The Health Consequences of Smoking—50 Years of Progress

A Report of the Surgeon General

Executive Summary

2014

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Message from Kathleen Sebelius

Secretary of Health and Human Services

Fifty years after the release of the first Surgeon General's report warning of the health hazards of smoking, we have learned how to end the tobacco epidemic. Over the past five decades, scientists, researchers and policy makers have determined what works, and what steps must be taken if we truly want to bring to a close one of our nation's most tragic battles—one that has killed ten times the number of Americans who died in all of our nation's wars combined.

In the United States, successes in tobacco control have more than halved smoking rates since the 1964 landmark Surgeon General's report came out. Americans' collective view of smoking has been transformed from an accepted national pastime to a discouraged threat to individual and public health. Strong policies have largely driven cigarette smoking out of public view and public air space. Thanks to smokefree laws, no longer is smoking allowed on airplanes or in a growing number of restaurants, bars, college campuses and government buildings.

Evidence in this new report shows tobacco's continued, immense burden to our nation—and how essential ending the tobacco epidemic is to our work to increase the life expectancy and quality of life of all Americans. This year alone, nearly one-half million adults will still die prematurely because of smoking. Annually, the total economic costs due to tobacco are now over $289 billion. And if we continue on our current trajectory, 5.6 million children alive today who are younger than 18 years of age will die prematurely as a result of smoking.

I believe that we can make the next generation tobacco-free. And I am extremely proud of the Obama Administration's tobacco-control record. For example, the 2009 *Children's Health Insurance Program Reauthorization Act* included an unprecedented $0.62 tax increase that raised the federal excise tax to $1.01 per pack of cigarettes; we know that increasing the cost of cigarettes is one of the most powerful interventions we can make to prevent smoking and reduce prevalence. Building on this knowledge, the President's Fiscal Year 2014 Budget includes a $0.94 per pack Federal tobacco tax increase. For the first time in history, the 2009 *Family Smoking Prevention and Tobacco Control Act* (*Tobacco Control Act) g*ave the U.S. Food and Drug Administration comprehensive authority to regulate tobacco products, which will play a critical role in reducing the harm caused by these products. The *Tobacco Control Act* also provided for user fees to be paid by tobacco manufacturers that can support sustained public education media campaigns targeting youth prevention and cessation. The 2010 *Affordable Care Act (ACA)* expands access to smoking cessation services and now requires most insurance companies to cover cessation treatments. The *Affordable Care Act's* Public Health and Prevention Fund is supporting innovative and effective community-based programs as well as public education campaigns promoting prevention and helping people to quit.

All of these tobacco control interventions are known to reduce tobacco use and, as a result, tobacco's extraordinary toll of death and disease. But in order to free the next generation from these burdens, we must redouble our tobacco control efforts and enlist nongovernmental partners—and society as a whole—to share in this responsibility. Ending the devastation of tobacco-related illness and death is not in the jurisdiction of any one entity. We must all share in this most worthwhile effort to end the tobacco epidemic.

Message from Howard Koh

Assistant Secretary for Health

The nation stands poised at the crossroads of tobacco control. On one hand, we can celebrate tremendous progress 50 years after the landmark 1964 Surgeon General's report: *Smoking and Health*. Adult smoking rates have fallen from about 43% (1965) to about 18% today. Mortality rates from lung cancer, the leading cause of cancer death in this country, are declining. Most smokers visiting health care settings are now routinely asked and advised about tobacco use. On the other hand, cigarette smoking remains the chief preventable killer in America, with more than 40 million Americans caught in a web of tobacco dependence. Each day, more than 3,200 youth (younger than 18 years of age) smoke their first cigarette and another 2,100 youth and young adults who are occasional smokers progress to become daily smokers. Furthermore, the range of emerging tobacco products complicates the current public health landscape.

In this context, the 50th Anniversary of the Surgeon General's report prompts us to pause and ask why this addiction persists when proven interventions can eliminate it. Of great concern, too many in our nation assume that past success in tobacco control guarantees future progress; nothing can be further from the truth. To rejuvenate and reinvigorate national efforts, in 2010, the U.S. Department of Health and Human Services unveiled its first ever strategic plan for tobacco control. *Ending the Tobacco Epidemic: A Tobacco Control Strategic Action Plan* provides a critical framework to guide efforts to rapidly drop prevalence rates of smoking among youth and adults. A major foundation and pillar of the plan is to encourage and promote leadership throughout all sectors of society. Now, this current 2014 Surgeon General's report can accelerate that leadership to fully implement the life-saving prevention that can make the next generation free of tobacco-related death and disease.

We have many tools that we know work. A comprehensive public policy approach emphasizing mass media campaigns to encourage prevention and quit attempts, smokefree policies, restrictions on youth access to tobacco products, and price increases can collectively drive further meaningful reductions in tobacco use. Furthermore, we can accelerate progress through full commitment to clinical and public health advances; including the widespread use of telephone quit lines and science-based counseling and medications for tobacco users. Promoting progress today also requires recognizing that tobacco use has evolved from being an equal-opportunity killer to one threatening the most vulnerable members of our society. We must confront, and reverse, the tragically higher tobacco use rates that threaten persons of low socioeconomic status, sexual minorities, high school dropouts, some racial/ethnic minority groups, and those living with mental illness and substance use disorders.

Of all the accomplishments of the 20th century, historians rank the 1964 Surgeon General's report as one of the seminal public health achievements of our time. Armed with both science and resolve, we can continue to honor the legacy of the report by completing the work it began in the last century. The current 2014 Surgeon General's report represents a national vision for getting the job done. With strategy, commitment, and action, our nation can leave the crossroads and move forward to end the tobacco epidemic once and for all.

Foreword

Fifty years have passed since publication of the landmark report of the Surgeon General's Advisory Committee on smoking and health. This report highlights both the dramatic progress our nation has made reducing tobacco use and the continuing burden of disease and death caused by smoking.

As a physician, when I think about smoking, I recall the patients I have cared for. The man who had a leg amputated. The woman who had to gasp for every single breath that she took. The man with heart disease who hoped to see his son graduate, but didn't live long enough to do so. That's the reality of smoking that health care providers see every day.

The prevalence of current cigarette smoking among adults has declined from 42% in 1965 to 18% in 2012. However, more than 42 million Americans still smoke. Tobacco has killed more than 20 million people prematurely since the first Surgeon General's report in 1964. The findings in this report show that the decline in the prevalence of smoking has slowed in recent years and that burden of smoking-attributable mortality is expected to remain at high and unacceptable levels for decades to come unless urgent action is taken.

Recent surveys monitoring trends in tobacco use indicate that more people are using multiple tobacco products, particularly youth and young adults. The percentage of U.S. middle and high school students who use electronic, or e-cigarettes, more than doubled between 2011 and 2012. We need to monitor patterns of use of an increasingly wide array of tobacco products across all of the diverse segments of our society, particularly because the tobacco industry continues to introduce and market new products that establish and maintain nicotine addiction.

