

Smoking Cessation

A Report of the Surgeon General

Executive Summary



U.S. Department of Health and Human Services

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Message from Alex M. Azar II

Secretary, U.S. Department of Health and Human Services

Throughout its history, the U.S. Department of Health and Human Services (USDHHS) has led efforts to prevent and reduce the devastating effects of tobacco use, especially the use of combustible tobacco products, as part of its mission to enhance and protect the health and well-being of all Americans. USDHHS has provided critical support in the fields of research and evaluation, program and policy development, public information and education, regulatory activities, systems-level change and management, and clinical practices that has contributed to a dramatic 67% decline in cigarette smoking among U.S. adults since 1965. Support from USDHHS has helped medical and healthcare organizations, government agencies at all levels, and nongovernmental partners create and sustain programs that prevent initiation; help tobacco product users quit; and foster healthy, smokefree environments.

This report is the latest of a longstanding tradition of tobacco prevention and control efforts by USDHHS. Our work includes a comprehensive tobacco control strategic action plan, *Ending the Tobacco Epidemic*, and coordination of tobacco control efforts with related efforts by other federal agencies through the Interagency Committee on Smoking and Health. Reports such as this one from the U.S. Surgeon General give the latest data on tobacco and health to scientists, healthcare professionals, and the public. Research leadership and grant funding through USDHHS's National Institutes of Health contribute to growing knowledge of effective tobacco control strategies and smoking cessation tools. The National Tobacco Control Program, led by the Centers for Disease Control and Prevention (CDC), ensures that these strategies and tools are readily available to state, local, tribal, and territorial public health programs, as well as to partners serving a variety of populations that are disproportionately affected by tobacco use. The U.S. Food and Drug Administration (FDA) regulates the manufacturing, marketing, and sale of tobacco products. Medicare and Medicaid provide smoking cessation tools and support to millions of Americans. Multiple public information campaigns, such as CDC's *Tips From Former Smokers* and FDA's *Every Try Counts*, educate Americans about the significant health risks from smoking and the importance of quitting. Additionally, many agencies in USDHHS provide direct assistance to smokers, including the National Cancer Institute through its Smokefree.gov initiative (<https://smokefree.gov>), and national quitline portal, 1-800-QUIT-NOW.

These and other important efforts are critical to improving the nation's public health. Smoking kills nearly half a million Americans every year, and millions more live with serious chronic diseases caused by smoking. We know that comprehensive interventions at all levels of government and by partners throughout the public health community are extremely effective at preventing and reducing tobacco use. We remain committed to ending the tobacco use epidemic in the United States.

Foreword

Tobacco use remains the number one cause of preventable disease, disability, and death in the United States. Approximately 34 million American adults currently smoke cigarettes, with most of them smoking daily. Nearly all adult smokers have been smoking since adolescence. More than two-thirds of smokers say they want to quit, and every day thousands try to quit. But because the nicotine in cigarettes is highly addictive, it takes most smokers multiple attempts to quit for good.

Today, we know much more about the science of quitting than ever before. Research shows that smokers who use evidence-based tools to help them quit are more likely to succeed than those who do not use such tools, and that using a combination of these tools—for example, calling 1-800-QUIT-NOW and using nicotine replacement therapy, such as the nicotine patch or gum or a prescription medication—raises success rates even higher. Studies also show that policies that prohibit smoking in indoor public places and work spaces and that increase the price of tobacco products promote smoking cessation.

This Surgeon General's report

- Examines the effectiveness of various smoking cessation tools and resources;
- Reviews the health effects of smoking and catalogues the improvements to health that can occur when smokers quit;
- Highlights important new data on populations in which the prevalence of smoking is high and quit rates are low; and
- Identifies gaps in the availability and utilization of programs, policies, and resources that can improve cessation rates and help smokers quit.

Although the benefits of quitting are greater the earlier in life that an individual quits, this report confirms that it is never too late to quit smoking. Even persons who have smoked for many years or who have smoked heavily can realize health and financial benefits from quitting smoking.

The financial toll of smoking is substantial. Each year in the United States, annual healthcare spending attributed to smoking exceeds \$170 billion. Measured against these numbers, comprehensive tobacco prevention and control strategies are extremely cost-effective investments that yield significant returns. For example, the first year of CDC's *Tips From Former Smokers* national campaign prevented thousands of premature deaths in the United States, costing less than \$500 for every smoker who quit.

We know what works to prevent and reduce tobacco use, including how to best help smokers quit for good. Putting this knowledge into action prevents disease, saves lives, and improves the quality of life for all Americans. At CDC, we remain committed to supporting the longstanding national effort to end the tobacco use epidemic and provide all Americans with the opportunity to live tobacco-free.

Robert R. Redfield, M.D.
Director
Centers for Disease Control and Prevention

Preface

from the Surgeon General

One of the most significant public health successes in modern U.S. history has been the reduction in smoking that has occurred during the past half century. Today, the prevalence of cigarette smoking among American adults is at an all-time low, 14%. Although this overall achievement is a source of pride, there is still more work to be done. Today, 16 million Americans are living with a smoking-related disease. In addition to the human costs, smoking places a significant financial burden on Americans, as smoking-attributable healthcare spending exceeds \$170 billion per year.

Research, medical advances, and years of documented experience have given us many tools to tackle the tobacco use epidemic in this country. Although quitting smoking can be a difficult process for many smokers, most say they want to quit, and every year more than half make a serious quit attempt. But only a small portion of smokers who try to quit succeed, and only a small portion use any of the tested and proven aids that will significantly increase their chances of success. This Surgeon General's report on smoking cessation, the 34th report on smoking and health since 1964, examines the most current research on this important issue, identifies barriers to continued success in reducing the prevalence of smoking across all populations, and summarizes evidence-based solutions that can help to eliminate those barriers.

Clinical interventions for smoking cessation are critical if we are to achieve our goal of eliminating the devastating effects of smoking on public health. Primary care physicians, nurses, pharmacists, and other providers in all medical disciplines and in all healthcare environments should take advantage of these opportunities to inform and encourage smokers to quit. Doing so could enable half a million smokers to quit each year.

As a physician, I am acutely aware of the many pressing demands that healthcare providers must address to deliver the highest quality care possible to their patients. At the same time, the evidence in this report clearly points to the tremendous positive impact that healthcare professionals can have on the health and quality of life of their patients and on the public health of our nation—just by helping smokers to quit.

