

Reducing Tobacco Use: What Works in the Population?

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Abstract: One-half of those who have ever smoked cigarettes are currently former smokers. This cessation coincided with a forty-year effort to educate and inform smokers about the risks of smoking. This paper examines the effects of several tobacco control interventions for smokers in the general population using population-based survey data. States with large media-led tobacco control programs have higher rates of smoking cessation, suggesting that these comprehensive approaches can alter smoking behavior. This paper also presents evidence supporting effects on smoking cessation for restrictions on where people can smoke, increases in the cost of cigarettes, provision of physician advice to quit coupled with cessation assistance, pharmacological assistance, and telephone hotlines. It also provides evidence that many of these interventions are being implemented in the general population in ways that are less effective than expected based on clinical trials. Increasing the effectiveness of these interventions and linking multiple interventions to provide synergy offer great opportunities to improve rates of population-based cessation.

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Prevention of smoking initiation is an important public health goal, but smoking cessation is the principal means by which a current cigarette smoker can alter his or her future risk of disease.¹ Cessation is often examined at the individual level to determine the effects of cessation interventions as part of a health care encounter or to define individual level predictors of who will or will not be successful in a cessation attempt. In this context, it has been suggested that “treating nicotine dependence” may be a more appropriate phrase for the effort than “smoking cessation.”² However, for individual interventions to create a substantial public health benefit, they must add up to change at the population level. Powerful interventions that affect only a few individuals will have little impact on disease rates, whereas weaker interventions that impact large numbers of smokers will have important and cumulative effects on disease rates. In addition, many interventions (price increases, changes in social norms, etc.) are delivered to the population as a whole rather than to individual smokers one at a time, and it is these population-based interventions that have formed the core of the tobacco control efforts currently under way in California, Massachusetts, and several other states.

Can We Change Cessation Rates in the Population?

Persistently high smoking prevalence and low rates of successful cessation discourage those interested in tobacco control and have led to suggestions that tobacco control efforts should be redirected to focus predominantly on preventing adolescent initiation.³ This pessimism is not supported by actual experience with smoking cessation over the past several decades. Currently, approximately one-half of all of those who have ever smoked are former smokers, demonstrating that not only is smoking cessation possible, but it is being achieved by a half of those who have ever smoked.³

This high rate of cessation is neither accidental nor a result of aging of the smokers in the population or other demographic shifts. Figure 1 presents cessation rates for white males born during sequential five calendar year periods (birth cohorts) as they advance in time (and age) from 1940 to 1990. Prior to the mid-1950s, cessation was uncommon at any age. With demonstrations of the risks associated with smoking during the mid-1950s and widespread press coverage of lung cancer risks for smokers, cessation

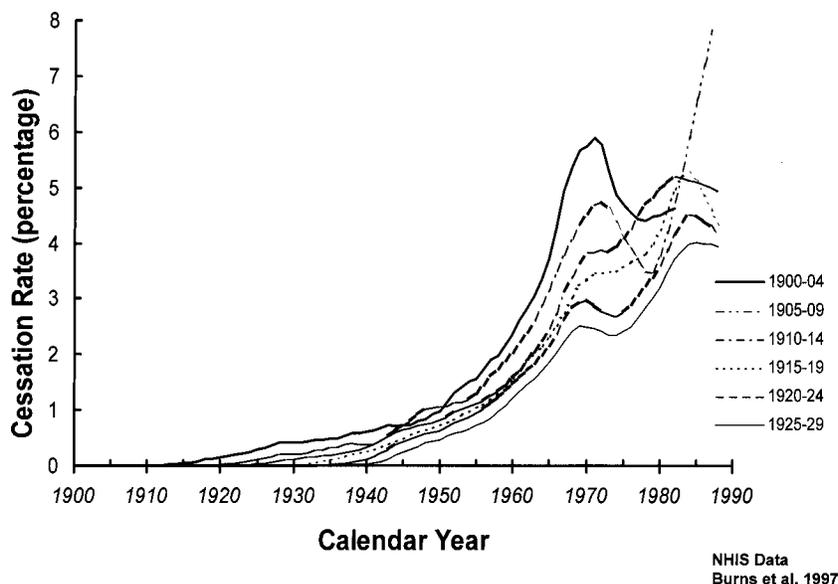


Figure 1. Annual smoking cessation rates by calendar year for five-year birth cohorts of white males born between 1900 and 1929

began to increase. These observations provide strong evidence that some individuals clearly do respond to risk information with a change in behavior, particularly in the context of changing norms about smoking behavior.