Tobacco control efforts need to not only address the general population, but also to focus on populations with a higher prevalence of tobacco use and lower rates of quitting. These populations include people from some racial/ethnic minority groups, people with mental illness, lower educational levels and socioeconomic status, and certain regions of the country. We now have proven interventions and policies to reduce tobacco initiation and use among youth and adults.

With intense use of proven interventions, we can save lives and reduce health care costs. In 2012, the Centers for Disease Control and Prevention (CDC) launched the first-ever paid national tobacco education campaign — *Tips From Former Smokers* (*Tips*) — to raise awareness of the harms to health caused by smoking, encourage smokers to quit, and encourage nonsmokers to protect themselves and their families from exposure to secondhand smoke. It pulled back the curtain in a way that numbers alone cannot, and showed the tobacco-caused tragedies that we as health care professionals see and are saddened by every day. As a result of this campaign, an estimated 1.6 million smokers made an attempt to quit and, based on a conservative estimate, at least 100,000 smokers quit for good. Additionally, millions of nonsmokers talked with friends and family about the dangers of smoking and referred smokers to quit services. In 2013, CDC launched a new round of advertisements that helped even more people quit smoking by highlighting the toll that smoking-related illnesses take on smokers and their loved ones.

CDC has also established reducing tobacco use as one of its "Winnable Battles." These are public health priorities with large-scale impact on health that have proven effective strategies to address them. CDC believes that with additional effort and support for evidence-based, cost-effective policy and program strategies to reduce tobacco use, we can reduce smoking substantially, prevent millions of people from being killed by tobacco, and protect future generations from smoking.

While we have made tremendous progress over the past 50 years, sustained and comprehensive efforts are needed to prevent more people from having to suffer the pain, disability, disfigurement, and death that smoking causes. Most Americans who have ever smoked have already quit, and most smokers who still smoke want to quit. If we continue to implement tobacco prevention and cessation strategies that have proven effective in reducing tobacco use, people throughout our country will live longer, healthier, more productive lives.

Thomas R. Frieden, M.D., M.P.H.
Director
Centers for Disease Control and Prevention

Preface

from the Acting Surgeon General,
U.S. Department of Health and Human Services

On January 11, 1964, Luther L. Terry, M.D., the 9th Surgeon General of the United States, released the first report on the health consequences of smoking: *Smoking and Health: Report of the Advisory Committee of the Surgeon General of the Public Health Service*. That report marked a major step to reduce the adverse impact of tobacco use on health worldwide.

Over the past 50 years, 31 Surgeon General's reports have utilized the best available evidence to expand our understanding of the health consequences of smoking and involuntary exposure to tobacco smoke. The conclusions from these reports have evolved from a few causal associations in 1964 to a robust body of evidence documenting the health consequences from both active smoking and exposure to secondhand smoke across a range of diseases and organ systems.

The 2004 report concluded that smoking affects nearly every organ of the body, and the evidence in this report provides even more support for that finding. A half century after the release of the first report, we continue to add to the long list of diseases caused by tobacco use and exposure to tobacco smoke. This report finds that active smoking is now causally associated with age-related macular degeneration, diabetes, colorectal cancer, liver cancer, adverse health outcomes in cancer patients and survivors, tuberculosis, erectile dysfunction, orofacial clefts in infants, ectopic pregnancy, rheumatoid arthritis, inflammation, and impaired immune function. In addition, exposure to secondhand smoke has now been causally associated with an increased risk for stroke.

Smoking remains the leading preventable cause of premature disease and death in the United States. The science contained in this and prior Surgeon General's reports provide all the information we need to save future generations from the burden of premature disease caused by tobacco use. However, evidence-based interventions that encourage quitting and prevent youth smoking continue to be underutilized. This report strengthens our resolve to work together to accelerate and sustain what works—such as hard-hitting media campaigns, smokefree air policies, optimal tobacco excise taxes, barrier-free cessation treatment, and comprehensive statewide tobacco control programs funded at CDC-recommended levels. At the same time, we will explore "end game" strategies that support the goal of eliminating tobacco smoking, including greater restrictions on sales. It is my sincere hope that 50 years from now we won't need another Surgeon General's report on smoking and health, because tobacco-related disease and death will be a thing of the past. Working together, we can make that vision a reality.

Boris D. Lushniak, M.D., M.P.H.
Rear Admiral, U.S. Public Health Service
Acting Surgeon General
U.S. Department of Health and Human Services

Overview

For the United States, the epidemic of smoking-caused disease in the twentieth century ranks among the greatest public health catastrophes of the century, while the decline of smoking consequent to tobacco control is surely one of public health's greatest successes. However, the current rate of progress in tobacco control is not fast enough, and much more needs to be done to end the tobacco epidemic. Unacceptably high levels of smoking-attributable disease and death, and the associated costs, will persist for decades without changes in our approach to slowing and even ending the epidemic. If smoking persists at the current rate among young adults in this country, 5.6 million of today's Americans younger than 18 years of age are projected to die prematurely from a smoking-related illness (Chapter 12).

More than 20 million Americans have died as a result of smoking since the first Surgeon General's report on smoking and health was released in 1964 (Table 1) (Chapter 12). Most were adults with a history of smoking, but nearly 2.5 million were nonsmokers who died from heart disease or lung cancer caused by exposure to secondhand smoke. Another 100,000 were babies who died of sudden infant death syndrome (often referred to as SIDS) or complications from prematurity, low birth weight, or other conditions caused by parental smoking, particularly smoking by the mother.

Table 1 Premature deaths caused by smoking and exposure to secondhand smoke, 1965–2014

Cause of death	Total
Smoking-related cancers	6,587,000
Cardiovascular and metabolic diseases	7,787,000
Pulmonary diseases	3,804,000
Conditions related to pregnancy and birth	108,000
Residential fires	86,000
Lung cancers caused by exposure to secondhand smoke	263,000
Coronary heart disease caused by exposure to secondhand smoke	2,194,000
Total	20,830,000

Source: Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, unpublished data.