But healthcare professionals alone cannot solve this public health challenge. Everyone has a role in helping to continue to reduce the burden of tobacco use on our society. It is critical that clinical interventions be adopted alongside broader efforts at the health system and population levels to promote and cultivate successful cessation and tobacco-free norms. Even today, with all the gains that have been made over the past few decades, smoking remains the single largest cause of preventable disease and death in the United States. As a nation, we can and must spare no effort to reduce the completely preventable health and financial costs that tobacco smoking has on society.

Jerome M. Adams, M.D., M.P.H.
Vice Admiral, U.S. Public Health Service
Surgeon General of the United States

Overview

Tobacco smoking is the leading cause of preventable disease, disability, and death in the United States (U.S. Department of Health and Human Services [USDHHS] 2014). Smoking harms nearly every organ in the body and costs the United States billions of dollars in direct medical costs each year (USDHHS 2014). Although considerable progress has been made in reducing cigarette smoking since the first U.S. Surgeon General's report was released in 1964 (USDHHS 2014), in 2018, 13.7% of U.S. adults (34.2 million people) were still current cigarette smokers (Creamer et al. 2019). One of the main reasons smokers keep smoking is nicotine (USDHHS 1988). Nicotine, a drug found naturally in the tobacco plant, is highly addictive, as with such drugs as cocaine and heroin; activates the brain's reward circuits; and reinforces repeated nicotine exposure (USDHHS 1988, 2010, 2014; National Institute on Drug Abuse 2018).

The majority of cigarette smokers (68%) want to quit smoking completely (Babb et al. 2017). The 1990 Surgeon General's report, *The Health Benefits of Smoking Cessation*, was the last Surgeon General's report to focus on current research on smoking cessation and to predominantly review the health benefits of quitting smoking (USDHHS 1990). Because of limited data at that time, the 1990 report did not review the determinants, processes, or outcomes of attempts at smoking cessation. Pharmacotherapy for smoking cessation was not introduced until the 1980s. Additionally, behavioral and other counseling approaches were slow to develop and not widely available at the time of the 1990 report because few were covered under health insurance, and programs such as group counseling sessions were hard for smokers to access, even by those who were motivated to quit (Fiore et al. 1990).

The purpose of this report is to update and expand the 1990 Surgeon General's report based on new scientific evidence on smoking cessation. Since 1990, the scientific literature has expanded greatly on the determinants and processes of smoking cessation, informing the development of interventions that promote cessation and help smokers quit (Fiore et al. 2008; Schlam and Baker 2013). This knowledge and other major developments have transformed the landscape of smoking cessation in the United States. This report summarizes this enhanced knowledge and specifically reviews patterns and trends of smoking cessation; biologic mechanisms; various health benefits; overall morbidity, mortality, and economic benefits; interventions; and policies that promote smoking cessation.

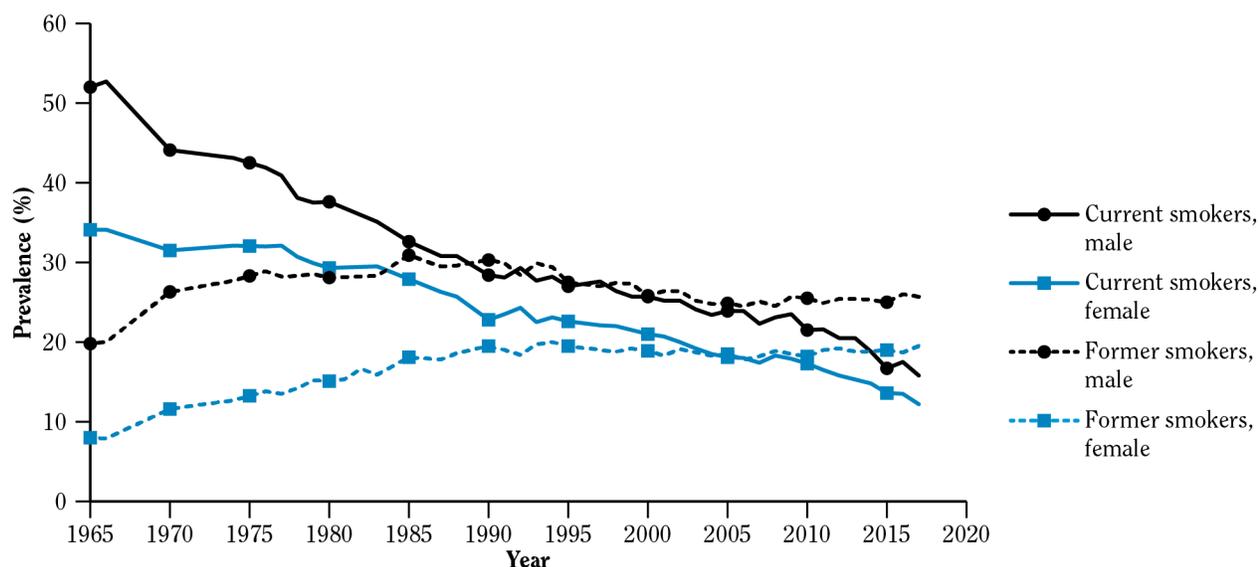
From 1965 to 2017, the prevalence of current smoking declined from 52.0% to 15.8% (relative percent change: 69.6%) among men and from 34.1% to

12.2% (relative percent change: 64.2%) among women (Figure ES.1). These declines have been attributed, in part, to progress made in smoking cessation since the 1960s, which has continued since the 1990 Surgeon General's report. Specifically, clinical, scientific, and public health communities have increasingly embraced and acted upon the concept of tobacco use and dependence as a health condition that can benefit from treatment in various forms and levels of intensity. Accordingly, a considerable range of effective pharmacologic and behavioral smoking cessation treatment options are now available. As of October 16, 2019, the U.S. Food and Drug Administration (FDA) has approved five nicotine replacement therapies (NRTs) and two non-nicotine oral medications to help smokers quit, and the use of these treatments has expanded, including stronger integration with counseling support (Fiore et al. 2008).