Data on cessation rates over time also suggest that public health efforts to change smoking behavior can have an effect above and beyond the effect of information alone. During the period from 1967 to 1970, anti-smoking television spots were broadcast in large numbers as a result of an FCC ruling requiring the spots as a fairness doctrine response to broadcast cigarette advertising.^{4,5} Together with this counter-advertising, there was substantial effort on the part of many professional and voluntary health organizations to help smokers quit. One result of this media-led activity was a substantial increase in cessation rates across all age and racial groups and in both genders.⁶ When cigarette advertisements were removed from the broadcast media and anti-smoking spots nearly disappeared as well, cessation rates leveled off or declined.⁷ The temporal association of change in cessation rates with these events strongly suggests that deliberate programmatic efforts can alter smoking behavior at the population level and provides one cornerstone of the foundation of current comprehensive tobacco control campaigns.

Since the 1960s, strategies to promote and enhance cessation have gradually transitioned from an

exclusive focus on the individual smoker toward understanding the role played by the environment within which the smoker smokes.⁸ Initial efforts to educate smokers and clinic-based cessation assistance have been supplemented by numerous activities to change community norms. These include efforts to increase the cost of cigarettes, restrict where smoking is allowed, and provide societal-based persistent and inescapable messages to quit coupled with other support for cessation. These concepts are reflected in the current state-based comprehensive tobacco interventions funded by the National Cancer Institute (NCI), the Centers for Disease Control and Prevention (CDC), and the Robert Wood Johnson Foundation.⁹ In California and Massachusetts, these comprehensive approaches have been funded at substantial levels for several years (since 1989 in California and since 1993 in Massachusetts). More recently, Arizona, Oregon, and Florida have developed programs, and the Master Settlement Agreement between state attorneys general and the tobacco industry will provide resources that some states may use to initiate comprehensive programs. The programs in California and Massachusetts have been associated with reductions in various measures of smoking behavior, and their program elements are being replicated in other states.^{10,11}

Measures of Cessation and Changes in Cessation Nationally

Figure 2 presents cessation measures for the United States as measured by the Current Population Survey (CPS) for the years 1992-93 and 1995-96.¹² The figure presents the current smoking status of those twenty-five years of age or older who were daily smokers one year prior to each survey. There is a clear and statistically significant decline in cessation activity and cessation success between these two surveys. The decline is statistically significant for each of the measures of cessation activity and cessation success, with the exception of becoming an occasional smoker. This decline is present for both genders and all age, race, and educational groups, and the decline in cessation is proportionately greater among those with higher levels of income. This decline in cessation contributes to the absence of a decline in per capita consumption of cigarettes in the United States observed during these same years and is a major public health concern.¹³

Older smokers are much less likely to make a cessation attempt than younger smokers, but they are much more likely to have successfully quit for three or more months. Thus, older smokers appear to be less likely to attempt to change their smoking be-

havior; but when they do, they are substantially more likely to be successful for three or more months. Differences among racial and ethnic groups are less pronounced. African-Americans have significantly higher rates of cessation activity than non-Hispanic whites, but they also have significantly lower rates of having quit for three or more months. Asian/Pacific Islander smokers also have significantly higher rates of cessation activity compared to non-Hispanic whites, but they have a non-significant lower rate of 3+ month cessation success.

Both cessation activity and 3+ month cessation success are significantly higher among smokers with higher levels of educational attainment. A similar pattern is seen with level of income where both cessation activity and 3+ month cessation success are significantly higher among smokers with higher family incomes. The percentage of all cessation activity that has resulted in 3+ months of successful cessation is relatively uniform across the middle strata of family income, but it is higher for the top income stratum and lower for the lowest income stratum.