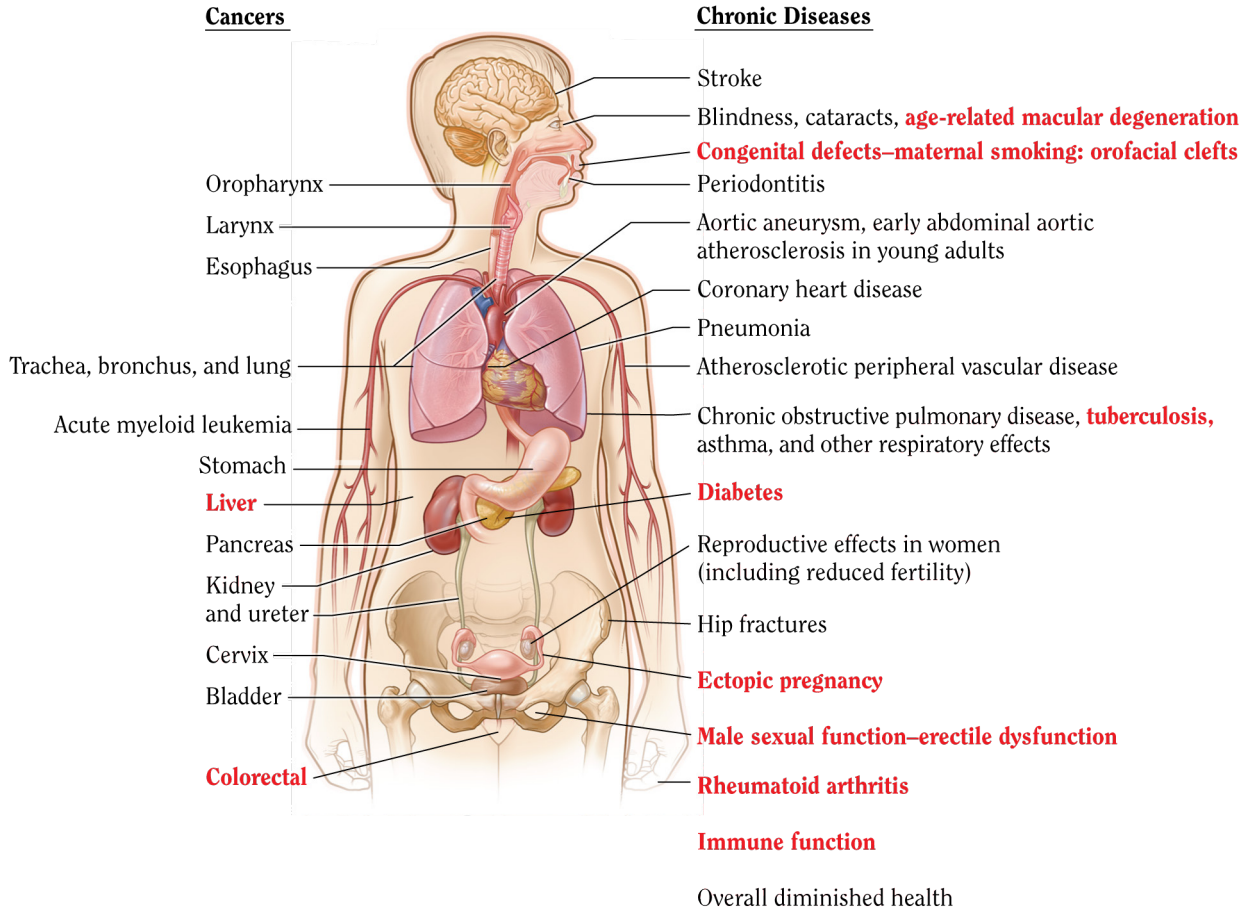
As these figures illustrate, the harms caused by the historic patterns of tobacco use in the United States, and especially by cigarette smoking, are staggering. More than 10 times as many U.S. citizens have died prematurely from cigarette smoking than have died in all the wars fought by the United States during its history. Study after study has confirmed the magnitude of the harm caused to the human body by exposure to toxicants and carcinogens found in tobacco smoke. Since 1964, the 31 previous Surgeon General's reports have chronicled a still growing but already conclusive body of evidence about the adverse impact of tobacco use on human cells and organs and on overall health. Health statistics show that all populations are affected.

Previous Surgeon General's reports have tracked the evolution of cigarettes into the current highly engineered, addictive, and deadly products containing thousands of chemicals that are harmful in themselves, but the burning of tobacco produces the complex chemical mixture of more than 7,000 compounds that cause a wide range of diseases and premature deaths as a result (U.S. Department of Health and Human Services [USDHHS] 2010). Although the prevalence of smoking has declined significantly over the past one-half century, the risks for smoking-related disease and mortality have not. In fact, today's cigarette smokers—both men and women—have a much higher risk for lung cancer and chronic obstructive pulmonary disease (COPD) than smokers in 1964, despite smoking fewer cigarettes (see Chapters 6, 7, and 11, and Figure 12.2 and Figure 13.16).

The 2004 Surgeon General's report showed that smoking impacts nearly every organ of the body (USDHHS 2004). The 2006 report concluded that the scientific evidence indicates that there is no risk-free level of exposure to secondhand smoke (USDHHS 2006). The new evidence in this report provides still more support for these conclusions. Fifty years after the first report in 1964, it is striking that the scientific evidence in this report expands the list of diseases and other adverse health effects caused by smoking and exposure of nonsmokers to tobacco smoke. Figures 1.1A and 1.1B highlight these new findings and show that the disease risks are even greater than presented in previous reports. These new findings include:

- Liver cancer and colorectal cancer are added to the long list of cancers caused by smoking;

Figure 1A The health consequences causally linked to smoking



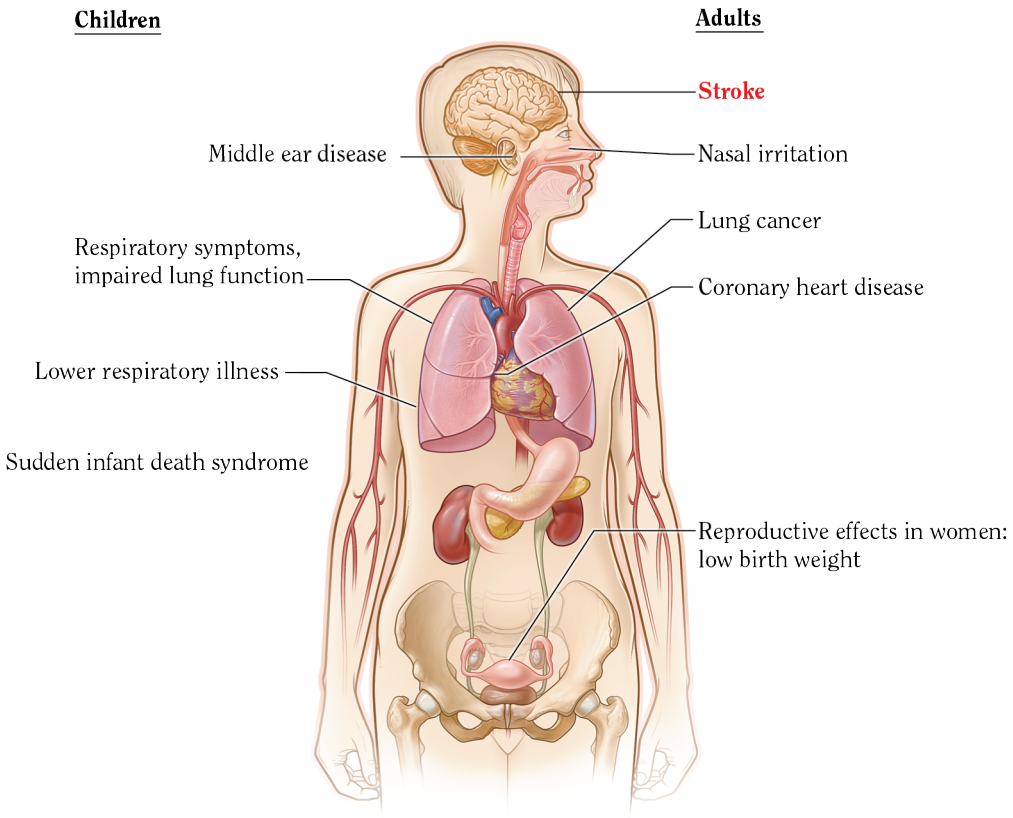
Source: USDHHS 2004, 2006, 2012.
Note: The condition in **red** is a new disease that has been causally linked to smoking in this report.

