Reaching Healthy People 2010 by 2013

A *SimSmoke* Simulation

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Background: Healthy People (HP2010) set as a goal to reduce adult smoking prevalence to 12% by 2010.

Purpose: This paper uses simulation modeling to examine the effects of three tobacco control policies and cessation treatment policies—alone and in conjunction—on population smoking prevalence.

Methods: Building on previous versions of the *SimSmoke* model, the effects of a defined set of policies on quit attempts, treatment use, and treatment effectiveness are estimated as potential levers to reduce smoking prevalence. The analysis considers the effects of (1) price increases through cigarette tax increases, (2) smokefree indoor air laws, (3) mass media/educational policies, and (4) evidence-based and promising cessation treatment policies.

Results: Evidence-based cessation treatment policies have the strongest effect, boosting the population quit rate by 78.8% in relative terms. Treatment policies are followed by cigarette tax increases (65.9%); smokefree air laws (31.8%); and mass media/educational policies (18.2%). Relative to the status quo in 2020, the model projects that smoking prevalence is reduced by 14.3% through a nationwide tax increase of $2.00, by 7.2% through smokefree laws, by 4.7% through mass media/educational policies, and by 16.5% through cessation treatment policies alone. Implementing all of the above policies at the same time would increase the quit rate by 296%, such that the HP2010 smoking prevalence goal of 12% is reached by 2013.

Conclusions: The impact of a combination of policies led to some surprisingly positive possible futures in lowering smoking prevalence to 12% within just several years. Simulation models can be a useful tool for evaluating complex scenarios in which policies are implemented simultaneously, and for which there are limited data.

(Am J Prev Med 2010;38(3S):S373–S381)

Introduction

In 2000, the U.S. government released a set of goals for the health of its people, to be achieved by 2010.[1] One goal was to reduce adult smoking prevalence to 12%. The feasibility of achieving this goal has been the subject of considerable debate.[2–4] One clear point of consensus, however, is that hefty increases in cessation are necessary to achieve major reductions in smoking prevalence in the next 10–15 years. Reducing initiation, even by substantial amounts, will have a relatively small impact on adult smoking prevalence in the next 15 years as initiation primarily takes place among those aged <21 years, and they make up only a small part of the adult population.[5] To reach smoking prevalence goals in a timely manner, it will be important to understand how tobacco control policies affect cessation.

Using the *SimSmoke* tobacco policy simulation model, the effects of three public health tobacco control policies (tobacco tax/price increases, smokefree air laws, mass media/educational policies) on the three components of population quit rates (quit attempts, treatment use, treat-

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0749-3797/00/$17.00
doi: 10.1016/j.amepre.2009.11.018

ment effectiveness) are estimated. The effects of the five cessation treatment policies are also estimated to understand how they might complement the effects of tax, smokefree air, and mass media policies. By creating potential synergies, the Healthy People 2010 (HP2010) prevalence goal may be attainable within the next 5 years. Moreover, this study may serve as an exemplar for the utility of simulation modeling for informing policy and goal setting in a variety of other health domains.

Methods

Previous iterations of *SimSmoke* have modelled the direct effects of a variety of tobacco control policies on smoking prevalence in the first year following their implementation.[6–12] This paper builds on that work by estimating the effects of a wider array of tobacco control and cessation treatment policies on three components of population cessation (quit attempts, treatment use, long-term treatment effectiveness) as pathways to reduce smoking prevalence.

Baseline Scenario

The *SimSmoke* model[5,13–17] begins with the population in a baseline year distinguished by age, the size and makeup of which evolve over time through births and deaths. The population in the initial year is divided into smokers, never smokers, and previous smokers. Individuals are classified as never smokers from birth until they initiate smoking. Smokers may become ex-smokers through cessation in the previous year and may return to smoking through relapse. Relapse rates after the first year are unchanged from previous models (about 30% spread mostly over the first 5 years after quitting), but the quit rate is based on the model of the cessation process presented by Levy and Friend.[16]