There is a clear decline in cessation activity with increasing number of cigarettes smoked per day. However, the picture for cessation success is less clear. Those who reported smoking one to four cigarettes per day one year prior to the survey were significantly more likely to successfully quit for 3+ months than were smokers who reported smoking 5-14 or 15-24 cigarettes per day. However, once the

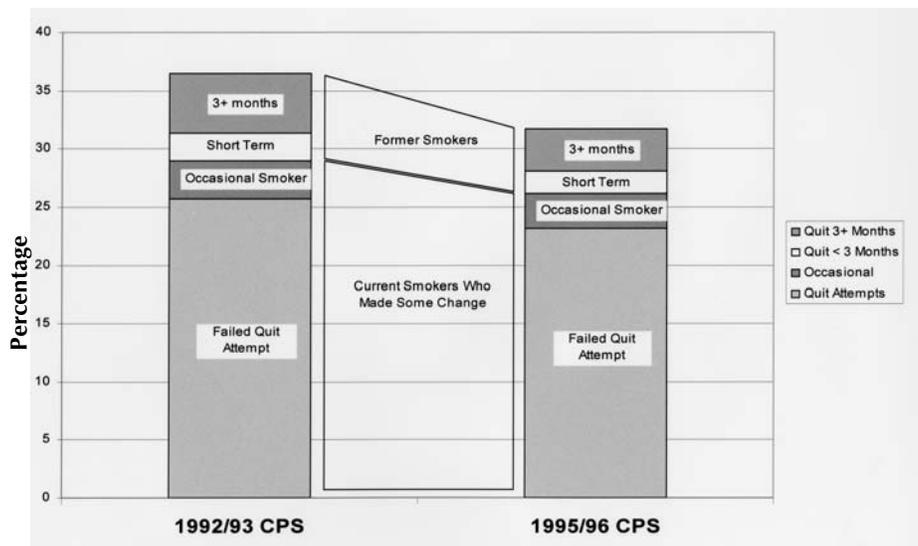


Figure 2. Current population surveys 1992-93 and 1995-96: percentage of daily smokers one year prior to the survey who reported some change in their smoking status during that year, age 25+ years

category of one to four cigarettes per day is excluded, there is no trend of lower likelihood of 3+ month successful cessation with increasing number of cigarettes smoked per day across the remaining number of cigarettes per day categories. These data suggest that, within that group of smokers who are likely to be dependent smokers (those who smoke 5+ cigarettes per day), heavier smokers are less likely to attempt to quit. However, when these heavier smokers do attempt to quit, they may be as likely to be successful for three or more months in that attempt as those who smoke less than one pack per day. These cross-sectional data need to be interpreted with caution in light of other data from a five-year longitudinal follow-up of current smokers in the Community Intervention Trial for Smoking Cessation (COMMIT) study. That study shows a consistent decline in successful cessation with increasing number of cigarettes smoked per day.¹⁴ The reasons for the differences between these two are unclear.

Comparison of California and Massachusetts to the Remaining States

California and Massachusetts have conducted large well-funded tobacco control interventions over the period covered by the Current Population Surveys. One measure of the success of these efforts is whether cessation rates are higher in these states than the other states where interventions have been more modest. Because smoking prevalence and cessation are influenced by differences between states in demographic characteristics and number of cigarettes smoked per day, measures of cessation were examined using multivariate logistic regression analyses to control for demographic differences and differences in number of cigarettes smoked per day.¹²

Both California and Massachusetts had statistically significantly higher cessation activity than other states. Massachusetts had an increase in cessation attempts, and California had an increase in likelihood of becoming an occasional smoker. Both Massachusetts and California also had an increase in the likelihood of becoming a former smoker in the past year compared to other states. The likelihood of achieving 3+ months of cessation also was significantly higher in California, and higher with borderline significance ($p = 0.051$) for Massachu-

setts, when compared to remaining states. The higher rates of cessation activity and cessation success in California and Massachusetts provide evidence for a substantial impact on cessation of the tobacco control programs in these two states.

What Works?