- Exposure to secondhand smoke is a cause of stroke;
- Smoking increases the risk of dying from cancer and other diseases in cancer patients and survivors;
- Smoking is a cause of diabetes mellitus; and
- Smoking causes general adverse effects on the body including inflammation and it impairs immune function. Smoking is a cause of rheumatoid arthritis.

Progress has been made in tobacco control. During the 50 years since the 1964 report, approaches have moved from single measures, such as small text-only pack warnings, to implementing comprehensive control programs, including indoor smoking bans, support for cessation, restrictions on advertising and promotion, media campaigns, and tax hikes to raise prices (Chapters 2 and 14). Smoking rates have declined, as have mortality rates for some diseases caused by smoking, such as heart disease and lung cancer for which smoking is the major cause.

Nonetheless, between 2005–2009, smoking was responsible for more than 480,000 premature deaths annually among Americans 35 years of age and older (Chapter 12). More than 87% of lung cancer deaths, 61% of all pulmonary disease deaths, and 32% of all deaths from coronary heart disease were attributable to smoking and exposure to secondhand smoke. Additionally, if current trends continue 5.6 million U.S. youth who are currently younger than 18 years of age will die prematurely during adulthood from their smoking (Chapter 12).

Figure 1B The health consequences causally linked to exposure to secondhand smoke



Source: USDHHS 2004, 2006.
Note: The condition in **red** is a new disease that has been causally linked to smoking in this report.

Many of the findings in this report have particular relevance to women who are current smokers. For the first time ever, they are as likely as men to die from many diseases caused by smoking (Chapter 12). The relative risk for dying from coronary heart disease among women 35 years of age and older is now higher than for men. Because the risks for women have increased so much in the last decades, women who smoke now have about the same high risk of death from lung cancer as men.

In addition to the impact that smoking has on health and well-being, the nation pays enormous financial costs because of smoking. Productivity losses from premature death alone now exceed $150 billion per year (Chapter 12). Additionally, the value of lost productivity due to premature deaths caused by exposure to secondhand smoke is now estimated to be $5.6 billion per year. The annual costs of direct medical care of adults attributable to smoking are now estimated to be over $130 billion (Chapter 12).

This comprehensive report chronicles the devastating consequences of 50 years of tobacco use in the United States. It updates data on the numerous health effects resulting from smoking and exposure to secondhand smoke, and details public health trends, both favorable and unfavorable, in tobacco use. This report marks the steady progress achieved in reducing the prevalence of smoking and validates tobacco control strategies that have consistently proven to be effective. It also examines strategies with the potential to eradicate the death and disease caused by the tobacco epidemic at long last, and identifies specific measures that should be taken immediately to move smoking off its decades-old number one spot as the largest single cause of preventable death and disease for the citizens of the United States. Finally, the report documents that effective interventions are available and calls for their full implementation.

Major Conclusions from the Report

1. The century-long epidemic of cigarette smoking has caused an enormous avoidable public health tragedy. Since the first Surgeon General's report in 1964 more than 20 million premature deaths can be attributed to cigarette smoking.

2. The tobacco epidemic was initiated and has been sustained by the aggressive strategies of the tobacco industry, which has deliberately misled the public on the risks of smoking cigarettes.

3. Since the 1964 Surgeon General's report, cigarette smoking has been causally linked to diseases of nearly all organs of the body, to diminished health status, and to harm to the fetus. Even 50 years after the first Surgeon General's report, research continues to newly identify diseases caused by smoking, including such common diseases as diabetes mellitus, rheumatoid arthritis, and colorectal cancer.

4. Exposure to secondhand tobacco smoke has been causally linked to cancer, respiratory, and cardiovascular diseases, and to adverse effects on the health of infants and children.

5. The disease risks from smoking by women have risen sharply over the last 50 years and are now equal to those for men for lung cancer, chronic obstructive pulmonary disease, and cardiovascular diseases.

6. In addition to causing multiple diseases, cigarette smoking has many adverse effects on the body, such as causing inflammation and impairing immune function.

7. Although cigarette smoking has declined significantly since 1964, very large disparities in tobacco use remain across groups defined by race, ethnicity, educational level, and socioeconomic status and across regions of the country.

8. Since the 1964 Surgeon General's report, comprehensive tobacco control programs and policies have been proven effective for controlling tobacco use. Further gains can be made with the full, forceful, and sustained use of these measures.

9. The burden of death and disease from tobacco use in the United States is overwhelmingly caused by cigarettes and other combusted tobacco products; rapid elimination of their use will dramatically reduce this burden.

10. For 50 years the Surgeon General's reports on smoking and health have provided a critical scientific foundation for public health action directed at reducing tobacco use and preventing tobacco-related disease and premature death.

The 2014 Surgeon General's report is presented in three sections:

Section 1: Historical Perspective, Overview, and Conclusions;

Section 2: The Health Consequences of Active and Passive Smoking: The Evidence in 2014; and

Section 3: Tracking and Ending the Epidemic.

The following is a summary of the contents of each section.

Section 1: Historical Perspective, Overview, and Conclusions

When Dr. Luther L. Terry released the first Surgeon General's report on smoking and health in January 1964, few could have anticipated the long-term impact it would have on this nation's health. The report reviewed more than 7,000 research articles related to smoking and disease—the evidence considered dated to the early twentieth century but most came from the wave of research that started at mid-century. The initial report concluded that smoking was associated with higher all-cause mortality rates among men, was a cause of lung cancer and laryngeal cancer in men, was a probable cause of lung cancer in women, and was the most important cause of bronchitis (U.S. Department of Health, Education, and Welfare 1964). News coverage of the report was extensive, and the release of the report was ranked among the top news stories of the twentieth century (*USA Today* 1999).

