lifetime. Baseline estimates of smoking status by age and gender for Michigan were obtained from the 1992/3 Tobacco Use Supplement (TUS) of the state-representative Current Population Survey.²⁶

Given the instability in estimates of initiation and cessation rates among individuals below the age of 24 and in order to ensure internal consistency with 1993 prevalence rates, we use a method previous applied in SimSmoke models;^{9,10,13,17} net initiation rates for each age were measured as the difference between the 1993 smoking prevalence at that age and the rate at the previous age. Because prevalence continued to rise until age 24, initiation in the model occurs through age 24. Quit rates were obtained from the 1993 TUS, measured as those who quit in the last year as a percent of smokers one year ago. Previously published estimates^{27,28} were used for relapse rates, distinguished by age, gender and years quit.

Death rates by age, gender and smoking status were calculated from population death rates, smoking prevalence, and smoking mortality relative risks. The number of current and former smokers at each age was multiplied by their respective excess risk and summed to obtain total smoking-attributable deaths. Assuming that relative risks in Michigan are similar to the U.S., relative risk estimates for current and former smokers were obtained from the U.S. Cancer Prevention Study II.^{29,30} The relative risks of former smokers decline with the number of years quit with no decline in the first year after quitting. Consequently, there is a lag between policy implementation and reductions in mortality, with the effects progressively increasing with time since implementation.

SimSmoke Policy Specifications

The policy effect parameters are based on literature reviews, the advice of an expert panel and validation of previous *SimSmoke* state and US models. The size of policy effects are assessed in terms of relative (percentage) reductions applied to smoking prevalence in the year that the policy was implemented, and applied to initiation and cessation rates in future years unless otherwise specified. The model allows for synergies between media campaigns and other policies, but otherwise assumes that the effect of a second policy is reduced by (1-the effect of the first policy) if another policy is simultaneously implemented. Table 1 summarizes policies and effect sizes.

The effect of implementing a new policy in *SimSmoke* depends on the prior level of that policy, so that the level of policies for each year is required. Data on policy levels were inputted for the years 1993 through 2013.

1. Taxes—Michigan prices (1993-2012) are measured by a retail price index weighted by brand sales that includes generic cigarettes,³¹ adjusted to June of each year. The prices are deflated using the consumer price index.³² Inflation-adjusted prices increased by 150% between 1993 and 2012 to an average price of \$6.30.¹⁷ Combined state and federal taxes increased from \$0.49 to \$3.01, with state taxes at \$2.00 since 2004. Price increases in absolute terms with the amount of the cigarette tax after 2013.

2. Smoke-free policies—*SimSmoke* models restrictions in worksites, restaurants, bars and other public places, and associated compliance.³³ Prior to the state-wide smoking ban in 2010, Michigan was considered to have weak smoke-free policies, because worksites had no restrictions, restaurants allowed smoking in restricted areas and few other places had bans (e.g., transit).¹⁷ Smoke-free worksites were implemented by Washtenaw County (population 354,947) in 2003, by Detroit (905,161) in 2005, and by Marquette County (64,904) and Midland County (85,240) in 2006.³⁴ In 2010, Michigan became smoke-free at a state level.¹⁷ The 2010 TUS indicates that about 20% of workers were still exposed to smoke in the workplace. Consequently, we set the level of enforcement to 8 on a 10-point scale.

3. Mass media/tobacco control expenditures—Tobacco control expenditures are mostly for mass media campaigns along with other state and local education policies are implemented at the state level. Per capita expenditures have fluctuated between \$0.20 and \$0.35 per capita between 1993 and 2010,¹⁷ which are at the low end of the CDC-recommended level and are considered at the low level for the purposes of the model.

4. Cessation Treatment Policies—As in other states, the patch NRT became available with prescription by 1993, and became available over-the-counter in 1997. Wellbutrin became available in 1998. An active quit line with follow-up was put in place in 2003.³⁵ By 2012, the quit line has received more than 66,000 calls. Cessation treatments are now available in some cases from primary care facilities, hospitals, offices of health care professionals, community and others at a value of 25% in 1993 increasing to 50% by 2004.¹⁷ Taking into account that not all brief cessation interventions by health care providers meet the recommended levels of advice and follow-up, the level is set at 3 increasing to 5 on a 10 point scale by 2006.