The differences in cessation activity and success that exist in California and Massachusetts may support an overall effect of a tobacco control program on cessation, but it does little to define which components of programs work. In reality, it probably will not be possible to define the exact causal effects of a specific component of any of these programs because they are not delivered in isolation and many of their effects may be created by synergistic interactions between program elements. However, by examining differences in cessation behaviors among individuals exposed or not exposed to the program elements, it is possible to identify those components associated with increases in cessation activity and success. In addition, there are substantial variations across the states in public policies on tobacco, including taxes and restrictions on where people can smoke, and these differences can be compared to differences in rates of cessation to determine the association of these policies with cessation.

Public Policy Components

Changes in public policies on tobacco can affect large numbers of individuals at minimal cost. Increasing the price of cigarettes through taxation and restrictions on smoking in the workplace are two public policy changes for which a substantial body of information exists to define their effectiveness.

Increases in the price of cigarettes have been linked repeatedly with a reduction in measures of total and per capita consumption of cigarettes, and most studies have shown a relatively consistent effect of a 4 percent decline in consumption for each 10 percent increase in price.¹⁵ More limited data are available for cessation, but fluctuations in the annual sales weighted price of cigarettes are associated with similar changes in calendar year rates of one year successful cessation. In addition, when differences across states in price of cigarettes are compared to differences in state-specific rates of cessation activity and success, controlling for differences in demographic factors and number of cigarettes smoked per day, there

is a statistically significant association between higher price and both higher rates of cessation activity and cessation success. These observations support the probability that an increase in the cost of cigarettes can influence not only short-term cessation attempts but also long-term cessation success.

There has been a dramatic increase in the fraction of the working population protected by total bans on smoking in the workplace, increasing from 3 percent in 1986 to 64 percent in 1996. Multiple workplace observations have demonstrated that instituting a change in workplace smoking restrictions is accompanied by an increase in cessation attempts and a reduction in number of cigarettes smoked per day.¹⁶ Once restrictions on smoking in the workplace have been successfully implemented, they continue to have an effect. Observations from the longitudinal follow-up in the COMMIT trial and cross sectional data from the CPS both demonstrate that working in a workplace where smoking is banned is associated with a reduction in the number of cigarettes smoked per day and an increase in the success rate of smokers who are attempting to quit.^{14,17} There may also be a small effect in increasing the frequency with which smokers attempt to quit. General environmental norms about smoking may also play a role in promoting smoking cessation. Multivariate logistic regression analyses of the effect of workplace restrictions on smoking show small independent effects on cessa-

tion activity and success for both the actual restrictions in the smoker's workplace and for the average level of workplace restrictions in the state as a measure of the social norms about smoking (Figure 3).

Pharmacological and Health Care Systems Interventions

The health care system has long been recognized as a logical and potentially productive means of reaching smokers with a cessation message and promoting their successful cessation. Approximately 70 percent of smokers see a physician each year, creating the potential to reach large numbers of smokers. The fraction of patients who report having been advised in the last year by their physician to quit smoking remains too low, but it has been increasing over time and now exceeds 50 percent of smokers.

A variety of pharmacological approaches to smoking cessation have been approved by the Federal Drug Association (FDA) over the last two decades, including nicotine replacement therapy with gum, patches, and nasal and oral inhalers, as well as clonidine and bupropion. The patch and gum have been approved for over the counter sale since 1996.

Both physician advice and pharmacological treatment have substantial effects on long-term successful smoking cessation as demonstrated in multiple controlled clinical trials.¹⁸ The magnitude of