In addition, the reach of smoking cessation interventions has increased substantially since 1990 with the emergence of innovative, population-level interventions and policies that motivate smokers to quit and raise awareness of the health benefits of smoking cessation (McAfee et al. 2013). This includes policies, such as comprehensive smokefree laws, that have been shown to promote cessation at the population level in addition to reducing exposure to secondhand smoke (USDHHS 2014). The development and subsequent expansion of telephone call centers ("quitlines"), mobile phone technologies, Internet-based applications, and other innovations have created novel platforms to provide behavioral and pharmacologic smoking cessation treatments (Ghorai et al. 2014). However, the continued diversification of the tobacco product landscape could have several different potential impacts, ranging from accelerating the rates of complete cessation among adult smokers to erasing progress in reducing all forms of use of tobacco products, especially among youth and young adults. For example, the increasing availability and rapidly increasing use of novel tobacco products, most notably e-cigarettes, raise questions about the potential impact that such products could have on efforts to eliminate disease and death caused by tobacco use at the individual and population levels. Therefore, when considering the impact of e-cigarettes on public health, it is critical to evaluate their effects on adults and youth.

Collectively, the changes cited in this report provide new opportunities and challenges for understanding and promoting smoking cessation in the United States. However, the extensive body of evidence-based clinical, health system, and population-based tobacco prevention, control, and cessation strategies that are outlined in this report are a necessary but insufficient means to

Figure ES.1 Trends in prevalence (%) of current and former cigarette smoking among adults 18 years of age and older, by sex; National Health Interview Survey (NHIS) 1965–2017; United States



Source: NHIS, National Center for Health Statistics, public use data, 1965–2017.

Note: From 1965 to 2017, data were reported for the following years: 1965, 1966, 1970, 1974, 1976–1980, 1983, 1985, 1987, 1988, 1990–1995, and 1997–2017.

end the tobacco epidemic. Reaching the finish line will require coordination across federal government agencies and other government and non-government stakeholders

at the national, state, and local levels. To achieve success, we must work together to maximize resources and coordinate efforts across a wide range of stakeholders.

Major Conclusions of the Report

1. Smoking cessation is beneficial at any age. Smoking cessation improves health status and enhances quality of life.
2. Smoking cessation reduces the risk of premature death and can add as much as a decade to life expectancy.
3. Smoking places a substantial financial burden on smokers, healthcare systems, and society. Smoking cessation reduces this burden, including smoking-attributable healthcare expenditures.
4. Smoking cessation reduces risk for many adverse health effects, including reproductive health outcomes, cardiovascular diseases, chronic obstructive pulmonary disease, and cancer. Quitting smoking is also beneficial to those who have been diagnosed with heart disease and chronic obstructive pulmonary disease.
5. More than three out of five U.S. adults who have ever smoked cigarettes have quit. Although a majority of cigarette smokers make a quit attempt each year, less than one-third use cessation medications approved by the U.S. Food and Drug Administration or behavioral counseling to support quit attempts.
6. Considerable disparities exist in the prevalence of smoking across the U.S. population, with higher prevalence in some subgroups. Similarly, the prevalence of key indicators of smoking cessation—quit attempts, receiving advice to quit from a health professional, and using cessation therapies—also varies across the population, with lower prevalence in some subgroups.
7. Smoking cessation medications approved by the U.S. Food and Drug Administration and behavioral counseling are cost-effective cessation strategies. Cessation medications approved by the U.S. Food and Drug Administration and behavioral counseling

increase the likelihood of successfully quitting smoking, particularly when used in combination. Using combinations of nicotine replacement therapies can further increase the likelihood of quitting.

8. Insurance coverage for smoking cessation treatment that is comprehensive, barrier-free, and widely promoted increases the use of these treatment services, leads to higher rates of successful quitting, and is cost-effective.
9. E-cigarettes, a continually changing and heterogeneous group of products, are used in a variety

of ways. Consequently, it is difficult to make generalizations about efficacy for cessation based on clinical trials involving a particular e-cigarette, and there is presently inadequate evidence to conclude that e-cigarettes, in general, increase smoking cessation.

10. Smoking cessation can be increased by raising the price of cigarettes, adopting comprehensive smoke-free policies, implementing mass media campaigns, requiring pictorial health warnings, and maintaining comprehensive statewide tobacco control programs.

Preparation of the Report

This Surgeon General's report was prepared by the Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention (CDC), which is part of USDHHS. This report was compiled using a longstanding, peer-reviewed, balanced, and comprehensive process designed to safeguard the scientific rigor and practical relevance from influences that could adversely affect impartiality (King et al. 2018). This process helps to ensure that the report's conclusions are defined by the evidence, rather than the opinions of the authors and editors. In brief, under the leadership of a senior scientific editorial team, 32 experts wrote the initial drafts of the chapters. The experts were selected for their knowledge of the topics addressed. These contributions, which are summarized in Chapters 1–7, were evaluated by 46 peer reviewers. After this initial stage of peer review, more than 20 senior scientists and other

experts examined the scientific integrity of the entire manuscript as part of a second stage of peer review. After each round of peer review, the report's scientific editors revised each draft based on reviewers' comments. Chapter 8, which summarizes and is founded upon the preceding content in the report, was written by the senior scientific editorial team once the content in Chapters 1–7 completed peer review. Subsequently, the report was reviewed by various institutes and agencies in the U.S. Government, including USDHHS. Throughout the review process, the content of each chapter was revised to include studies and information that were not available when the chapters were first drafted; updates were made until shortly before the report was submitted for publication. These updates reflect the full scope of identified evidence, including new findings that confirm, refute, or refine the initial content. Conclusions are based on the preponderance and quality of scientific evidence.

Scientific Basis of the Report

The statements and conclusions throughout this report are based on an extensive review of the existing scientific literature. Thus, the report primarily focuses on cessation in the context of adults because this is the population for which the preponderance of scientific literature exists on this topic; however, data on youth and young adults are also presented, when available. The report primarily cites peer-reviewed journal articles, including reviews that integrate findings from numerous studies and books that were published between 2000 and 2018, which reflects the period after the last Surgeon General's report on the topic of cessation. This report also refers, on occasion, to unpublished research, such as presentations at professional meetings, personal communications from researchers, and

information available in various media. These references are used when acknowledged by the editors and reviewers as being scientifically valid and reliable, and a critical addition to the emerging literature on a topic. Throughout the writing and review process, highest priority was given to peer-reviewed, scientific research that is free from tobacco industry interests. As noted in the 2014 Surgeon General's report, the tobacco industry has a well-documented record of manipulating scientific information about the extent of the harms from cigarette smoking (USDHHS 2014).