5. Youth access laws—Sales to youth have been illegal since before 1993. According to information regarding Synar enforcement of sales to minors, noncompliance was at 63% in 1994, decreasing to about 20% in 2002, 15% in 2011 and 11% in 2012.¹⁷ Enforcement of youth access laws in Michigan was low from 1997 to 2002 and increased to medium by 2005 where it remained until 2012. Since 1993, Michigan had limited restrictions on self-service displays, but had some vending machines restrictions (set at 0.05).¹⁷ In 2010, self-service displays and vending machines were allowed only in adult only facilities.

Model Calibration, Validation and the Effect of Tobacco Control Policies

To calibrate *SimSmoke*, we compared predictions of smoking prevalence by age and gender to corresponding estimates from the CPS-TUS data for 1996 and 1999. Based on those comparisons, the first year cessation rate net of relapse was adjusted downward for ages

24-35, but upward for ages 55 and above. To validate the model, *SimSmoke* predictions were compared to smoking rates from the TUS (1992/3, 1995/6, 1998/9, 2001/2, 2002/3, 2006/7 and 2009/10), and the yearly Michigan BRFSS (MiBRFSS) from 1996 through 2010 (the methodology changed in 2011).³⁶

To examine the effect of individual and combined policies implemented between 1993 and 2013, the counterfactual scenario of no-policies was first programmed by setting all policies between 1993 and 2054 to their 1993 levels. The difference between predictions of this scenario and predictions with actual policies provides an estimate of the net reduction in smoking prevalence due to all policies implemented since 1993. The contribution of individual policies implemented since 1993 relative to the predicted decline in smoking rates and smoking-attributable deaths from all policies were estimated by examining the effect of implementing each policy relative to the counterfactual. The contribution of a policy is estimated relative to the summed effect of all policies, since the effect of individual policies are interrelated and thus do not sum to the effect of simultaneously implemented policies.

New, stricter policies are also modeled as implemented and maintained from 2014 through 2054, including policies consistent with MPOWER goals, such as a tax increase of \$3.00, which would increase taxes to nearly 70% of price, and strong media campaigns and more inclusive cessation treatment programs. The effect of these policies on smoking prevalence is gauged relative to the *status quo*, in which tobacco control policies remain unchanged from their 2013 levels.

RESULTS

Validation

Smoking prevalence (ages 18 and above) from *SimSmoke* and the TUS and MiBRFSS surveys are presented in Figures 1a and 1b for males and females respectively. For both genders, smoking prevalence as projected by *SimSmoke* falls slowly from 1993 to 1997, then declines more rapidly beginning in 1998 with the steep price increase. Another rapid decline is seen beginning in 2008 following the implementation of a state smoke-free air law.

For validation purposes, we compared the smoking prevalence by gender and age predicted by *SimSmoke* to the estimates from the TUS and MiBRFSS. As shown in Table 2, the *SimSmoke* prediction is close to TUS and MiBRFSS estimates for ages 18 and above. In 1999, the *SimSmoke* predicted male prevalence rate 27.2% which is very close to 26.7% from the TUS and 26.4 from the MiBRFSS. The predicted female prevalence rate (23.3%) is close to that of the TUS (23.0%) and MiBRFSS (23.6%). A similar pattern is seen for the prevalence in 2010; predicted male and female prevalence rates (20.6% for men and 17.1% for women) are between that of the TUS (18.2% for men and 17.7% for women) and MiBRFSS (21.0% and 17.0%).

To further validate the model's prediction, we also compared model predictions of smoking prevalence with TUS survey results by gender and age groups (18-24, 25-44, 45-64, and 65+). For ages 18-24, the predicted male and female prevalence rates (28.5% and 22.7%) are

lower than those from the TUS (36.2% and 28.4%) in 1999, which may reflect a delayed response to the large price increases in late 1998 not seen in the TUS. The predicted rates for 18-24 year olds (24.4% for men and 18.8% for women) are closer to that of the TUS (24.1% for men and 15.2% for women) in 2010. For age groups 25-44 and 45-64 in both 1999 and 2010, *SimSmoke* predicted rates within 10% of the prevalence rates from the TUS except for ages 25-44 for males in 2010. For males and females ages 65 and above, *SimSmoke* predictions are higher than that of the TUS in 1999 and 2010. Except for those ages 65 and above, the model predicts within confidence intervals from the TUS.