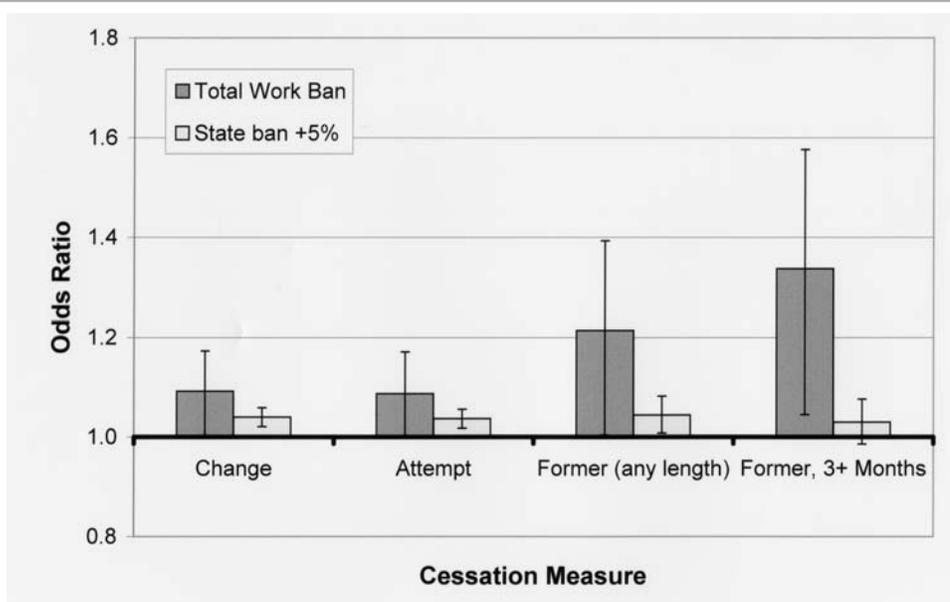


Figure 3. Odds ratios for cessation activity and cessation success for smokers working in workplaces where smoking is banned or living in states where there is a high prevalence of workplace smoking bans

effects demonstrated in these trials represents what can be achieved when these approaches are utilized effectively. Once these interventions move beyond the controlled investigational setting where there is careful attention to the protocol, it is likely that they are used in isolation without the structure and support provided by a clinical trial, and they may have less impact on the smoker.

Analyses of cessation activity and success among those who were daily smokers one year prior to the 1996 California Tobacco Survey suggest that this may currently be the case, particularly for physician advice. When multivariate logistic regression analyses are performed on physician advice to quit, controlling for age, gender, level of education and income, race/ethnicity, and number of cigarettes smoked per day, there is a significant increase in the likelihood of making any change or making a cessation attempt among those receiving physician advice to quit, but there is no effect on the likelihood of having quit at the time of the survey or having quit for three or more months (Figure 4). These data suggest that physician advice to quit in the real world is having an effect on cessation attempts but little effect on longer-term cessation.

One of the differences between the clinical trials and real world applications is that, in clinical trials, resources are provided for the investigatory team to ensure that the intervention is delivered according to the research protocol. These protocols often specify the content and extent of physician advice, directions on how best to use the medications, an offer of additional support if desired, and intent to follow-up on

the individual's cessation effort. Even in those studies where the patient-physician interaction is not specified, in order to mimic real world conditions, the structured environment of a trial may create an integration of the intervention into the care delivery process that provides a structure supporting cessation. Many of these components may be lacking in the actual real world application of these clinically proven interventions. This lack may explain at least part of the difference in effectiveness between the clinical trials and the population-based data.

The difference between clinical trials and real world situations suggests opportunities to improve smoking cessation rather than limitations of physician advice and pharmacological approaches in the real world. The answer to improving the effectiveness of these interventions may lie in focusing resources on supplementing the quality of these interventions to improve their effectiveness and on enhancing the capacity of other tobacco control structures to support pharmacological- and physician-based interventions. This can be accomplished by reducing the barriers to accessing these interventions (particularly cost) and by linking them with other existing components of comprehensive tobacco control interventions. For example, linking physician advice with telephone hotline counseling, providing information on how to effectively utilize over-the-counter medications at community cessation events, and encouraging health care systems to view cessation as a population-based intervention delivered across all interactions with the system, rather than