Following the model of the 1964 report, this Surgeon General's report includes comprehensive compilations of the evidence on smoking cessation. The evidence is analyzed to identify causal associations according

to enunciated principles, sometimes referred to as the “Surgeon General’s criteria” or the “Hill” criteria (after Sir Austin Bradford Hill) for causality. The criteria, offered in Chapter 3 of the 1964 report, included

- Consistency of the association,
- Strength of the association,
- Specificity of the association,
- Temporal relationship of the association, and
- Coherence of the association (U.S. Department of Health, Education, and Welfare [USDHEW] 1964, p. 20).

In the 2004 Surgeon General’s report (USDHHS 2004), the framework for interpreting evidence on smoking and health was revisited in depth for the first time since the 1964 report. The 2004 report provided a four-level hierarchy of categories for interpreting evidence, and this current report follows the same model:

- a. “Evidence is **sufficient** to infer a causal relationship.
- b. Evidence is **suggestive but not sufficient** to infer a causal relationship.
- c. Evidence is **inadequate** to infer the presence or absence of a causal relationship (which encompasses evidence that is sparse, of poor quality, or conflicting).
- d. Evidence is **suggestive of no causal relationship**” (USDHHS 2004, p. 18).

Answers to several questions helped to guide judgment toward these categories:

- Do multiple high-quality studies show a consistent association between smoking and disease?
- Are the measured effects large enough and statistically strong?
- Does the evidence show that smoking occurs before the disease occurs (a temporal association)?
- Is the relationship between smoking and disease coherent or plausible in terms of known scientific principles, biologic mechanisms, and observed patterns of disease?
- Is there a dose-response relationship between smoking and disease?
- Is the risk of disease reduced after quitting smoking?

The categories acknowledge that evidence can be “suggestive but not sufficient” to infer a causal relationship, and the categories allow for evidence that is “suggestive of no causal relationship.” This framework also separates conclusions regarding causality from the implications of such conclusions. Inference is sharply and completely separated from policy or research implications of the conclusions, thus adhering to the approach established in the 1964 report. However, consistent with past Surgeon General’s reports on tobacco, conclusions are not limited to just causal determinations and frequently include recommendations for research, policies, or other actions.

Chapter Summaries and Conclusions

Chapter 2: Patterns of Smoking Cessation Among U.S. Adults, Young Adults, and Youth

Chapter 2 documents key patterns and trends in cigarette smoking cessation in the United States among adults overall (persons 18 years of age and older), young adults (18–24 years of age), and youth (12–17 years of age). The chapter also reviews the changing demographic and smoking-related characteristics of cigarette smokers, with a focus on how these changes may influence future trends in cessation.

This chapter also describes persistent disparities in cessation by age, race/ethnicity, level of education, type of health insurance, and other demographic characteristics. The chapter highlights trends and recent findings for several different measures, including the quit ratio (the proportion of ever smokers who are former smokers); recent successful cessation; past-year quit attempts; interest in quitting; receipt of cessation advice from healthcare professionals; and use of effective cessation strategies, such as behavioral counseling and medication. As with previous Surgeon General’s reports, the chapter focuses primarily on cigarette smoking (USDHHS 1990, 2014); however, given the shifting patterns of tobacco product use in the

United States, it also touches on cessation as it relates to all tobacco products.

Conclusions

1. In the United States, more than three out of every five adults who were ever cigarette smokers have quit smoking.
2. Past-year quit attempts and recent and longer term cessation have increased over the past 2 decades among adult cigarette smokers.
3. Marked disparities in cessation behaviors, such as making a past-year quit attempt and achieving recent successful cessation, persist across certain population subgroups defined by educational attainment, poverty status, age, health insurance status, race/ethnicity, and geography.
4. Advice from health professionals to quit smoking has increased since 2000; however, four out of every nine adult cigarette smokers who saw a health professional during the past year did not receive advice to quit.
5. Use of evidence-based cessation counseling and/or medications has increased among adult cigarette smokers since 2000; however, more than two-thirds of adult cigarette smokers who tried to quit during the past year did not use evidence-based treatment.
6. A large proportion of adult smokers report using non-evidence-based approaches when trying to quit smoking, such as switching to other tobacco products.

Chapter 3: New Biological Insights into Smoking Cessation

Chapter 3 focuses on how biology can influence smoking cessation and reviews four areas of intensive research since the publication of the 2010 Surgeon General's report: (1) cell and molecular biology of nicotine addiction; (2) vaccines and other immunotherapies as treatments for tobacco addiction; (3) insights into smoking cessation from the field of neurobiology; and (4) genetic studies of smoking phenotypes.

The biological mechanisms underlying nicotine addiction continue to be a subject of great research interest, and several promising pharmacotherapeutic targets have emerged. For example, acquisition of basic knowledge about the function of nicotinic acetylcholine receptors (nAChRs) led to the development of targeted

smoking cessation medications currently in use, and research would benefit from an additional understanding of molecular mechanisms (USDHHS 2010). The 2010 Surgeon General's report, *How Tobacco Smoke Causes Disease—The Biology and Behavioral Basis for Smoking-Attributable Disease*, described the pharmacokinetics of nicotine, the behavioral pharmacology of nicotine addiction, and the known genotypes and receptor subtypes that contribute to nicotine addiction (USDHHS 2010).

Conclusions

1. The evidence is suggestive but not sufficient to infer that increasing glutamate transport can alleviate nicotine withdrawal symptoms and prevent relapse.
2. The evidence is suggestive but not sufficient to infer that neuropeptide systems play a role in multiple stages of the nicotine addiction process, and that modulating the function of certain neuropeptides can reduce smoking behavior in humans.
3. The evidence is suggestive but not sufficient to infer that targeting the habenulo-interpeduncular pathway with agents that increase the aversive properties of nicotine are a useful therapeutic target for smoking cessation.
4. The evidence is suggestive but not sufficient to infer that vaccines generating adequate levels of nicotine-specific antibodies can block the addictive effects of nicotine and aid smoking cessation.
5. The evidence is suggestive but not sufficient to infer that dysregulated brain circuits, including prefrontal and cingulate cortical regions and their connections with various striatal and insula loci, can serve as novel therapeutic targets for smoking cessation.
6. The evidence is suggestive but not sufficient to infer that the effectiveness of nicotine replacement therapy may vary across specific genotype groups.