The Effect of Past Policies

Tables 3 and 4 present smoking prevalence and smoking-attributable deaths for the *status quo* (with actual policies in place) and the counterfactual policy scenarios. Relative to the counterfactual where all policies are held constant at their 1993 level, the 2013 male and prevalence are both about 22.5% lower than the respective 2012 prevalence with policies implemented. By 2054, the effect of the implemented policies reaches a 30% reduction for males and a 32% reduction for females. With the implemented policies in place, *SimSmoke* estimates 35,909 smoking-attributable deaths in 2013. Under the counterfactual of no new policies since 1993, 39,164 smoking-attributable deaths are estimated in 2013. With the difference in deaths attributed to the implemented policies, 3,255 fewer smoking-attributable deaths (2,054 male and 1,201 female) are estimated for 2013. Cumulatively, the policies implemented between 1993 and 2013 are projected to avert 24,439 (15,516 males and 8,923 females) deaths between 1993 and 2013. By 2054, 234,480 deaths (142,277 males and 92,203 females) would be averted.

Effect of Individual Past Policies

Inflation-adjusted cigarette prices were relatively constant between 1993 and 1997, and then increased through 2013. From increased prices alone, smoking rates were reduced by about 11% by 2013 and 17% by 2054. The cumulative deaths averted by 2013 is 15,595, increasing to 100,457 deaths by 2054. Based on smoke-free laws implemented by 2010, smoking rates are 7% lower in 2013 and 9% lower in 2054, which is projected to avert 1,728 deaths through 2013 and 66,236 deaths by 2054. From cessation treatment policies, smoking rates declined by 6.5% in 2013. A total of 8,471 deaths were averted by 2013 and 91,203 deaths would be averted by 2054. The enforcement of youth access laws reduced prevalence by 0.9% by 2013, since these laws only affect youth, but prevalence is reduced by 3% by 2054. With youth access enforcement, 3,632 deaths would be averted by 2054 with most averted after 2030.

Of the total reduction in smoking prevalence due to tobacco control policies, tax increases account for 44%, smoke-free air laws for 28%, cessation treatment policies for 26%, youth access enforcement for 2%. By 2054, the role of price increased to 49% and youth access increase to 8% of the policy effect, both due to their relatively larger effect on youth.

Recommended Future Tobacco Control Policies

To show the effects of implementing stronger policies consistent with MPOWER goals, Table 5 presents smoking prevalence for males and females respectively, and Table 6 shows

total smoking-attributable deaths. In the *status quo* scenario (with policies kept at 2013 levels), adult male smoking prevalence is projected to decline from 19.6% in 2013 to 15.5% in 2018, while the female smoking prevalence is projected to decline from 16.3% in 2013 to 12.4% in 2034. At least some of the reduction in smoking prevalence is explained by stricter public policies implemented prior to 2013, including price increases, more stringent smoking restrictions in work and public places, and better information about the effects of smoking.⁵

Of the tobacco control policies, *SimSmoke* attributes the most pronounced effect on smoking prevalence trends between 1993 and 2007 to taxes.⁴ However, the same absolute increase in taxes or price has a smaller percentage effect at the higher prices found in 2006 than in earlier years, since prices are now at a higher rate and the changes represent smaller relative increases. A \$1.00 increase in the 2013 average tax rate to a total tax of \$3.00 in Michigan is projected to result in a relative decline in both male and female smoking prevalence of 1.8% by 2018 and a 2.6% decline by 2054. By 2054, a cumulative total of 7,407 (4,551 male and 2,856 female) smoking-attributable deaths would be averted. For a \$2 tax increase, a 4.7% reduction is projected in smoking prevalence with 13,847 deaths averted. For a \$3 tax increase, a 6.4% reduction is projected in smoking prevalence with 19,434 deaths averted by 2054. Price increases have the greatest effect on younger individual, particularly those below age 18, leading to increasing effects over time.

Since smoke-free air laws were implemented in 2010, the model shows only a reduction of about 2% through increased enforcement, with 8,131 deaths averted. Increasing media campaigns to a high level is projected to lead to relative decline of 4% in male and female smoking after five years, increasing to a 6% by 2054. The model projects that a total of 28,509 deaths would be averted by 2054. A policy of mandated health care provider interventions along with full financial coverage of cessation treatments and well publicized quit lines with free NRT have smaller effects in the earlier years of the projection, but their impact grows over time through increased cessation rates.³⁷ The combined cessation policies are projected to reduce adult male and female smoking prevalence by about 3.5% by 2018, increasing to a 4.0% for males and 4.5% for females by 2054. A complete cessation treatment program is projected to avert a cumulative total of 26,897 lives (15,685 male and 11,212 female) by 2054.