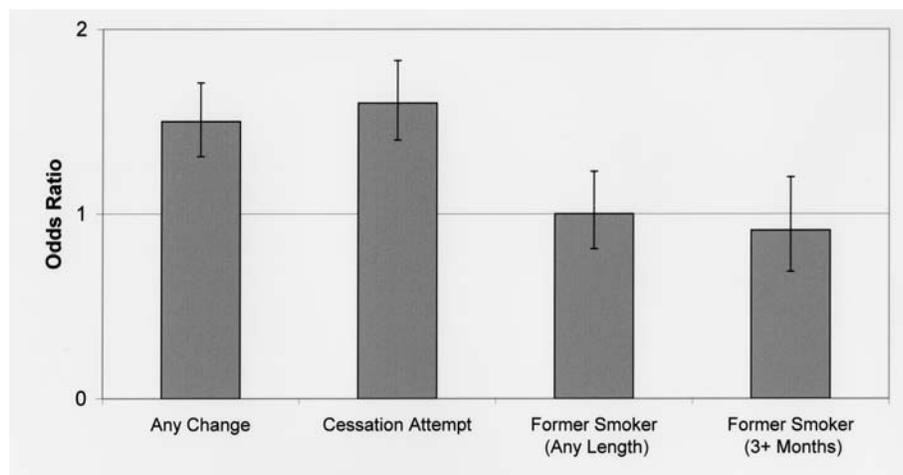


Figure 4. Multivariate logistic regression of physician advice to quit on cessation activity and success, controlling for gender, race/ethnicity, education, income, and number of cigarettes smoked per day

initiated exclusively by physicians, could enhance the effectiveness of these modalities.

If other components of a comprehensive tobacco control program can be linked to physician advice and pharmacological assistance, it may be possible to provide the enhanced level of support and follow-up that characterized these interventions in the clinical trial setting as they are delivered to large segments of the population. When this was done within a large HMO setting, and when the barriers to accessing these modalities were reduced by lowering or eliminating the cost to the smoker, the cessation results were consistent with those achieved in clinical trials.¹⁹

Self-Help Materials and Media

Two common components of most comprehensive tobacco control programs are mass media and self-help materials. They share the ability to reach large numbers of individuals at relatively low cost. However, they also share the misconception that they are autonomous interventions in which the cessation goals are achieved simply by delivering self-help materials to smokers or having smokers exposed to media messages. Both of these tobacco control channels are just that: channels. They are methods by which other tobacco control interventions can be facilitated, reinforced, and publicized and by which agendas can be set; but in isolation, without integration into a more comprehensive approach to cessation, they have little effect.

What Works at the Population Level?

Any analytic approach is limited by the tools it uses and its perspective on the problem. We have chosen to utilize a set of measures of smoking cessation activity and success, and have linked them to various measures of policy and programmatic tobacco control interventions. These associations provide measures of the independent relationships between the exposure to a tobacco control intervention and a change in smoking behavior. These associations in turn provide useful insights into what components of tobacco control programs are working. However, this approach is less able to examine the interactions and synergies across these programmatic elements that may be critical for their success; and it has only the most limited ability to examine local

community programmatic activity, even though the important role that this activity plays in supporting individual interventions is acknowledged.

With these caveats in mind, what can be said about what works if the trans-theoretical model of smoking behavior change is used as a framework for examining population-based smoking cessation activity and success?²⁰ This model postulates that smokers cycle through stages in which they are disinterested in cessation, contemplate quitting, make a quit attempt, and are either successful or relapse to smoking. The relapse to smoking may be followed by a period of disinterest in cessation, or the smoker may think about making an additional cessation attempt. One concept of how various tobacco control interventions may work within this model is presented in Figure 5. In this figure, cessation influences are located based on the stage of this process that they are likely to influence, with internal personal characteristics presented inside the circle and external environmental influences presented outside the circle.

Individual components of a comprehensive tobacco control program may affect the process of cessation at different stages. Public information campaigns may get smokers to think about the need to quit; physician advice may trigger a cessation attempt; and working in a smoke-free environment may facilitate cessation once the attempt is made. An additional advantage of this formulation is that it facilitates identification of potential synergistic interactions among program components. For example, physician advice seems to have a significant impact on the likelihood of a smoker making a quit attempt, but little effect on long-term cessation; so as an isolated cessation intervention, it has little impact on smoking prevalence. But if the smokers who are attempting to quit can be linked to interventions predominantly affecting long-term success (e.g., telephone counseling, clinic-based cessation assistance, or pharmacological treatment), the net effect on long-term cessation is likely to be substantially greater than the sum of the effects of these interventions offered independently.

Public information about the risks of smoking, negative images about being a smoker, and physician warnings about the risk of smoking can all convert a smoker who is not interested in quitting into one who is considering a cessation attempt. The desire to set a good example for children and concern about being dependent on smoking are other reasons smokers give for wanting to quit. An acute illness also can often trigger cessation activity.