Chapter 4: The Health Benefits of Smoking Cessation

Chapter 4 reviews the findings on disease risks from smoking and how these risks change after smoking cessation for major types of chronic diseases, including cancer, the cardiovascular and respiratory systems, and a wide range of reproductive outcomes. The more recent studies expand the observational evidence documenting

the benefits of smoking cessation and provide insights into the mechanisms underlying these benefits. The review of smoking cessation and reproductive outcomes documents health benefits of maternal smoking cessation across all phases of reproduction, from preconception to birth and also for male reproductive health.

This chapter also addresses the clinically relevant benefits of cessation for mitigating the effects of diseases, particularly in persons with cancer and coronary heart disease. This general topic received mention in previous Surgeon General's reports (USDHHS 1982, 1983, 1990, 2004), and the consequences of smoking following a diagnosis of cancer received specific attention in the 2014 Surgeon General's report, leading to a conclusion that cigarette smoking has adverse causal effects on persons already diagnosed with cancer (USDHHS 2014). This chapter also reviews cessation and cardiovascular disease and the implications of cessation for the natural history of chronic obstructive pulmonary disease.

Conclusions

Cancer

1. The evidence is sufficient to infer that smoking cessation reduces the risk of lung cancer.
2. The evidence is sufficient to infer that smoking cessation reduces the risk of laryngeal cancer.
3. The evidence is sufficient to infer that smoking cessation reduces the risk of cancers of the oral cavity and pharynx.
4. The evidence is sufficient to infer that smoking cessation reduces the risk of esophageal cancer.
5. The evidence is sufficient to infer that smoking cessation reduces the risk of pancreatic cancer.
6. The evidence is sufficient to infer that smoking cessation reduces the risk of bladder cancer.
7. The evidence is sufficient to infer that smoking cessation reduces the risk of stomach cancer.
8. The evidence is sufficient to infer that smoking cessation reduces the risk of colorectal cancer.
9. The evidence is sufficient to infer that smoking cessation reduces the risk of liver cancer.
10. The evidence is sufficient to infer that smoking cessation reduces the risk of cervical cancer.

11. The evidence is sufficient to infer that smoking cessation reduces the risk of kidney cancer.
12. The evidence is sufficient to infer that smoking cessation reduces the risk of acute myeloid leukemia.
13. The evidence is sufficient to infer that the relative risk of lung cancer decreases steadily after smoking cessation compared with the risk for persons continuing to smoke, with risk decreasing to half that of continuing smokers approximately 10–15 years after smoking cessation and decreasing further with continued cessation.

Smoking Cessation After a Cancer Diagnosis

1. The evidence is suggestive but not sufficient to infer a causal relationship between smoking cessation and improved all-cause mortality in cancer patients who are current smokers at the time of a cancer diagnosis.

Cardiovascular Disease

1. The evidence is sufficient to infer that smoking cessation reduces levels of markers of inflammation and hypercoagulability and leads to rapid improvement in the level of high-density lipoprotein cholesterol.
2. The evidence is sufficient to infer that smoking cessation leads to a reduction in the development of subclinical atherosclerosis, and that progression slows as time since cessation lengthens.
3. The evidence is sufficient to infer that smoking cessation reduces the risk of cardiovascular morbidity and mortality and the burden of disease from cardiovascular disease.
4. The evidence is sufficient to infer that the relative risk of coronary heart disease among former smokers compared with never smokers falls rapidly after cessation and then declines more slowly.
5. The evidence is sufficient to infer that smoking cessation reduces the risk of stroke morbidity and mortality.
6. The evidence is sufficient to infer that, after smoking cessation, the risk of stroke approaches that of never smokers.
7. The evidence is suggestive but not sufficient to infer that smoking cessation reduces the risk of atrial fibrillation.

8. The evidence is suggestive but not sufficient to infer that smoking cessation reduces the risk of sudden cardiac death among persons without coronary heart disease.
9. The evidence is suggestive but not sufficient to infer that smoking cessation reduces the risk of heart failure among former smokers compared with persons who continue to smoke.
10. Among patients with left-ventricular dysfunction, the evidence is suggestive but not sufficient to infer that smoking cessation leads to increased survival and reduced risk of hospitalization for heart failure.
11. The evidence is suggestive but not sufficient to infer that smoking cessation reduces the risk of venous thromboembolism.
12. The evidence is suggestive but not sufficient to infer that smoking cessation substantially reduces the risk of peripheral arterial disease among former smokers compared with persons who continue to smoke, and that this reduction appears to increase with time since cessation.
13. The evidence is suggestive but not sufficient to infer that, among patients with peripheral arterial disease, smoking cessation improves exercise tolerance, reduces the risk of amputation after peripheral artery surgery, and increases overall survival.
14. The evidence is sufficient to infer that smoking cessation substantially reduces the risk of abdominal aortic aneurysm in former smokers compared with persons who continue to smoke, and that this reduction increases with time since cessation.
15. The evidence is suggestive but not sufficient to infer that smoking cessation slows the expansion rate of abdominal aortic aneurysm.

Smoking Cessation After a Diagnosis of Coronary Heart Disease

1. In patients who are current smokers when diagnosed with coronary heart disease, the evidence is sufficient to infer a causal relationship between smoking cessation and a reduction in all-cause mortality.
2. In patients who are current smokers when diagnosed with coronary heart disease, the evidence is sufficient to infer a causal relationship between

smoking cessation and reductions in deaths due to cardiac causes and sudden death.

3. In patients who are current smokers when diagnosed with coronary heart disease, the evidence is sufficient to infer a causal relationship between smoking cessation and reduced risk of new and recurrent cardiac events.

Chronic Respiratory Disease

Chronic Obstructive Pulmonary Disease

1. Smoking cessation remains the only established intervention to reduce loss of lung function over time among persons with chronic obstructive pulmonary disease and to reduce the risk of developing chronic obstructive pulmonary disease in cigarette smokers.
2. The evidence is suggestive but not sufficient to infer that airway inflammation in cigarette smokers persists months to years after smoking cessation.
3. The evidence is suggestive but not sufficient to infer that changes in gene methylation and profiles of proteins occur after smoking cessation.
4. The evidence is inadequate to infer the presence or absence of a relationship between smoking cessation and changes in the lung microbiome.