The outcome variable of interest is the annual population quit rate (PQR), defined as the proportion of the U.S. smoking population that, on an annual basis, quits smoking and maintains abstinence for at least 6 months. The three components that contribute to the PQR are quit attempts (QA), treatment utilization (TxUse), and treatment effectiveness (TxEff). Expressed mathematically:

$$\mathrm{PQR} = \mathrm{QA} \times \sum\nolimits_{i=1,\ldots,4} (\mathrm{TxUse}_i \times \mathrm{TxEff}_i), \text{ where } i = \text{category of treatment.}$$

The model is "initialized" in 2003, the baseline year, using data from the 2003 Tobacco Use Supplement to the Current Population Survey (TUS-CPS).[18] Data are collected by age group: 15–17, 18–24, 25–34, 35–44, 45–54, 55–64, 65–74, and ≥75 years. People who report smoking at least 100 cigarettes in their lifetime and current smoking some days or every day on the TUS-CPS are considered current smokers. Ex-smokers are those who have exceeded the 100-cigarette lifetime threshold but no longer smoke, and never smokers are those who have not reached the 100-cigarette lifetime threshold. Initiation rates are tracked through age 24 years and are measured at a particular age as the change in prevalence rate between those smoking at that age and those smoking at the ages in the preceding age group.

In the 2003 TUS-CPS, current smokers were asked, *Have you ever stopped smoking for 1 day or longer because you were trying to quit smoking?* followed by *During the past 12 months, have you stopped smoking for 1 day or longer because you were trying to quit smoking?* Those who answered *yes* to both questions and those who were ex-smokers at the time of the survey were designated as smokers who made a quit attempt in the model. Those who had made a quit attempt in the 12 months prior to the TUS-CPS were asked about treatment use during their last quit attempt. Cessation treatments were classified as falling into four mutually exclusive categories: (1) No evidence-based treatment (NoEBT); (2) evidence-based behavioral treatment; (3) evidence-based pharmacologic treatment; and (4) combined behavioral treatment and pharmacologic treatment.

Based on studies finding a 1-year cessation rate of 3% to 5% for those quitting without an evidence-based treatment,[19–23] the 1-year quit rate is approximated at 4% for smokers using NoEBT. Effectiveness rates of the other treatment modalities in the model (i.e., behavioral treatment, pharmacologic treatment, behavioral treatment and pharmacologic treatment) were developed relative to the annual quit rate for smokers quitting without an evidence-based treatment, based on estimates presented in the 2008 Guideline[24] and related Cochrane reviews.[23,25–32] Compared to NoEBT, quit rates were estimated to increase by 100% when pharmacologic treatment is used, by 60% when behavioral treatment is used, and by 200% when pharmacologic treatment and behavioral treatment are used.

The 2003 TUS-CPS asks about treatment use in the past year as a singular event, but smokers who make a quit attempt average over 3.5 quit attempts per year. To account for the effect of multiple quit attempts on quit rates, it is assumed that half of those that make at least one quit attempt go on to make at least a second quit attempt, and half of those make a third quit attempt (i.e., $1+0.5 \times 2+0.25 \times 3+ .0125 \times 4\ldots$). If the same pattern of treatment use is applied to each quit attempt, this results in a doubling of TxEff (i.e., $1+0.5+0.25+.0125\ldots=2$), yielding rates of 8%, 12.8%, 16%, and 24% for NoEBT, behavioral treatment only, pharmacologic treatment only and combined behavioral treatment and pharmacologic treatment, respectively.

Public Health Tobacco Control Policies

A model is presented of the effects of three public health tobacco control policies (tobacco tax/price increases, smokefree indoor air laws, mass media/educational campaigns) and a defined set of cessation treatment policies on quit attempts, treatment use, and long-term treatment effectiveness. In addition, the effects of the five evidence-based and promising cessation treatment policies are considered as described in the two previous papers. The effect-size parameters for each of these policies were based on empirical studies that directly demonstrated the impact of the policy on quitting behaviors. It was also considered whether the change in quit rates due to the policy yielded changes in smoking prevalence comparable to the results of studies that relate policy variations directly to prevalence.[12]

Price changes through cigarette tax increases. While many studies examine the effect of price changes on smoking prevalence, few studies report the direct impact of price on cessation behaviors. For a 10% price increase, Tauras and Chaloupka[33] found that the probability of a quit attempt increased 6% to 9% among young adult smokers. For a 10% price increase, Levy et al.[34] reported 5% increases in quit attempts for those aged ≥24 years. Tauras et al.[35,36] found that a 10% tax hike increased nicotine replacement therapy use by 7% to 8%. These studies rely on cross-sectional data and do not distinguish how long the policy is in effect.