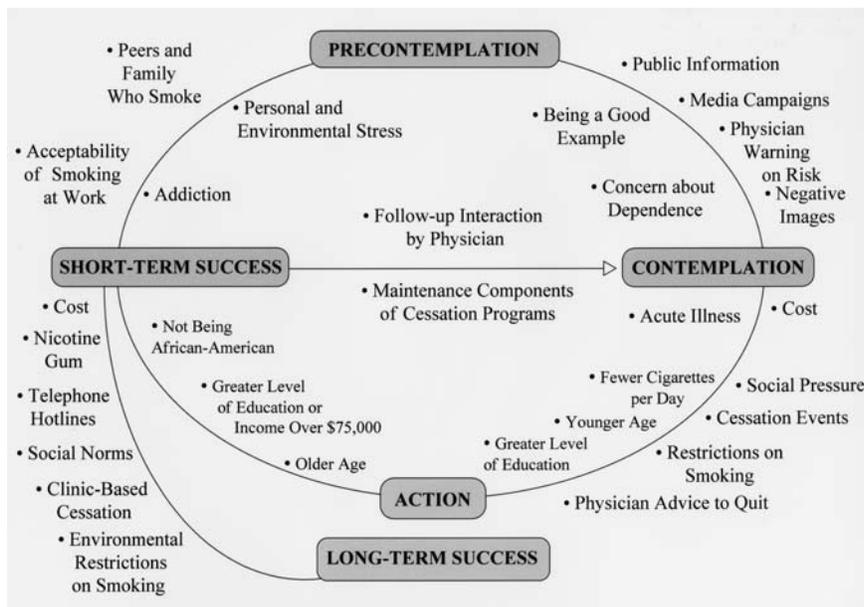


Figure 5. The process of cessation

Quantifying the Effect of Population-Based Cessation Interventions

Figure 6 presents a simplified model of cessation. The principal population-based interventions of physician advice and media campaigns affect cessation attempts, but these strategies have less of an effect on longer-term cessation success.

In contrast, restricting where smoking is allowed, increasing cost of cigarettes, pharmacological interventions, and comprehensive tobacco control campaigns seem to predominantly affect longer-term cessation success.

Table 1 presents these estimates for comprehensive tobacco control programs, physician advice, and a ban on smoking in the workplace. In addition, estimates are utilized for physician advice, increases in taxes, and use of medication. The purpose is to

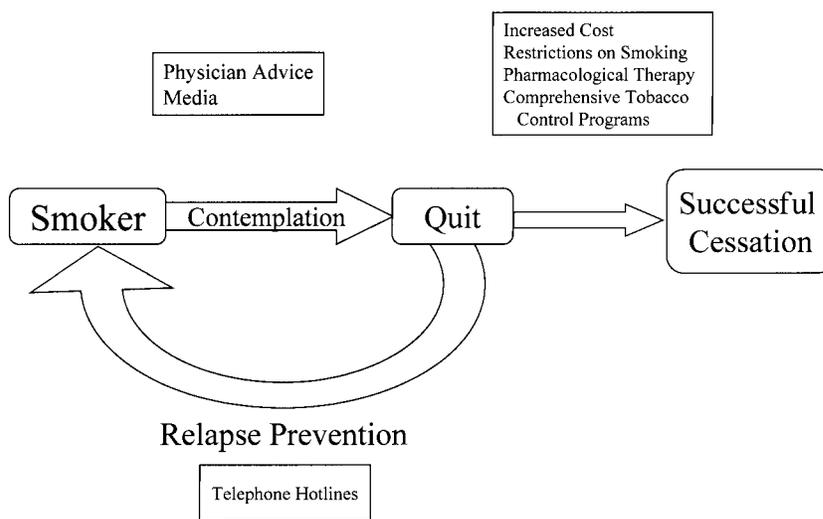


Figure 6. Population-based smoking cessation

provide a rough comparison of the effects on cessation across these modalities, with the understanding that effects presented for one intervention may contain direct and synergistic effects from other interventions. Therefore, the numbers presented are not mutually exclusive cessation effects.

In the United States, the Current Population Survey estimates that there are approximately 44 million smokers and about one-third of them (14 million) attempt to change their smoking behavior each year. Only 3.6 percent (about 1.5 million) are successful for three or more months.