Asthma

1. The evidence is suggestive but not sufficient to infer that smoking cessation reduces asthma symptoms and improves treatment outcomes and asthma-specific quality-of-life scores among persons with asthma who smoke.
2. The evidence is suggestive but not sufficient to infer that smoking cessation improves lung function among persons with asthma who smoke.

Reproductive Health

1. The evidence is sufficient to infer that smoking cessation by pregnant women benefits their health and that of their fetuses and newborns.
2. The evidence is inadequate to infer that smoking cessation before or during early pregnancy reduces the risk of placental abruption compared with continued smoking.
3. The evidence is inadequate to infer that smoking cessation before or during pregnancy reduces the

risk of placenta previa compared with continued smoking.

4. The evidence is inadequate to infer that smoking cessation before or during pregnancy reduces the risk of premature rupture of the membranes compared with continued smoking.
5. The evidence is inadequate to infer that smoking during early or mid-pregnancy alone, and not during late pregnancy, is associated with a reduced risk of preeclampsia.
6. The evidence is sufficient to infer that women who quit smoking before or during pregnancy gain more weight during gestation than those who continue to smoke.
7. The evidence is suggestive but not sufficient to infer that women who quit smoking before or during pregnancy gain more weight during gestation than nonsmokers.
8. The evidence is inadequate to infer that smoking cessation during pregnancy increases the risk of gestational diabetes.
9. The evidence is sufficient to infer that smoking cessation during pregnancy reduces the effects of smoking on fetal growth and that quitting smoking early in pregnancy eliminates the adverse effects of smoking on fetal growth.
10. The evidence is inadequate to determine the gestational age before which smoking cessation should occur to eliminate the effects of smoking on fetal growth.
11. The evidence is sufficient to infer that smoking cessation before or during early pregnancy reduces the risk for a small-for-gestational-age birth compared with continued smoking.
12. The evidence is suggestive but not sufficient to infer that women who quit smoking before conception or during early pregnancy have a reduced risk of preterm delivery compared with women who continue to smoke.
13. The evidence is suggestive but not sufficient to infer that the risk of preterm delivery in women who quit smoking before or during early pregnancy does not differ from that of nonsmokers.
14. The evidence is inadequate to infer that smoking cessation during pregnancy reduces the risk of stillbirth.
15. The evidence is inadequate to infer that smoking cessation during pregnancy reduces the risk of perinatal mortality among smokers.
16. The evidence is inadequate to infer that women who quit smoking before or during early pregnancy have a reduced risk for infant mortality compared with continued smokers.
17. The evidence is inadequate to infer an association between smoking cessation, the timing of cessation, and female fertility or fecundity.
18. The evidence is suggestive but not sufficient to infer that smoking cessation reduces the risk of earlier age at menopause compared with continued smoking.
19. The evidence is inadequate to infer that smoking cessation reduces the effects of smoking on male fertility and sperm quality.
20. The evidence is suggestive but not sufficient to infer that former smokers are at increased risk of erectile dysfunction compared with never smokers.
21. The evidence is inadequate to infer that smoking cessation reduces the risk of erectile dysfunction compared with continued smoking.

Chapter 5: The Benefits of Smoking Cessation on Overall Morbidity, Mortality, and Economic Costs

Chapter 5 considers broad indicators of burden in relation to smoking cessation, including morbidity, mortality, and economic costs. General measures of health can be informative because they provide an integrative indicator of the health burden placed on smokers and on society overall. Initially, the chapter considers how general indicators of health can change after smoking cessation. This type of information is critical to informing smokers about the potential benefits of cessation and serves as a strong rationale to provide interventions that can help increase the success of quitting smoking. Such programs may be offered through healthcare organizations, communities, states, and other organizations. Smoking is known to generate healthcare and other economic costs and to affect the economics of the households of smokers (USDHHS 2014).

In addition to the direct human costs that smoking places on persons and society, one general measure with acknowledged implications for public health policy and practice is the economic cost of smoking. Previous Surgeon General's reports on tobacco have periodically reviewed the economic costs of smoking, as tracked by CDC's Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC) model. This chapter expands on this work by focusing on the most recently available scientific literature on the economic benefits of smoking cessation, while also complementing the kinds of cost estimates previously provided by SAMMEC.

Conclusions

1. The evidence is sufficient to infer that smoking cessation improves well-being, including higher quality of life and improved health status.
2. The evidence is sufficient to infer that smoking cessation reduces mortality and increases the lifespan.
3. The evidence is sufficient to infer that smoking exacts a high cost for smokers, healthcare systems, and society.
4. The evidence is sufficient to infer that smoking cessation interventions are cost-effective.

Chapter 6: Interventions for Smoking Cessation and Treatments for Nicotine Dependence

Chapter 6 reviews both evidence-based and emerging treatments for smoking cessation. A large body of evidence highlights the efficacy of multiple treatments that can double or triple the rate of success in quitting smoking (Fiore et al. 2008; Prochaska and Benowitz 2016). Specifically, current evidence-based treatment approaches to smoking cessation include several behavioral treatments—such as individual, group, and telephone counseling—and seven pharmacotherapies approved by FDA. These treatments have been shown to be effective when delivered across a wide variety of settings, via several platforms, and to a diversity of populations—including groups that have been disproportionately impacted by tobacco use, such as low-income populations, and populations with other comorbid medical conditions, including behavioral health conditions (U.S. Preventive Services Task Force 2015).

This chapter also highlights key topics and developments associated with the content and delivery of smoking cessation interventions, with a focus on emerging evidence

that can inform future smoking cessation efforts. Promising directions include leveraging emerging technologies to enhance the sustained engagement of smokers in cessation treatment, accelerating the integration of cessation services across multiple platforms and within healthcare systems, and developing new tobacco cessation medications and new indications for existing cessation medications.