A policy of strong youth access enforcement has smaller effects in the earlier years of the projection, but the impact grows over time through decreased initiation rates for those below age 18. Combined youth access policies are projected to reduce adult male and smoking prevalence by about 0.35% relative to the *status quo* scenario by 2018, which increases to a 3.0%-3.5% relative reduction by 2054. From 2013 to 2054, a cumulative total of 781 lives (559 male and 222 female) are projected to be saved by a comprehensive youth access policy.

The final cases consider a combination of policies representing a tax increase of \$2.00 and \$3, with a high-level media campaign, strong youth access policies and comprehensive cessation policies. With combined policies and a \$2 increase, the smoking rate is projected to fall by a relative 12.4% (12.6%) below the *status quo* level for males (females) by 2018

and by 19.4% (21.0%) for males (females) by 2054 and avert 77,090 deaths. With combined policies and a \$3 tax increase, the reduction by 2054 increases to 20.9% (22.4%) for males, and is projected to avert 81,861 deaths from 2013 to 2054. Overall, the largest effects on youth are through the effects of price and youth access policies, while for adults the largest effects are through cessation treatment programs.

CONCLUSIONS

Smoking rates in Michigan have fallen more than 34% in relative terms since 1993. Allowing for trends in the absence of policy change, *SimSmoke* suggests that policies played an important role in Michigan's decline in smoking rates, leading to a 23% relative reduction between 1993 and 2013, mostly due to cigarette price increases and to a lesser extent smoke-free air laws and cessation treatment policies.

With no future changes in tobacco control policies, *SimSmoke* projects a reduction of cigarette smoking prevalence to 16.5% by 2020, a slower rate of decline than proposed by the HP 2020 national objectives (12% smoking prevalence by 2020).³⁸ Though some of Michigan's tobacco control policies are strong, the model predicts that there is room for improvement. For example, with state taxes were increased by \$3.00 to \$4.00 per pack and a high level media campaign sustained, smoking prevalence would drop to 14% by 2020, still above the HP 2020 goal of 12%. Furthermore, results from a more detailed cessation treatment model for the US³⁹ suggest potentially large effects with a comprehensive cessation treatment program that incorporates involvement of the health care system and better follow-up.

Michigan SimSmoke also estimates that 35,900 people in Michigan will die from smoking in 2013. Based, however, on the policies already implemented since 1993, *SimSmoke* estimates that 3,255 deaths were averted through 2013, and that 234,480 cumulative deaths would be averted by 2054. The stronger set of policies with the tax rate at \$3.00 is projected to avert more than 80,000 smoking-attributable deaths by 2054. These figures do not include deaths from second-hand smoke^{40,41} or fires caused by smoking, nor the considerable excess medical costs and lost productivity associated with smoking-related conditions.⁴²

The model validated well for prevalence of ages 18 and above by gender compared to the TUS for 1993 to 2010 and the MiBRFSS data for 1996-7 to 2010. The model validated less well for 18-24 year olds, and this age group merits special attention. Although the different surveys conducted for Michigan yield slightly different trends, the MiBRFSS data employ the largest sample and seem to provide the most reliable estimates. Besides the validation conducted here, previous applications of *SimSmoke* to the US, Arizona, California, Kentucky and Minnesota^{12,19,23,43} have accurately projected trends and turning points in population smoking rates, providing additional validation of the model's assumptions and parameters. Extending *Michigan SimSmoke* with updated policy data as it becomes available will allow for stronger trend analyses. By assessing the effect of policies on different demographic groups, opportunities might be identified and future policies could be targeted to those groups.

The *SimSmoke* results depend on effect sizes derived from the literature, and assumptions inherent in the model. The impact that an array of tobacco control policies has on different age and gender groups of the population, as well as different racial-ethnic and socio-economic status groups, can be exceedingly complex. The strength of evidence for each of the policies varies.^{3,4} The evidence for taxes and smoke-free air policies are stronger than the evidence for media campaigns, and the evidence for youth access and cessation policies are weaker and less consistent. Knowledge about the synergistic effect of combined policies is especially limited. *SimSmoke* also does not explicitly model potential feedbacks through industry practices, social norms and attitudes, or peer and family behaviors.