In studies that examine the effect of tax changes over time, Reed et al.[37] found that quit attempts more than doubled in the next 6 months following a tax that resulted in a 60% price increase on cigarettes in California, and Metzger et al.[38] found that NRT sales increased 10% within 4 weeks following a $0.39 tax increase (i.e., an effective 10% in price per pack), and more than 30% after a $1.42 city tax increase (i.e., a 35% increase in price). A 10% increase in pack price was estimated to lead to a 10% increase in QAs and a 10% increase in TxUse. A $2.00 per pack tax increase (approximately a 50% increase relative to the 2007 U.S average price of $4.20), which translates into a 50% increase in QAs and a 50% increase in TxUse, is considered.

Smokefree indoor air laws. In cross-sectional studies comparing workplaces with smokefree policies to those with no smokefree policies, studies have found a 10% to 40% higher likelihood of quit attempts among smokers[39] and a 20% to 40% higher likelihood of quit success.[39–41] Longo et al.[42] found that workers under workplace bans were twice as likely to maintain abstinence over a 2-year period compared to workers who were not. Regarding treatment use, Wilson et al.[43,44] reported a doubling of calls to New Zealand's national quitline and in the number of first-time NRT voucher cards distributed following implementation of smokefree legislation. Thus, implementing smokefree indoor air laws at the workplace was estimated to increase QAs and TxUse each by 50% among workers who were smokers before the policy was implemented. After taking into account that more than half of the U.S. population is already covered by smokefree workplace laws,[45] the incremental impact on quit attempts and TxUse would be 25%.

Mass media/educational policies. There is strong evidence that health communication campaigns as defined by the CDC can achieve substantial reductions in tobacco use.[46,47] In a cross-sectional study controlling for tax and clean air policies, Levy et al.[34] found a 45% higher rate of quit success among those smokers making a quit attempt in states with media-focused tobacco control programs compared to those without such campaigns. Hyland et al.[48] found that 44% more smokers had quit after 8 years in states with a strong tobacco control program compared to those without such programs. Using data presented in Burns et al.,[49] the quit attempt and abstinence rates in two states with active, media-focused, tobacco control programs were compared to those in less active states in 1996. Relative to comparison states, the annual rate of quit attempts was 15% higher in California and 20% higher in Massachusetts; the rate of quit success was 36% higher in California and 22% higher in Massachusetts than in the average of the comparison states.

Based on these findings and on studies of prevalence,[7] mass media/educational policies were estimated to lead to a 20% increase in QAs, a 15% increase in TxUse, and a 15% increase in TxEff. After accounting for state spending on tobacco control campaigns (most of which is spent on mass media/educational efforts) at about 40% of the CDC recommended minimum,[50] a strong mass media/educational policy was estimated to increase QAs by 12% and increase TxUse and TxEff by 9%.

Cessation treatment policies. Levy et al.[51] examined three evidence-based cessation treatment policies: (1) expand cessation treatment coverage and provider reimbursement; (2) mandate adequate funding for the use and promotion of evidence-based state-sponsored telephone quitlines; and (3) support healthcare system changes to prompt, guide, and incentivize tobacco treatment. QAs were estimated to increase by 50% and TxUse nearly doubled, with different effects across treatments. Levy et al.[51] also examined the effects of two promising policies that would (4) support and promote evidence-based treatment via the Internet; and (5) improve individually tailored, stepped-care approaches and the long-term effectiveness of evidence-based treatments. The availability of high-quality, web-based cessation programs was estimated to increase behavioral treatment use by 2.5%, and individually tailored, stepped-care approaches were estimated to increase TxEff by 100% relative to NoEBT. Because these estimates are more tentative (i.e., based on less direct evidence), these effects are separately considered.