Conclusions

1. The evidence is sufficient to infer that behavioral counseling and cessation medication interventions increase smoking cessation compared with self-help materials or no treatment.
2. The evidence is sufficient to infer that behavioral counseling and cessation medications are independently effective in increasing smoking cessation, and even more effective when used in combination.
3. The evidence is sufficient to infer that proactive quit-line counseling, when provided alone or in combination with cessation medications, increases smoking cessation.
4. The evidence is sufficient to infer that short text message services about cessation are independently effective in increasing smoking cessation, particularly if they are interactive or tailored to individual text responses.
5. The evidence is sufficient to infer that web or Internet-based interventions increase smoking cessation and can be more effective when they contain behavior change techniques and interactive components.
6. The evidence is inadequate to infer that smartphone apps for smoking cessation are independently effective in increasing smoking cessation.
7. The evidence is sufficient to infer that combining short- and long-acting forms of nicotine replacement therapy increases smoking cessation compared with using single forms of nicotine replacement therapy.
8. The evidence is suggestive but not sufficient to infer that pre-loading (e.g., initiating cessation medication in advance of a quit attempt), especially with the nicotine patch, can increase smoking cessation.
9. The evidence is suggestive but not sufficient to infer that very-low-nicotine-content cigarettes can reduce smoking and nicotine dependence and increase

smoking cessation when full-nicotine cigarettes are readily available; the effects on cessation may be further strengthened in an environment in which conventional cigarettes and other combustible tobacco products are not readily available.

10. The evidence is inadequate to infer that e-cigarettes, in general, increase smoking cessation. However, the evidence is suggestive but not sufficient to infer that the use of e-cigarettes containing nicotine is associated with increased smoking cessation compared with the use of e-cigarettes not containing nicotine, and the evidence is suggestive but not sufficient to infer that more frequent use of e-cigarettes is associated with increased smoking cessation compared with less frequent use of e-cigarettes.
11. The evidence is sufficient to infer that certain life events—including hospitalization, surgery, and lung cancer screening—can trigger attempts to quit smoking, uptake of smoking cessation treatment, and smoking cessation.
12. The evidence is suggestive but not sufficient to infer that fully and consistently integrating standardized, evidence-based smoking cessation interventions into lung cancer screening increases smoking cessation while avoiding potential adverse effects of this screening on cessation outcomes.
13. The evidence is suggestive but not sufficient to infer that cytisine increases smoking cessation.

Chapter 7: Clinical-, System-, and Population-Level Strategies that Promote Smoking Cessation

Chapter 7 focuses on broad strategies that can facilitate the integration of individual components of treatment for smoking cessation, as discussed in Chapter 6, into routine clinical care—making cessation interventions available and accessible to individual smokers and creating conditions whereby smokers become aware of these interventions and are motivated to use them.

Clinical-, system-, and population-level strategies can broadly influence the behavior of smokers as they try to quit or think about quitting smoking. Actions taken at the clinical and health system levels typically target quitting behavior directly and generally focus on the use or effectiveness of treatments for smoking cessation. These actions include implementing policies that transform systems of

care to better address tobacco use and dependence; promoting evidence-based treatments for tobacco cessation; and enacting policies that are clinically focused, address health insurance coverage, and promote cessation. In contrast, population-based strategies are aimed at influencing tobacco cessation at a macro level by motivating smokers to quit and by providing an environment that supports or simplifies efforts to quit or lowers barriers to quitting that smokers might encounter. Population-based strategies include increasing the price of and/or the tax on cigarettes and other tobacco products; restricting where tobacco can be used by implementing smokefree and tobacco-free policies; adequately funding tobacco control programs at the state level; carrying out mass media campaigns (CDC 2018; FDA 2018) making changes to the tobacco retail density and point-of-sale environments; and developing product regulations, including regulating nicotine content and requiring pictorial health warnings. Importantly, combining clinical and health system-based and macro-level strategies can have a synergistic effect on improving cessation outcomes.

This chapter does not attempt to provide a review of all tobacco control policy actions that may result in smokers attempting to quit or that may increase quit success outside the context of cessation treatment interventions; these have been covered comprehensively in previous Surgeon General's reports, including the 50th anniversary report, *The Health Consequences of Smoking—50 Years of Progress* (USDHHS 2014), as well as in other documents (National Cancer Institute and World Health Organization 2017; World Health Organization 2019).

Conclusions

1. The evidence is sufficient to infer that the development and dissemination of evidence-based clinical practice guidelines increase the delivery of clinical interventions for smoking cessation.
2. The evidence is sufficient to infer that with adequate promotion, comprehensive, barrier-free, evidence-based cessation insurance coverage increases the availability and utilization of treatment services for smoking cessation.
3. The evidence is sufficient to infer that strategies that link smoking cessation-related quality measures with payments to clinicians, clinics, or health systems increase the rate of delivery of clinical treatments for smoking cessation.
4. The evidence is sufficient to infer that tobacco quitlines are an effective population-based approach to motivate quit attempts and increase smoking cessation.

5. The evidence is suggestive but not sufficient to infer that electronic health record technology increases the rate of delivery of smoking cessation treatments.
6. The evidence is sufficient to infer that increasing the price of cigarettes reduces smoking prevalence, reduces cigarette consumption, and increases smoking cessation.
7. The evidence is sufficient to infer that smokefree policies reduce smoking prevalence, reduce cigarette consumption, and increase smoking cessation.
8. The evidence is sufficient to infer that mass media campaigns increase the number of calls to quitlines and increase smoking cessation.
9. The evidence is sufficient to infer that comprehensive state tobacco control programs reduce smoking prevalence, increase quit attempts, and increase smoking cessation.
10. The evidence is sufficient to infer that large, pictorial health warnings increase smokers' knowledge about the health harms of smoking, interest in quitting, and quit attempts and decrease smoking prevalence.
11. The evidence is suggestive but not sufficient to infer that plain packaging increases smoking cessation.
12. The evidence is suggestive but not sufficient to infer that decreasing the retail availability of tobacco products and exposure to point-of-sale tobacco marketing and advertising increases smoking cessation.
13. The evidence is suggestive but not sufficient to infer that restricting the sale of certain types of tobacco products, such as menthol and other flavored products, increases smoking cessation, especially among certain populations.

Chapter 8: A Vision for the Future

Chapter 8 discusses the past, present, and future of tobacco cessation in the United States. Specifically, it provides a historical perspective, discusses the current tobacco control landscape, and provides a vision for enhancing tobacco cessation in the United States.