We have considered policies that are traditionally considered at the state level in the US. However, MPOWER policies include comprehensive marketing restrictions and large and graphic health warnings. With the new powers vested in the US Federal Trade Commission,⁴⁴ the federal government is charged with implementing stronger health warnings. Restrictions on marketing, especially point of sale bans, is also now under the purview of the FTC. Other *SimSmoke* models estimate that health warnings can reduce smoking prevalence by 4%¹⁰ and point of sale restrictions can reduce smoking prevalence by 5% by 2020,⁴⁵ thereby getting Michigan close to the HP 2020 goal of 12%. Point-of sale restrictions that include bans on price promotions can also reduce discounting that undermines tax increases. Other demand-reducing policies might include campaigns to encouraging smoke-free homes or laws requiring smoke-free multi-housing units. Nevertheless, additional policies⁴⁶ will be needed to reduce smoking prevalence toward the endgame goal of 0% smoking prevalence, as described in the 2014 Surgeon General's Report.⁴⁷ In particular, while MPOWER policies focus on reducing the demand for cigarettes, policies may be needed that limit the supply of cigarettes, including policies that reduce smuggling,⁷ raise the legal purchase age from cigarettes to 21,⁴⁸ regulate the content of the product, such as restrictions on nicotine levels or policies that encourage complete substitution to less harmful substitutes (e.g., e-cigarettes).³

In sum, *SimSmoke* projects that past tobacco control policies implemented between 1993 and 2012 in Michigan will have reduced smoking prevalence by 31% and will have averted 234,480 deaths by 2054. Taxes, smoke-free air laws, cessation treatment policies and youth access enforcement will have contributed to the decline in prevalence and deaths averted, with the strongest factor being price/tax. In order to further drive down smoking rates and move closer to the Healthy People 2020 target of 12%, a continued focus on both current tobacco control policies and an increased cigarette tax are recommended. With stronger policies including a tax increase of \$3.00, smoking rates could be reduced by another 2.3 percentage points and 80,000 smoking-attributable deaths could be further averted by 2054.

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Figure 1.
A) Male Smoking Prevalence, Michigan, Ages 18 years and above. B) Female Smoking Prevalence, Michigan, Ages 18 years and above

Table 1Policy Inputs and Effect Sizes for *Michigan SimSmoke*

Policy	Description	Percentage Effect Size [*]
<i>Cigarette Taxes</i>		
Cigarette Price	The state level average price for a pack of cigarettes (including branded and generic), including state and federal excise taxes.	For each 10% price increase: 6% reduction ages 15-17, 3% reduction ages 18-24, 2% reduction ages 25-34, & 1% reduction ages 35 & above
<i>Smoke-free Air Policies</i>		
Worksite Ban, well-enforced	Smoking banned in all indoor worksites in all areas	6% reduction.
Worksite restrictions, weak	Smoking in restricted areas only	2% reduction
Restaurant and Bar Ban, well enforced	Ban in all indoor restaurants in all areas	3% reduction
Restaurant Ban, weak	Smoking in restricted areas only	0.5% reduction
Other Places Bans	Ban in 3 of 4 (government buildings, retail stores, public transportation and elevators)	1% reduction
Enforcement and publicity	Compliance reflecting norms and government agencies to enforce and publicize the laws	Effects reduced by as much as 50% if no compliance or publicity
<i>Mass Media Campaigns</i>		
Highly publicized media campaign	Campaign expenditures meeting the pre-2009 CDC minimum recommended	6% reduction
Moderately publicized media campaign	Campaign expenditures meeting 50% of the pre-2009 minimum recommended	3.6% reduction
Low publicity media campaign	Campaign expenditures meeting 25% of the pre-2009 minimum recommended	1.2% reduction
<i>Cessation Treatment Programs</i>		
Comprehensive cessation treatment	A proactive quitline with NRT, complete treatment coverage through insurance	~ 4% reduction, but > effect on cess. rates ^{***}
<i>Youth Access Restrictions</i>		
Strongly enforced & publicized	Compliance checks are conducted 4 times per year per outlet, penalties are potent and enforced, and with heavy publicity and community involvement	20% reduction for those ages 16-17 and 30% reduction for those age < 16
Low enforcement	Compliance checks are conducted sporadically, penalties are weak, there is little merchant awareness and minimal community participation	2.5% reduction

* Unless otherwise specified, the same percentage effect is applied as a percentage reduction in the prevalence in the initial year and as a percentage reduction in initiation rate and a percentage increase in the cessation rate in future years, and is applied to all ages and both genders. The effect sizes are shown relative to the absence of any policy.