Application of Policy Effects

Studies examining smoking prevalence and consumption find that policies have their greatest influence in the first few years after they are implemented.[52–56] Smokers who are most amenable to quitting are likely to quit when the policy is first implemented; in ensuing years, those who tried to quit and failed may be less likely to try again and more likely to fail if they do try again. Unfortunately, most empirical studies have not examined the effect of policies on quitting behaviors beyond the first year. To capture the time pattern of effects, a geometric decline in the effect of the policy on the quit rate (i.e., for an annual decay rate of x%, $PQR_{status\ quo} + [PQR_{with\ policy} - PQR_{status\ quo}] \times (1\text{–}x)^{i-1}$ in the *i*th year that the policy has been in place) is assumed. This structure implies that the effects decline by the same percentage each additional year that the policy is in effect. An initial estimate of a 10% decay rate for all policies was based on an examination of recent versus long-term differences in prevalence effects found in previous policy studies, but bounds of 0% and 25% decay rates were also considered.

In the combined policy model, data on smoking prevalence and quit behaviors were collected by age group, but it is assumed that individual policies have the same effect across age, as previous studies do not provide sufficient information to distinguish policy effects by age. Unlike in Levy et al.,[51] the policies are assumed to affect all smokers aged ≥18 years rather than ≥24 years, because tax and clean air laws in particular have been found to have prominent effects on those aged 18–24 years.[12]

Information on the effect of combined policies compared to individually implemented policies is also sparse.[12] In combining policies, it was assumed that the effect of each additional policy on QAs, TxUse, and TxEff depends on the percentage of the relevant population not already affected by other policies. For example, if one policy increases QAs from 40% to 60%, the effect of an additional policy on QAs will be reduced by 1/3 [$= 1-(60-40)/(100-40)$] compared to the initial scenario when there was no other policy simultaneously implemented. This assumption takes into consideration the percentage of smokers affected by other policies and ensures that the maximum reduction in smoking prevalence is bounded at 100%.

Model Validation and Projection

To validate the PQR estimates, the estimate was compared to a quit rate measure suggested by Burns et al.,[49] developed using the 2003 TUS-CPS. This measure defines the population quit rate as the number of ex-smokers who quit in the past year and are abstinent for at least 3 months as a percentage of those who were smokers 1 year ago.

The model takes into account the effects of actual policies implemented between 2003 and 2007, as described in Levy et al.[57] The model was validated over the 2003–2007 period by comparing the projected smoking rates over that period to changes in prevalence according to National Health Interview Survey (NHIS) data.[58] As the model is based on 2003 CPS-TUS data, the 2003 value of smoking prevalence was multiplied by the ratio of the 2003 NHIS to the 2003 CPS-TUS smoking prevalence in order to have comparable estimates.

The effects of new policies are assumed to be implemented in 2009 and sustained through 2020. Policy effects are compared to a status quo scenario, in which policies and quit rates remain at their 2008 levels. Scenarios are considered in which each of the policies is implemented individually and in which all policies are implemented simultaneously.

Results

Baseline Year and Validation

From the TUS-CPS data, quit attempts in 2003 averaged 42.3% for all smokers aged ≥18 years, decreasing with age from a rate of 52% among those aged 18–24 years to 31% among those aged ≥75 years. Among all smokers who made a quit attempt in the past year, TxUse averaged 72% for NoEBT, 24.9% for pharmacologic treatment, 1.2% for behavioral treatment, and 2.0% for pharmacologic treatment and behavioral treatment. Treatment use increased to age 45 years and then decreased after age 65 years.

To calibrate the initial 2003 PQR, the PQR computed from the model was compared to the actual annual quit rate estimated obtained using 2003 TUS-CPS data. The overall quit rate from the model was 4.4% per year for those aged ≥18 years, which compares favorably to the 4.5% quit rate obtained from TUS-CPS data. However, when quit rates were considered by age, the rates projected by the model were higher for those aged 35–64 years than the actual rates, and lower for those aged <35 years and >64 years compared to the actual rates. In response, the quit rates were adjusted by age (120% for ages 18–24 years, 110% for ages 24–35 years, 90% for ages 35–64 years, 120% for ages 65–74 years, and 130% for ages ≥75 years).