Nonetheless, public attitudes about smoking and its adverse health effects were slow to change, and smoking declined slowly after the report. In 1964, more than one-half of men and nearly one-third of women were regular smokers; it took approximately 15 years for rates of smoking among men to drop by one-quarter or more (Chapter 2). The scientific evidence helped to launch public health campaigns about the dangers of smoking. The tobacco industry attempted to counter these campaigns through aggressive advertising. It used a variety of tactics to create doubt about the findings on smoking and health and launched marketing strategies that obscured the dangers of smoking by implying that certain cigarettes were safer than others. In fact, rates of smoking among women actually increased in the years following the first Surgeon General's report.

During the decades that followed, however, a number of local, state, and federal laws and policies addressed tobacco product marketing and advertising, labeling and packaging, youth access, and exposure to secondhand smoke. Social norms that had made smoking acceptable everywhere began to change as a grassroots movement aimed at protecting nonsmokers emerged. Surgeon General's reports on the impact of tobacco use on specific populations, the changing cigarette, nicotine addiction, specific smoking-related diseases, and secondhand smoke gave impetus to a steady movement away from smoking as an acceptable social norm. The prevalence of smoking among adults is now less than one-half of what it was in 1964, and the prevalence among youth is less than one-half. A 2011 Gallup poll reported that for the first time, a majority of Americans supported a ban on smoking in all public places (Newport 2011).

The ongoing story of tobacco use covered in this Surgeon General's report illustrates the complexity and dynamic nature of the issue. This report examines smoking from a public health standpoint; as a cultural and social phenomenon; as an extension of the tobacco industry's aggressive and fraudulent campaigns to mislead the public on health hazards; and from legal, policy, and public education perspectives.

Section 2: The Health Consequences of Active and Passive Smoking: The Evidence in 2014

Since 1964, the evidence on smoking and health has expanded greatly; the list of adverse consequences of tobacco smoking has lengthened progressively; and since the 1970s, scientific research has linked the inhalation of secondhand smoke by nonsmokers to specific diseases and other adverse effects. Even in this report, a half-century following the first report, the evidence has been found sufficient to infer further causal associations of active and passive smoking with disease.

Nicotine and Addiction: Nicotine was found to be addicting in the 1988 Surgeon General's report (USDHHS 1988). That conclusion has been repeatedly reaffirmed in subsequent reports, and nicotine addiction figures centrally in initiation and in the difficulty of cessation (USDHHS 2010, 2012). Additionally, nicotine is a pharmacologically active agent that has acute toxicity and that readily enters the body and is distributed throughout. Beyond causing addiction, it activates multiple biologic pathways that are relevant to fetal growth and development, immune function, the cardiovascular system, the central nervous system, and carcinogenesis. Nicotine exposure during fetal development, a critical window

for the brain, has lasting adverse consequences for brain development. Nicotine exposure during pregnancy also contributes to adverse reproductive outcomes, such as preterm birth and stillbirth.

Cancer: Lung cancer, the first of many deadly diseases to be identified in a Surgeon General's report as being caused by smoking (Chapter 6), is now the nation's most common cancer killer among men and women. Two studies carried out by the American Cancer Society have been key sources of information on the risks of lung cancer in smokers. These two studies each followed more than 1 million U.S. men and women, starting in 1959 for the first study and then again in 1982 for the second. Results from these studies have now been compared with data combined from several large populations followed from 2000–2010 (Thun et al. 1997a,b, 2013). Although the risk of lung cancer for never smokers in all three studies stayed about the same, the risk to smokers increased steadily. Among women, risk of lung cancer went up dramatically. In the 1959 study, women smokers were 2.7 times more likely than women never smokers to develop lung cancer; by 2000–2010 that additional risk for women smokers had jumped nearly tenfold, to 25.7. For men who smoked, the risk more than doubled, from 12.2 to 25.0 between the first and last studies. These relative risks increased over the same period as the prevalence of smoking and the average number of cigarettes consumed per smoker decreased. Although the incidence of squamous cell carcinoma of the lung—the type of lung cancer most often diagnosed among smokers at the start of the lung cancer epidemic—declined as smoking rates dropped, the incidence of adenocarcinoma of the lung increased dramatically. Evidence suggests that changes in the composition and design of the cigarette itself may have had some impact on the relative risk of lung cancer, as well as on the shift in the types of lung cancer occurring in the contemporary cohorts of smokers (Thun et al. 2013).

This latest Surgeon General's report also evaluated the evidence on other cancers, and concluded that smoking is a cause of liver cancer and of colorectal cancer, the fourth most diagnosed cancer in the United States and the cancer responsible for the second largest number of cancer deaths annually (Chapter 6). The report found that the evidence is suggestive but insufficient to conclude that smoking and exposure to secondhand smoke cause breast cancer, and that smoking is not a cause for prostate cancer. The report also found that smoking increases the risk of dying from cancer and other diseases in cancer patients and survivors, including breast and prostate cancer patients.

Respiratory diseases: In the 1964 Surgeon General's report, smoking was found to be a cause of "chronic bronchitis," a term used then for the disease now generally referred to as chronic obstructive pulmonary disease (COPD) (Fletcher et al. 1959). Because smoke is inhaled into the lung and its components are deposited and absorbed in the lungs, it has long been linked to adverse effects on the respiratory system, causing malignant and nonmalignant diseases, exacerbating chronic lung diseases, and increasing the risk for respiratory infections. The scientific literature showing associations with multiple diseases of the respiratory tract is extensive as is the evidence supporting the biologic plausibility of smoking as a cause of these associations (Chapter 7). This report has reviewed the updated evidence on COPD. Mortality from COPD continues to rise, and smoking remains responsible for the vast majority of cases (Chapter 7). As for lung cancer, comparison of the findings of the two American Cancer Society studies with the more recent studies spanning 2000–2010 showed rising risks for COPD, particularly in women. Recent studies show that the relative risk for COPD in women has risen greatly, reaching 22.4 compared to never smokers, and similar to the risk in men (Thun et al. 2013).

For asthma, another obstructive lung disease, the evidence was found to be sufficient to infer that smoking worsens asthma in adults who smoke (Chapter 7). The benefits of implementing smokefree policies have been shown for workers with asthma (Eisner et al. 1998; Menzies et al. 2006; Ayres et al. 2009; Wilson et al. 2012). Evidence considered in this report points to a reduction in admissions for respiratory diseases following the implementation of a smokefree policy (Tan and Glantz 2012). Tuberculosis was once a leading cause of death in the United States. Now far less frequent in the United States, it remains prominent worldwide. Evidence reported over the last decade is sufficient to lead to a conclusion that smoking increases the risk for tuberculosis and for dying from tuberculosis (Chapter 7).