*** Affects prevalence and first year quit rates only

Table 2

Michigan Smoking Prevalence by Age: SimSmoke predictions, Tobacco Use Supplement-Current Population Survey and Michigan Behavioral Risk Factor Surveillance System

SimSmoke Predictions							
Male							
Age groups/Year	1993	1996	1999	2002	2003	2006	2010
18-24	33.1%	30.2%	28.5%	27.4%	26.6%	26.1%	24.4%
25-44	35.4%	33.8%	31.3%	29.1%	28.3%	26.3%	23.0%
45-64	28.8%	30.1%	29.3%	28.2%	27.6%	26.1%	22.8%
65 and above	13.2%	13.9%	13.0%	12.3%	12.3%	13.6%	13.0%
18 and above	29.8%	29.0%	27.2%	25.6%	25.0%	23.5%	20.6%
Female							
18-24	25.4%	25.0%	22.7%	21.5%	20.5%	20.2%	18.8%
25-44	30.6%	28.8%	26.9%	25.3%	24.8%	22.6%	19.3%
45-64	26.4%	25.8%	24.9%	23.9%	23.3%	22.2%	19.7%
65 and above	10.7%	10.6%	10.2%	9.8%	9.8%	11.0%	11.0%
18 and above	25.1%	23.8%	22.3%	21.1%	20.6%	19.4%	17.1%

Tobacco Use Supplement Survey							
Male	1992/3	1995-96	1998-99	2001-2002	2003	2006-07	2010-11
18-24	32.9%	34.5%	36.2%	34.0%	29.8%	22.5%	24.1%
25-44	35.4%	32.1%	29.3%	27.7%	27.8%	26.6%	18.3%
45-64	28.8%	25.9%	26.7%	29.3%	24.2%	22.8%	20.1%
65 and above	13.0%	12.8%	8.8%	9.9%	10.0%	10.2%	9.1%
18 and above	29.4%	27.8%	26.7%	26.5%	24.5%	22.5%	18.2%
Female							
18-24	12.8%	27.7%	28.4%	26.9%	22.6%	23.4%	15.2%
25-44	25.5%	32.6%	28.2%	25.3%	25.4%	23.1%	22.4%
45-64	30.6%	21.4%	21.8%	22.5%	20.4%	18.6%	20.1%
65 and above	26.4%	8.9%	8.7%	7.5%	10.9%	8.3%	6.7%
18 and above	24.8%	24.6%	23.0%	21.5%	20.9%	18.8%	17.7%

Michigan Behavioral Risk Factor Surveillance System							
		1996	1999	2002	2003	2006	2010
Male 18 and above		26.5%	26.4%	25.0%	30.2%	24.7%	21.0%
Female 18 and above		24.8%	23.6%	23.4%	22.3%	20.0%	17.0%

Table 3

Michigan SimSmoke, Smoking Prevalence, Differences between policies at 1993 levels combined and for individual policies, 1993-2054

MALE	1993	1999	2013	2054
Prevalence with:				
Policies implemented	29.8%	27.2%	19.6%	15.1%
Policies at 1993 level	29.8%	29.2%	25.2%	21.7%
Prevalence Reduction with:				
All policies implemented *	-	-6.9%	-22.4%	-30.3%
Price only *	-	-5.2%	-10.9%	-16.7%
Smoke free air only *	-	-0.2%	-6.9%	-8.8%
Youth access only *	-	0.0%	-0.6%	-2.9%
Cessation treatment only *	-	-1.6%	-6.4%	-5.4%

FEMALE	1993	1999	2013	2054
Prevalence:				
Policies actually implemented	25.1%	22.3%	16.3%	12.2%
Policies at 1993 level	25.1%	24.0%	21.1%	18.0%
Prevalence Reduction with:				
All policies implemented *	-	-7.1%	-22.8%	-32.0%
Price only *	-	-5.3%	-10.8%	-17.1%
Smoke free air only *	-	-0.2%	-6.9%	-8.8%
Youth access only *	-	0.0%	-0.7%	-3.5%
Cessation treatment only *	-	-1.7%	-6.9%	-6.5%