The model is initialized with adult (aged ≥18 years) smoking prevalence at 21.6% in 2003, which falls to 20.8% in 2006 and to 20.4% by 2007. These values were compared to the 2007 smoking rate of 19.8% (95% CI=19.0%, 20.6%) from NHIS data,[59] which fell from 20.8% (95% CI=20.1%, 21.5%) in 2006. Thus, the model is well validated over the short period from 2003 to 2007.

The Effect of Tobacco Control and Cessation Treatment Policies on the Population Quit Rate

The effects of policies on QAs, TxUse, TxEff, and ultimately on the PQR in the first year that the policy is implemented, are shown in Table 1. The greatest impacts on increasing the population quit rate during the first year following implementation are those resulting from the three evidence-based cessation policies. The annual quit rate increases by 3.2 percentage points to 7.6%, or by 73% in relative terms from the initial level of 4.4%. When promising policies related to web-based programs and individually tailored/stepped-care approaches are combined with the three evidence-based cessation treatment policies, the quit rate increases to 10.7%, a 144% relative increase over

Table 1. Annual treatment effectiveness, treatment use, quit attempts, and population quit rates under different policy scenarios (%)

	NoEBT	PT only	BT only	PT + BT	QA	Change in QA	PQR	Change in PQR
Treatment effectiveness rate	8.0	16.0	12.8	24.0	NA	NA	NA	NA
Treatment use rates under status quo	71.9	24.9	1.2	2.0	42.3	NA	4.4	NA
50% tax increase	57.9	37.4	1.8	3.0	63.5	50.0	7.3	65.9
Smokefree indoor air laws	64.9	31.1	1.5	2.5	52.9	25.0	5.8	31.8
Mass media/educational policies	69.4	27.1	1.3	2.2	47.4	12.0	5.2	18.2
Evidence-based cessation treatment policies[a]	52.7	35.9	3.2	8.3	61.3	45.0	7.6	72.6
With promising cessation treatment policies	50.2	35.8	4.8	9.3	62.3	47.3	10.7	143.8
Evidence-based cessation treatment policies and tobacco control policies								
Without promising cessation treatment policies	39.9	46.2	4.1	9.8	80.1	89.5	11.9	170.2
With promising cessation treatment policies	38.6	46.6	5.7	10.8	82.2	94.4	17.3	295.0

[a]Includes treatment coverage, quitlines with no-cost NRT, and healthcare provider interventions.
BT, behavioral treatment; NA, not applicable; NoEBT, no evidence-based treatment; PQR, population quit rate; PT, pharmacologic treatment; QA, smokers making a quit attempt in the last year

the baseline scenario. Cigarette price increases through tax increases have the second-greatest impact on the population quit rate (a 66% increase in relative terms), followed by smokefree laws (a 32% increase), and mass media/educational campaigns (an 18% increase). When the three public health tobacco control policies are combined with the three evidence-based cessation treatment policies, the quit rate increases by 170% to 11.9%, and by 295% when the two promising policies are added, resulting in a 17.3% annual quit rate.

The Effect of Policies on Smoking Prevalence over Time

As shown in Table 2, the model projects that smoking prevalence will drop from 20.1% to 19.6% in 2010, to 18.6% in 2015, and to 17.5% in 2020 in the absence of tobacco control policy changes (i.e., "status quo"). With a nationwide tax increase of $2.00 per pack on cigarettes, the model projects that smoking prevalence would fall to 18.5% in 2010 (5.6% below status quo) and to 15.0% in 2020 (14.3% below status quo). Smokefree laws alone lead to a smoking rate of 19.1% in 2010 and 16.3% in 2020, or 7.2% below the status quo. Mass media/educational policies have a smaller effect with a smoking rate of 19.3% in 2010 and 16.8% in 2020, or 4.1% below the status quo. Evidence-based cessation treatment policies reduce smoking prevalence to 18.4% in 2010, and 14.8% in 2020 or 15.5% below the status quo. With the addition of promising policies related to web-based programs and individually tailored/stepped care approaches, the smoking prevalence is reduced to 12.8% by 2020, or 26.9% below the status quo and to the HP2010 goal of 12%.