Cardiovascular diseases: Although lung cancer is often assumed to be the largest smoking-attributable cause of death in the United States, cardiovascular disease actually claims more lives of smokers 35 years of age and older every year compared with lung cancer (Chapter 8). Exposure to secondhand smoke causes significantly more deaths due to cardiovascular disease than due to lung cancer, and this new report finds that exposure to secondhand smoke is also a cause of stroke. Exposure to secondhand smoke increases the risk for stroke by an estimated 20–30%. Even so, the evidence is clear that reductions in smoking and exposure to secondhand smoke have contributed to the decline in death rates from cardiovascular diseases since the late 1960s. Smokefree laws and policies have been proven to reduce the incidence of heart attacks

and other coronary events among people younger than 65 years of age, and evidence suggests that there could be a relationship between such laws and policies and a reduction in cerebrovascular events.

Diabetes: Previous Surgeon General's reports have found that smoking complicates the treatment of diabetes and that smokers who have been diagnosed with diabetes are at a higher risk for kidney disease, blindness, and circulatory complications leading to amputations. This report concludes that smoking is a cause of type 2 diabetes mellitus, and that the risk of developing diabetes is 30–40% higher for active smokers than nonsmokers (Chapter 10). Furthermore, the risk of developing diabetes increases as the number of cigarettes smoked grows.

Immune and autoimmune disorders: This report finds that smoking is a cause of general adverse effects on the body, including systemic inflammation and impaired immune function (Chapter 10). One result of this altered immunity is increased risk for pulmonary infections among smokers. For example, risks for *Mycobacterium tuberculosis* and for death from tuberculosis disease are higher for smokers than nonsmokers (Chapter 7). Additionally, smoking is known to compromise the equilibrium of the immune system, increasing the risk for several immune and autoimmune disorders. This report finds that smoking is a cause of rheumatoid arthritis, and that smoking interferes with the effectiveness of certain treatments for rheumatoid arthritis (Chapter 10).

Reproductive effects: Several additional adverse reproductive effects are now found to be attributable to smoking (Chapter 9). One is ectopic pregnancy, in which the embryo implants in the Fallopian tube or elsewhere outside the uterus. Ectopic pregnancy is very rarely a survivable condition for the fetus and is a potentially fatal condition for the mother. This report finds that maternal smoking during early pregnancy is causal for orofacial clefts in infants, and evidence suggests that smoking could be associated with certain other birth defects. This report also finds that the evidence is now sufficient to conclude that there is a causal relationship between smoking and erectile dysfunction in men.

Eye disease: The retina is a delicate, light-sensitive tissue that lines the inside of the eye. The macula is the most sensitive part of the retina and is the part of the eye that supplies sharp vision. Age-related macular degeneration (AMD) gradually destroys the macula and can ultimately lead to loss of vision in the center of the eye. This report finds that smoking is a cause of AMD (Chapter 10). Evidence in the report also suggests that quitting smoking may reduce the risk for AMD, but the reduced risk may not appear for 20 or more years after smoking cessation.

General health: Smokers have long been known to suffer from poorer general health than nonsmokers, beginning at an early age and extending throughout adult life (Chapter 11). Although emphasis has been given to smoking as a cause of specific and avoidable diseases, it is a powerful cause of ill-health generally. These health deficits not only reduce the quality of life of smokers but also affect their participation in the workplace and increase their costs to the health care system.

All-cause mortality: The evidence in this report reaffirms that smoking is a major cause of premature death (Chapter 11). During the past 50 years, as generations of men and women who began smoking in adolescence and continued to smoke into middle and older ages have been stricken with the health consequences of lifetime smoking, the relative risk for all-cause mortality associated with current cigarette smoking has increased. The age-standardized relative risk, comparing the all-cause death rate in current smokers to that of never smokers, has more than doubled in men and more than tripled in women during the years since the release of the first Surgeon General's report on smoking and health. The lives of smokers are cut short by the development of the many diseases caused by smoking and by their greater risk of dying from common health events, such as complications of routine surgeries and pneumonia. Smoking shortens life far more than most other risk factors for early mortality; smokers are estimated to lose more than a decade of life. Smoking cessation by 40 years of age reduces that loss approximately 90%. Even stopping by about 60 years of age reduces that loss approximately 40%. However, reducing the number of cigarettes smoked per day is much less effective than quitting entirely for avoiding the risks of premature death from all smoking-related causes of death.

Much of this 50th anniversary Surgeon General's report is devoted to examining evidence on the myriad health effects, avoidable diseases, and all-cause mortality from smoking. Chapters highlight findings on specific health topics from previous Surgeon General's reports in addition to presenting current information. The following are chapter-specific conclusions related to the health effects of smoking from Section 2 of the report.

Chapter 5: Nicotine

1. The evidence is sufficient to infer that at high-enough doses nicotine has acute toxicity.

2. The evidence is sufficient to infer that nicotine activates multiple biological pathways through which smoking increases risk for disease.

3. The evidence is sufficient to infer that nicotine exposure during fetal development, a critical window for brain development, has lasting adverse consequences for brain development.

4. The evidence is sufficient to infer that nicotine adversely affects maternal and fetal health during pregnancy, contributing to multiple adverse outcomes such as preterm delivery and stillbirth.

5. The evidence is suggestive that nicotine exposure during adolescence, a critical window for brain development, may have lasting adverse consequences for brain development.

6. The evidence is inadequate to infer the presence or absence of a causal relationship between exposure to nicotine and risk for cancer.

Chapter 6: Cancer

Lung Cancer

1. The evidence is sufficient to conclude that the risk of developing adenocarcinoma of the lung from cigarette smoking has increased since the 1960s.

2. The evidence is sufficient to conclude that the increased risk of adenocarcinoma of the lung in smokers results from changes in the design and composition of cigarettes since the 1950s.

3. The evidence is not sufficient to specify which design changes are responsible for the increased risk of adenocarcinoma, but there is suggestive evidence that ventilated filters and increased levels of tobacco-specific nitrosamines have played a role.

4. The evidence shows that the decline of squamous cell carcinoma follows the trend of declining smoking prevalence.

Liver Cancer

1. The evidence is sufficient to infer a causal relationship between smoking and hepatocellular carcinoma.

Colorectal Cancer

1. The evidence is sufficient to infer a causal relationship between smoking and colorectal adenomatous polyps and colorectal cancer.

Prostate Cancer

1. The evidence is suggestive of no causal relationship between smoking and the risk of incident prostate cancer.

2. The evidence is suggestive of a higher risk of death from prostate cancer in smokers than in nonsmokers.

3. In men who have prostate cancer, the evidence is suggestive of a higher risk of advanced-stage disease and less-well-differentiated cancer in smokers than in nonsmokers, and—independent of stage and histologic grade—a higher risk of disease progression.