* The effects of the policies are estimated relative to the counterfactual with all policies kept the 1993 level in the same year

Table 4

Michigan SimSmoke: Smoking Attributable Deaths, Differences between policies at 1993 levels combined and for individual policies, 1993-2054

MALE AND FEMALE	1993	1999	2013	2034	2054	1993-2013	1993-2054
Smoking-Attributable Deaths							
Policies actually implemented	30,276	33,644	35,909	26,238	12,530	715,700	1,769,208
Policies at 1993 level	30,276	33,863	39,164	31,956	16,891	740,139	2,003,688
Lives Saved							
All policies implemented *	-	219	3,255	5,718	4,361	24,439	234,480
Price only *	-	151	1,690	2,049	2,072	15,595	100,457
Smoke free air only *	-	10	608	1,955	1,282	1,728	66,236
Youth access only *	-	0	0	59	267	0	3,632
Cessation treatment only *	-	65	1,249	2,384	1,306	8,471	91,203

* The effects of the policies are estimated as the difference in smoke-attributable deaths between that policy and the counterfactual with all policies kept the 1993 level in the same year

Table 5a

Male and Male Smoking Prevalence, Michigan SimSmoke with Additional Policies Implemented in 2014, ages 18 and above, 2013-2054

Policies/Year	2013	2018	2034	2054
Male Smoking Prevalence				
Status Quo Policies	19.6%	18.2%	15.5%	15.1%
% Change in Smoking Prevalence from Status Quo:				
Independent Policy Effects				
Tax increase of \$1	-	-1.8%	-2.1%	-2.6%
Tax increase of \$2	-	-3.4%	-3.8%	-4.6%
Tax increase of \$3	-	-4.7%	-5.3%	-6.4%
Smoke free air laws and enforcement		-1.4%	-1.7%	-1.9%
High Level Tobacco Control Campaign	-	-4.1%	-6.2%	-6.5%
Strong Youth Access Enforcement	-	-0.3%	-1.6%	-2.9%
Cessation Treatment Policies	-	-3.6%	-4.5%	-4.0%
Combined Policy Effects				
All above, w/ \$2 tax increase	-	-12.4%	-17.6%	-19.4%
All above, w/ \$3 tax increase		-13.6%	-18.9%	-20.9%
Female Smoking Prevalence				
Status Quo Policies	16.3%	15.2%	12.4%	12.2%
% Change in Smoking Prevalence from Status Quo:				
Independent Policy Effects				
Tax increase of \$1	-	-1.8%	-2.0%	-2.6%
Tax increase of \$2	-	-3.4%	-3.7%	-4.7%
Tax increase of \$3	-	-4.7%	-5.0%	-6.5%
Smoke free air laws and enforcement		-1.4%	-1.8%	-2.0%
High Level Tobacco Control Campaign	-	-4.1%	-6.4%	-6.8%
Strong Youth Access Enforcement	-	-0.4%	-1.8%	-3.5%
Cessation Treatment Policies	-	-3.8%	-5.1%	-4.6%
Combined Policy Effects				
All above, w/ \$2 tax increase	-	-12.6%	-18.5%	-21.0%
All above, w/ \$3 tax increase		-13.8%	-19.6%	-22.4%

Table 6

Total Smoking-Attributable Deaths Michigan SimSmoke with Additional Policies Implemented in 2014, 2013-2054

Policies/Years	2013	2033	2044	2054	2013-2054
Smoking-Attributable Deaths					
Status Quo Policies	35,909	27,327	17,856	12,530	1,089,417
Lives Saved					
Independent Policy Effects					
Tax increase of \$1	-	250	164	178	7,407
Tax increase of \$2	-	469	307	329	13,847
Tax increase of \$3	-	660	431	456	19,434
Smoke free air laws and enforcement		293	218	181	8,131
High Level Tobacco Control Campaign	-	1,016	828	688	28,509
Strong Youth Access Enforcement	-	5	33	85	781
Cessation Treatment Policies	-	966	791	617	26,897
Combined Policy Effects					
All above, w/ \$2 tax increase	-	1,364	1,097	895	77,090
All above, w/ \$3 tax increase	-	2,879	2,271	1,982	81,861