The estimates in Table 1 for a comprehensive tobacco control program utilize the odds ratios for cessation attempts and cessation success lasting three or more months presented for the State of California compared to other states except Massachusetts.¹² The numbers are estimates of the difference in cessation produced by these two well-funded tobacco control programs compared to the remaining states. Since most other states also have substantial tobacco control efforts under way—funded by American Stop Smoking Intervention Study (ASSIST), Initiatives to Mobilize for the Prevention and Control of Tobacco Use (IMPACT), and other sources—these numbers underestimate the true effect of tobacco control campaigns. Further, they estimate only the increment in effect expected from the difference in intensity and funding between the programs in Massachusetts and California and those in remaining states. The column in the table labeled “potential effect” presents an estimate for the effect expected if all states adopted programs similar to those of California and Massachusetts. It would appear that tobacco control programs have a modest effect on the already high rate of cessation attempts among smokers, but a much

larger proportional effect on successful cessation lasting three or more months. If comprehensive tobacco control programs were implemented nationally, rates of successful cessation might be increased by one third, approaching 500,000 new successful quits.

Total bans on smoking (120,000 quits) and pharmacological interventions (150,000 quits) are the largest current contributions to successful cessation lasting three or more months. If all workplaces were smoke-free, the effect on cessation would increase by more than 100,000 quits of three months or longer per year, and if the success of pharmacological interventions in the general population matched that of clinical trials, an additional 350,000 quits of three months or longer might be achieved.

Physician advice to quit appears to have a significant effect on cessation attempts, but no effect on long-term cessation success as it is currently practiced in the general population. If the success of physician advice were comparable to that found in clinical trials, an additional 126,000 successful quits might be expected. This number represents a substantial number of quits, but only a small fraction of the increase in quit attempts promoted by this modality. In contrast, approximately 750,000 additional quits might be achieved if the health care delivery system were to deliver optimal cessation assistance to all of its insured population.

An increase in the cost of cigarettes could also increase both cessation attempts and cessation success, with a 20 percent increase in cost generating an additional 222,000 successful quits. The increase in cost of cigarettes (\$0.45 per pack) that may over time result from the Master Settlement Agreement of the state attorneys general lawsuits would be approximately a 20 percent increase in cost. If and when

Table 1. Current and potential impact of population-based smoking cessation interventions

	Cessation Attempt			Former 3+ Months			Conditions Required for Potential Effect
	Odds Ratio	Current Effect	Potential Effect	Odds Ratio	Current Effect	Potential Effect	
Comprehensive Tobacco Control Program	1.04	57,049	506,360	1.32	57,246	508,111	All States Have Tobacco Control Programs Comparable in Scope to California and Massachusetts
Advised by Physician to Quit	1.60	2,276,986	3,497,231	0.91	0	126,000	Effect of Physician Advice in the Real World Matches That in Trials (Odds ratio for cessation 1.2)
20% Increase in Cost			1,139,309			222,298	Cost Increases 20% from 1996 Values
Total Work Ban	1.09	312,112	576,918	1.34	119,828	221,493	All Workplaces Are Smoke Free
Medication					150,000	500,000	Effect of Medication in the Real World Matches That in Trials

this increase is translated into an actual change in the price of cigarettes to the smoker (that is, when the additional discounting that accompanied the increase in cost is no longer reducing the actual price paid by the consumer), this price increase may result in an increase in the number of cessation attempts and successful quits.

Summary

Approximately one half of current smokers have become former smokers. Most of this cessation has coincided with a forty-year effort to educate and inform smokers about the risks of smoking. Large media-led tobacco control programs also have coincided with increases in smoking cessation, suggesting that tobacco control approaches can alter smoking behavior. This paper presents evidence supporting the effects of restrictions on where people can smoke, increasing the cost of cigarettes, providing physician advice to quit coupled with cessation assistance, pharmacological assistance, and telephone hotlines can have on cessation among smokers in the general population. It also provides evidence that many of these interventions are being implemented in the general population in ways that are less effective than expected based on clinical trials. Increasing the effectiveness of these interventions, and linking multiple interventions to provide synergy, offers great opportunities to improve rates of population-based cessation.

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