Finally, the impact of all policies combined was considered. Without the two promising cessation treatment policies, smoking prevalence falls to 17.0% in 2010 and to 12.2% in 2020 (30.6% below status quo). In this scenario, the 12% HP2010 goal is reached by 2020. With the two promising cessation treatment policies, there is a 22.1% reduction in smoking prevalence by 2010 and 44.6% by 2020 such that the HP2010 smoking prevalence goal is reached by 2013.

This simulation used a 10% decay rate each additional year that the policy was in effect. When 0% and 25% decay rates are used as bounds for the policies' effects in future years, the effects are changed little through 2010 but change considerably in later years as shown in the last four columns of Table 2. For taxes, smokefree air laws, mass media/educational campaigns, and evidence-based cessation treatment policies alone, the percent reductions are increased by about 40% with a 0% decay rate and reduced by about 35% with a 25% decay rate. With all policies included in the model, including the two prom-

Table 2. The effects of public policies on adult (aged ≥18 years) smoking prevalence, 2008–2020 (% unless otherwise indicated)

Policy	2008	2009	2010[a]	Δ vs 2010 SQ	2015[a]	2020[a]	Δ vs 2020 SQ	Upper bound 2020[b]	Δ vs 2020 SQ	Lower bound 2020[c]	Δ vs 2020 SQ
Status quo	20.1	19.9	19.6	NA	18.6	17.5	NA	17.5	NA	17.5	NA
50% tax increase	20.1	19.3	18.5	–5.6	16.3	15.0	–14.3	13.8	–21.4	15.9	–9.4
Smokefree indoor air laws	20.1	19.6	19.1	−2.7	17.5	16.3	−7.2	15.6	−11.0	16.7	−4.7
Mass media/educational policies	20.1	19.7	19.3	−1.6	17.9	16.8	−4.1	16.3	−6.7	17.0	−2.9
Evidence-based cessation treatment policies[d]	20.1	19.2	18.4	−6.2	16.1	14.8	−15.5	13.4	−23.4	15.7	−10.5
With promising cessation treatment policies[e]	20.1	18.6	17.3	−11.7	14.2	12.8	−26.9	10.7	−39.1	14.5	−17.4
Evidence-based cessation treatment policies and tobacco control policies											
Without promising cessation treatment policies	20.1	18.4	17.0	−13.4	13.6	12.2	−30.6	9.9	−43.4	14.0	−20.4
With promising cessation treatment policies[e]	20.1	17.4	15.3	−22.1	11.1	9.7	−44.6	7.1	−59.5	12.2	−30.6

Note: % change (Δ) is measured relative to the status quo in the same year, (i.e., [SRp,t–SRStatus quo,t]/SRStatus quo,t, where SRp,t is the smoking rate in year t with policy p and SRStatus quo, t is the smoking rate in year t under the status quo).
[a]Policy effects decay at a rate of 10% per year.
[b]Policy effects decay at a rate of 0% per year.
[c]Policy effects decay at a rate of 25% per year.
[d]Includes treatment coverage, quitlines with no-cost NRT, and healthcare provider interventions.
[e]Includes above and changes that increase treatment effectiveness of evidence-based treatments by 100%.
NA, not applicale; NRT, nicotine replacement therapy; SQ, status quo

ising cessation treatment policies, the HP2010 goal is reached by 2012 if there is no decay and by 2020 if there is 25% decay.

Discussion

Results from this study suggest that the HP2010 goal of 12% smoking prevalence can be reached before 2020 if a comprehensive set of policies related to tobacco tax/price increases, smokefree air laws, mass media/educational campaigns, and cessation treatment (including improved web-based treatments and policies to improve the effectiveness of evidence-based treatments) are implemented. With all of these policies in effect simultaneously, the model projects that the HP2010 goal of 12% can be reached by 2013.

A tax increase of $0.62 and smokefree laws implemented in 2009 should help to reach the HP 2010 goal. The tax increase should reduce smoking rates by 2% in 2010, increasing to 5% by 2020. This study also suggests that stronger policies to promote cessation treatments, in particular, can have strong effects. Evidence-based cessation treatment policies, such as improved financial access, greater healthcare provider involvement and improved quitlines, are estimated to have effects similar to those of a $2.00 tax increase. The findings also indicate that improved web-based programs and individually tailored/stepped-care approaches merit further attention.