Although substantial progress has been made to reduce smoking in the United States over the past five decades, by increasing adult smoking cessation and by reducing youth smoking initiation, more can and should

be done. The following major conclusions from this report provide evidence that points to an urgent need for intensified and coordinated actions to reduce the considerable—and preventable—human and financial burden of smoking in the United States:

- More than three out of five U.S. adults who have ever smoked cigarettes have quit. Although a majority of cigarette smokers make a quit attempt each year, less than one-third use FDA-approved cessation medications or behavioral counseling to support these attempts.
- Smoking places a substantial financial burden on smokers, their families, and healthcare systems. Smoking cessation reduces the burden on smokers and their families and can reduce smoking-attributable healthcare expenditures.

Considerable disparities exist in the prevalence of smoking across the U.S. population; such prevalence is higher in some subgroups. Similarly, the prevalence of key indicators of smoking cessation—making quit attempts, receiving advice to quit from a health professional, and using cessation therapies—also varies across the population, with lower prevalence among some subgroups. To increase smoking cessation and reduce smoking in the United States, this report outlines a broad range of well-defined and effective population-based interventions that are necessary, at present, to help the 34 million American adults who currently smoke cigarettes quit:

- Fully funded, comprehensive statewide tobacco control programs;
- Higher average retail prices of cigarettes—at least \$10 a pack;
- Complete protection of the entire U.S. population from exposure to secondhand smoke through comprehensive indoor smokefree policies in workplaces, restaurants, and bars;
- High-impact media campaigns, such as CDC's *Tips From Former Smokers*, that run with sufficient reach, frequency, and duration—ideally for 12 months a year; and
- Product regulations, such as requiring pictorial health warnings.

However, these population-based actions and the more aggressive use of the evidence-based policies and

programs reviewed in Chapter 7 are not enough. An array of effective clinical and health system-based interventions should also be implemented to increase smoking cessation and treat tobacco use and dependence in the United States:

- Increasing the appeal and reach of existing evidence-based interventions to individuals, including leveraging emerging technologies and accelerating the integration of cessation services across multiple platforms and in healthcare systems;
- Increasing the effectiveness of existing interventions, including recommending the combination of short- and long-acting forms of NRT, combined with behavioral support interventions, as first-line treatment for tobacco use;
- Conducting research to develop and better understand cessation interventions that have the potential for greater reach and/or effectiveness than existing interventions or that appeal to and are used by different populations of smokers;
- Conducting research to develop and better understand cessation interventions that are safe and effective among both youth and adults, including those that address the diversity of tobacco products being used by these populations, including e-cigarettes;
- Embedding policies and protocols for tobacco use screening and intervention into the clinical workflow; embedding prompts, decision support, and documentation tools into health records, such as electronic health records; and distributing specific components of the intervention across the broader healthcare team to reduce the burden on time-constrained physicians and to reinforce the importance of cessation to patients;
- Adopting policies to make the provision of cessation care in health systems more routine, as well as policies that remove cost and barriers to access for patients to increase the delivery and utilization of tobacco dependence treatment;
- Providing timely and relevant clinical guidelines and clinical quality measures to ensure that clinicians and health systems intervene consistently with tobacco users;
- Providing barrier-free cessation insurance coverage—without prior authorization, duration limits,

cost-sharing, or other barriers that impede smokers' access to cessation treatments—to increase the availability and utilization of treatment services for smoking cessation;

- Ensuring comprehensive cessation insurance benefits for all smokers that include coverage of all evidence-based cessation interventions, including brief and intensive counseling and all FDA-approved medications, including combination NRT therapy;
- Promoting cessation coverage and services, whether offered through a health insurer or an employee wellness program, to smokers and healthcare providers to increase awareness and use of the covered treatments; coverage alone, without promotion, is not sufficient; and
- Adequately funding and promoting tobacco quitlines to enable their operations and services to function at levels sufficient to maximize their reach and impact.

The implementation of scientifically proven interventions has been a hallmark of the successes made in combating the tobacco use epidemic in the United States for more than 50 years. However, the tobacco control community must remain nimble and vigilant in conducting and disseminating timely, high-quality scientific studies on best practices; in modernizing existing interventions to keep pace with the rapidly diversifying landscape of tobacco products; and in identifying emerging strategies to ensure more rapid elimination of the health and economic burden of tobacco use in the United States. To that end, several end-game strategies could help to increase cessation and reduce the disease and premature death caused by tobacco use. Strategies that have been proposed include:

- Implementing a tobacco product standard to lower the level of nicotine in cigarettes to minimally addictive or nonaddictive levels, and
- Restricting the sale of tobacco products, such as prohibitions on entire categories of flavored tobacco products, including menthol.

Such actions have the potential to accelerate increases in smoking cessation and declines in the prevalence of smoking in the United States, thus hastening the end of the tobacco epidemic. However, these actions and the extensive body of evidence-based clinical, health system, and population-based tobacco prevention, control, and cessation strategies that are outlined in this report are a necessary but insufficient means to end the tobacco epidemic.

To achieve success, we must work together to maximize resources and coordinate efforts across a wide range of stakeholders. Stakeholders who have a role to play include federal, state, local, tribal, and territorial governments; voluntary health agencies; nongovernmental and community-based organizations; civic and community leaders; public health and healthcare professionals; researchers; and individuals (USDHHS 2016). Stakeholders must also continue to hold the tobacco industry accountable for its role in creating, obscuring, and perpetuating the tobacco use epidemic in the United States (USDHHS 2014).

Action at the federal level is a key lever to success, but such action must be complemented by subnational and nongovernmental efforts to continue to denormalize tobacco use and advance the strategies that we know work to combat the devastating effects of tobacco use on society (USDHHS 2014). Each stakeholder can make unique and critical contributions toward reducing tobacco-related disease and death in the United States. In particular, there are opportunities for practitioners, experts, and researchers

who have traditionally focused primarily on population-based tobacco control policy interventions, to collaborate more closely with their counterparts who have traditionally focused on cessation interventions as part of a broader effort to build linkages.

We are at the precipice of a critical period in the more-than-half-century history of the tobacco control movement in the United States. The considerable reduction in the prevalence of smoking since the mid-1960s is an important public health achievement, which has been driven in part by increases in adult smoking cessation and the multiple advances in smoking cessation interventions since the last Surgeon General's report on this topic nearly three decades ago (USDHHS 1990). However, we cannot rest on our laurels. More work must be done, and we have the experience and wherewithal to do it. Equipped with both science and resolve, we will continue to move forward to end the tobacco epidemic in the United States. Working together, we can make tobacco-related disease and death a thing of the past.

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