Breast Cancer

1. The evidence is sufficient to identify mechanisms by which cigarette smoking may cause breast cancer.

2. The evidence is suggestive but not sufficient to infer a causal relationship between tobacco smoke and breast cancer.

3. The evidence is suggestive but not sufficient to infer a causal relationship between active smoking and breast cancer.

4. The evidence is suggestive but not sufficient to infer a causal relationship between exposure to secondhand tobacco smoke and breast cancer.

Adverse Health Outcomes in Cancer Patients and Survivors

1. In cancer patients and survivors, the evidence is sufficient to infer a causal relationship between cigarette smoking and adverse health outcomes. Quitting smoking improves the prognosis of cancer patients.

2. In cancer patients and survivors, the evidence is sufficient to infer a causal relationship between cigarette smoking and increased all-cause mortality and cancer-specific mortality.

3. In cancer patients and survivors, the evidence is sufficient to infer a causal relationship between cigarette smoking and increased risk for second primary cancers known to be caused by cigarette smoking, such as lung cancer.

4. In cancer patients and survivors, the evidence is suggestive but not sufficient to infer a causal relationship between cigarette smoking and (1) the risk of recurrence, (2) poorer response to treatment, and (3) increased treatment-related toxicity.

Chapter 7: Respiratory Diseases

Chronic Obstructive Pulmonary Disease

1. The evidence is sufficient to infer that smoking is the dominant cause of chronic obstructive pulmonary disease (COPD) in men and women in the United States. Smoking causes all elements of the COPD phenotype, including emphysema and damage to the airways of the lung.

2. Chronic obstructive pulmonary disease (COPD) mortality has increased dramatically in men and women since the 1964 Surgeon General's report. The number of women dying from COPD now surpasses the number of men.

3. The evidence is suggestive but not sufficient to infer that women are more susceptible to develop severe chronic obstructive pulmonary disease at younger ages.

4. The evidence is sufficient to infer that severe α1-antitrypsin deficiency and cutis laxa are genetic causes of chronic obstructive pulmonary disease.

Asthma

1. The evidence is suggestive but not sufficient to infer a causal relationship between active smoking and the incidence of asthma in adolescents.

2. The evidence is suggestive but not sufficient to infer a causal relationship between active smoking and exacerbation of asthma among children and adolescents.

3. The evidence is suggestive but not sufficient to infer a causal relationship between active smoking and the incidence of asthma in adults.

4. The evidence is sufficient to infer a causal relationship between active smoking and exacerbation of asthma in adults.

Tuberculosis

1. The evidence is sufficient to infer a causal relationship between smoking and an increased risk of *Mycobacterium tuberculosis* disease.

2. The evidence is sufficient to infer a causal relationship between smoking and mortality due to tuberculosis.

3. The evidence is suggestive of a causal relationship between smoking and the risk of recurrent tuberculosis disease.

4. The evidence is inadequate to infer the presence or absence of a causal relationship between active smoking and the risk of tuberculosis infection.

5. The evidence is inadequate to infer the presence or absence of a causal relationship between exposure to secondhand smoke and the risk of tuberculosis infection.

6. The evidence is inadequate to infer the presence or absence of a causal relationship between exposure to secondhand smoke and the risk of tuberculosis disease.

Idiopathic Pulmonary Fibrosis

1. The evidence is suggestive but not sufficient to infer a causal relationship between cigarette smoking and idiopathic pulmonary fibrosis.

Chapter 8: Cardiovascular Disease

1. The evidence is sufficient to infer a causal relationship between exposure to secondhand smoke and increased risk of stroke.

2. The estimated increase in risk for stroke from exposure to secondhand smoke is about 20–30%.

3. The evidence is sufficient to infer a causal relationship between the implementation of a smokefree law or policy and a reduction in coronary events among people younger than 65 years of age.

4. The evidence is suggestive but not sufficient to infer a causal relationship between the implementation of a smokefree law or policy and a reduction in cerebrovascular events.

5. The evidence is suggestive but not sufficient to infer a causal relationship between the implementation of a smokefree law or policy and a reduction in other heart disease outcomes, including angina and out-of-hospital sudden coronary death.

Chapter 9: Reproductive Outcomes

Congenital Malformations

1. The evidence is sufficient to infer a causal relationship between maternal smoking in early pregnancy and orofacial clefts.

2. The evidence is suggestive but not sufficient to infer a causal relationship between maternal smoking in early pregnancy and clubfoot, gastroschisis, and atrial septal heart defects.

Neurobehavioral Disorders of Childhood

1. The evidence is suggestive but not sufficient to infer a causal relationship between maternal prenatal smoking and disruptive behavioral disorders, and attention deficit hyperactivity disorder in particular, among children.

2. The evidence is insufficient to infer the presence or absence of a causal relationship between maternal prenatal smoking and anxiety and depression in children.

3. The evidence is insufficient to infer the presence or absence of a causal relationship between maternal prenatal smoking and Tourette syndrome.

4. The evidence is insufficient to infer the presence or absence of a causal relationship between maternal prenatal smoking and schizophrenia in her offspring.

5. The evidence is insufficient to infer the presence or absence of a causal relationship between maternal prenatal smoking and intellectual disability.

Ectopic Pregnancy

1. The evidence is sufficient to infer a causal relationship between maternal active smoking and ectopic pregnancy.

Spontaneous Abortion

1. The evidence is suggestive but not sufficient to infer a causal relationship between maternal active smoking and spontaneous abortion.

Male Sexual Function

1. The evidence is sufficient to infer a causal relationship between smoking and erectile dysfunction.

Chapter 10: Other Specific Outcomes

Eye Disease: Age-Related Macular Degeneration

1. The evidence is sufficient to infer a causal relationship between cigarette smoking and neovascular and atrophic forms of age-related macular degeneration.

2. The evidence is suggestive but not sufficient to infer that smoking cessation reduces the risk of advanced age-related macular degeneration.

Dental Disease

1. The evidence is suggestive but not sufficient to infer a causal relationship between active cigarette smoking and dental caries.

2. The evidence is suggestive but not sufficient to infer a causal relationship between exposure to tobacco smoke and dental caries in children.

3. The evidence is suggestive but not sufficient to infer a causal relationship between cigarette smoking and failure of dental implants.

Diabetes

1. The evidence is sufficient to infer that cigarette smoking is a cause of diabetes.

2. The risk of developing diabetes is 30–40% higher for active smokers than nonsmokers.

3. There is a positive dose-response relationship between the number of cigarettes smoked and the risk of developing diabetes.

Immune Function and Autoimmune Disease

1. The evidence is sufficient to infer that components of cigarette smoke impact components of the immune system. Some of these effects are immune activating and others are immune-suppressive.