Because some policies (e.g., taxes or clean air laws) are more likely to affect quit attempts while others more directly affect treatment use (e.g., treatment coverage), their combined effect is shown to be synergistic. The effect of increased treatment use is (multiplicatively) enhanced through improved treatment effectiveness, leading to higher levels of treatment success for those making a quit attempt. Similarly, the multiplicative relationship between more quit attempts and improved treatment effectiveness implies synergies. While a growing number of studies document the synergies that occur when multiple tobacco control policies are applied,[60–62] the model synthesizes this evidence and estimates actual effects.

The results in this paper are subject to seven general limitations. First, the effect sizes for policy parameters are preliminary, due to relatively sparse data on the effects of policies on quit attempts, treatment use, and treatment effectiveness. For taxes, clean air laws, and media campaigns, in particular, research is needed to gauge the variance in how each of the policies affects quit attempts, treatment use, and especially treatment effectiveness.

Second, in combining policies, it was assumed that the effect of each additional policy on quit attempts, treatment use, and treatment effectiveness depends on the percentage of the relevant population that has not already been affected by other simultaneously implemented policies. If the percentage effects were additive, the effect of policies—especially on quit attempts—would increase quite dramatically, and would further increase if the percentage increases were multiplicative. If, however, the effects of different policies cancel each other out, the effects estimated above for combined policies may be overstated.

Third, when the model was calibrated, the quit rates in the initial model were underpredicted for those aged 18–34 years and for those aged >65 years, which merits further exploration. More generally, the current levels of treatment effectiveness are subject to uncertainty. Levy et al.[51] suggested bounds of 50% above and 50% below estimates for treatment effectiveness.

A fourth limitation relates to the use of a 10% annual decay rate for the eroding effect of policies over time in the model. Although this rate yields policy parameter estimates that are roughly consistent with studies of the effect of policies on smoking prevalence,[12] the results from the model were found to be sensitive to the decay rate. Fifth, the model did not consider how the policies themselves might have a differential impact by age and gender. Sixth, the study considered the effectiveness, but did not consider the costs of implementing the policies. Finally, this paper did not consider youth initiation-oriented policies (e.g., school education, limiting youth access to cigarette purchases) or other policies (health warnings, advertising bans) that may also help to reach HP2010 objectives.

This study highlights the importance of tracking each of the components of smoking prevalence—quit attempts, treatment use, and treatment effectiveness—to understand the impact of policy changes and to identify the optimal combination of policy changes. Simulation models are a critical tool to evaluate scenarios for which there is no clear evidence regarding the impact of the policies (e.g., if different cessation treatment policies were successfully integrated and tailored to the needs of individual smokers with follow-up).

In sum, the *SimSmoke* policy simulation model was used to examine the effects of multiple public health tobacco control and cessation treatment policies on the national adult quit rate. Results demonstrate that while it is not reasonable to expect that the HP2010 goals will be reached by 2010, if a suite of policies are implemented nationwide, the HP2010 goals are achievable within the next 5–12 years. Tax policies, smokefree laws, mass media/educational policies, and both evidence-based and promising cessation treatment policies must be implemented nationally and in all states. Policy implementation is especially critical in states with historically poor performance in tobacco control and high smoking rates.[63] Because the effects of policy changes take time to unfold, policies must be implemented soon if we are to come close to reaching HP2010 targets.

This paper was conducted under the auspices of the national Consumer Demand Roundtable and was supported by funds provided by the Office of Behavioral and Social Sciences Research (OBSSR) at the NIH and the Robert Wood Johnson Foundation (RWJF). David Levy also received funding from the Cancer Intervention and Surveillance Modeling Network (CISNET) of the Division of Cancer Control and Population Sciences (DCCPS), National Cancer Institute (NCI) under grant UO1-CA97450-02. The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the American Legacy Foundation, the University of Baltimore, NCI, OBSSR, or RWJF.

No financial disclosures were reported by the authors of this paper.

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