2. The evidence is sufficient to infer that cigarette smoking compromises the immune system and that altered immunity is associated with increased risk for pulmonary infections.

3. The evidence is sufficient to infer that cigarette smoke compromises immune homeostasis and that altered immunity is associated with an increased risk for several disorders with an underlying immune diathesis.

Rheumatoid Arthritis

1. The evidence is sufficient to infer a causal relationship between cigarette smoking and rheumatoid arthritis.

2. The evidence is sufficient to infer that cigarette smoking reduces the effectiveness of the tumor necrosis factor-alpha (TNF-α) inhibitors.

Systemic Lupus Erythematosus

1. The evidence is inadequate to infer the presence or absence of a causal relationship between cigarette smoking and systemic lupus erythematosus (SLE), the severity of SLE, or the response to therapy for SLE.

Inflammatory Bowel Disease

1. The evidence is suggestive but not sufficient to infer a causal relationship between cigarette smoking and Crohn's disease.

2. The evidence is suggestive but not sufficient to infer a causal relationship between cigarette smoking and a protective effect for ulcerative colitis.

Chapter 11: General Morbidity and All-Cause Mortality

1. The evidence is sufficient to infer a causal relationship between smoking and diminished overall health. Manifestations of diminished overall health among smokers include self-reported poor health, increased absenteeism from work, and increased health care utilization and cost.

2. The evidence is sufficient to infer that cigarette smoking increases risk for all-cause mortality in men and women.

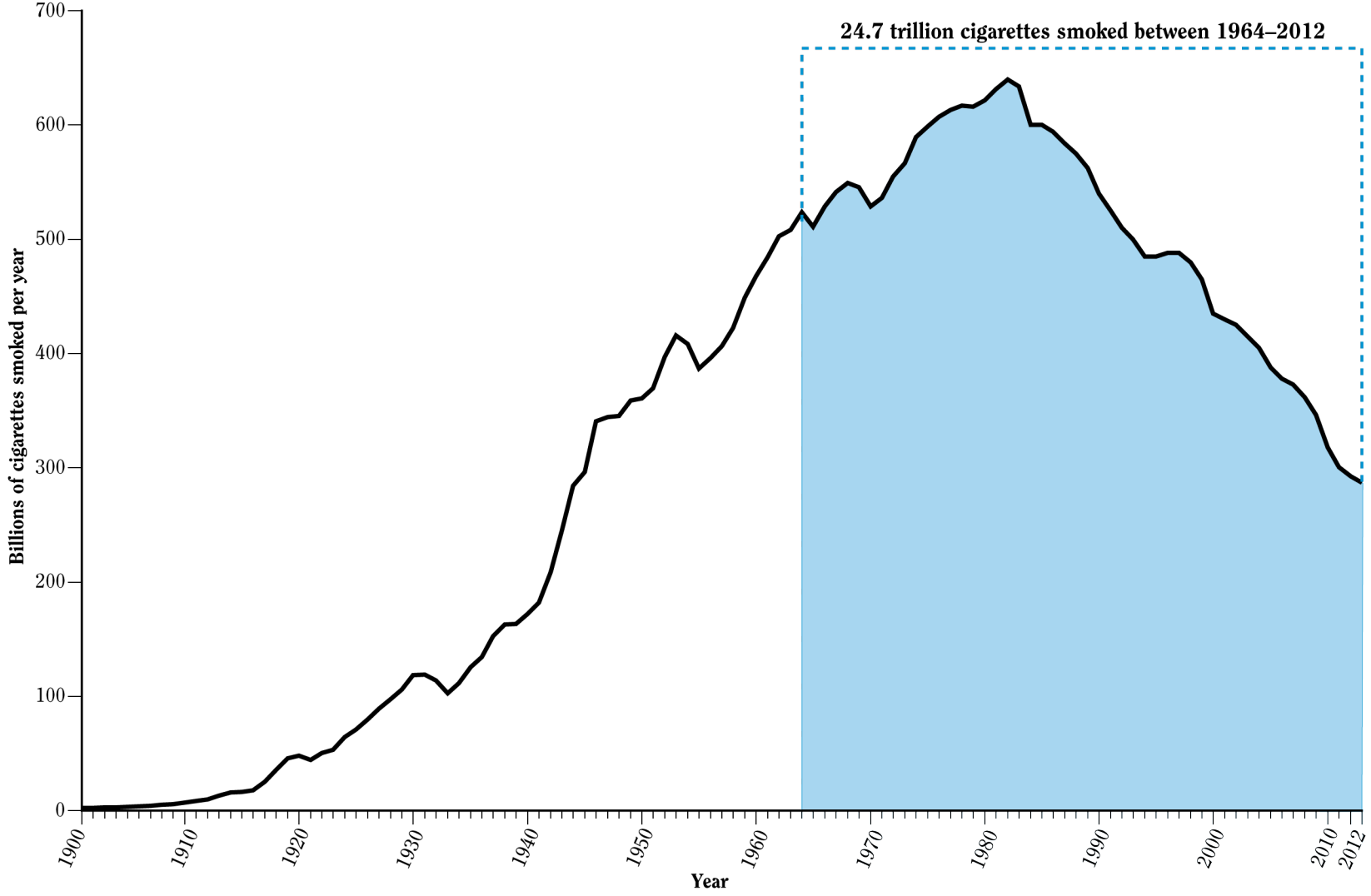
3. The evidence is sufficient to infer that the relative risk of dying from cigarette smoking has increased over the last 50 years in men and women in the United States.

Section 3: Tracking and Ending the Epidemic

The final section of the 50th anniversary Surgeon General's report on smoking and health covers the human and economic costs of the smoking epidemic in the United States, current trends in tobacco use and tobacco control, the status of interventions and programs that address the smoking epidemic, and a vision for a future that is free of death and disease caused by tobacco use.

Throughout this report, the overwhelming harm done to this nation's health by cigarette smoking is made clear repeatedly. Accumulated data from the past 50 years graphically illustrate the devastating loss of life and the economic waste that have flowed from the manufacture, marketing, sale, and consumption of combustible tobacco products. In this half-century, nearly 25 trillion cigarettes have been consumed, despite a significant drop in consumption per smoker (Figure 2). The annual costs attributed to smoking in the United States are between $289 billion and $333 billion, including at least $130 billion for direct medical care of adults over $150 billion for lost productivity due to premature death, and more than $5 billion for lost productivity from premature death due to exposure to secondhand smoke (Chapter 12).

Figure 2 Total cigarette consumption, United States, 1900–2012



Source: Miller 1981; U.S. Department of Agriculture 1987, 1996, 2005, 2007a,b; Centers for Disease Control and Prevention 2012.
Note: Data shown are annual total consumption of cigarettes. This differs from Figure 2.1, which reports the annual adult (18 years of age and older) per capita consumption.

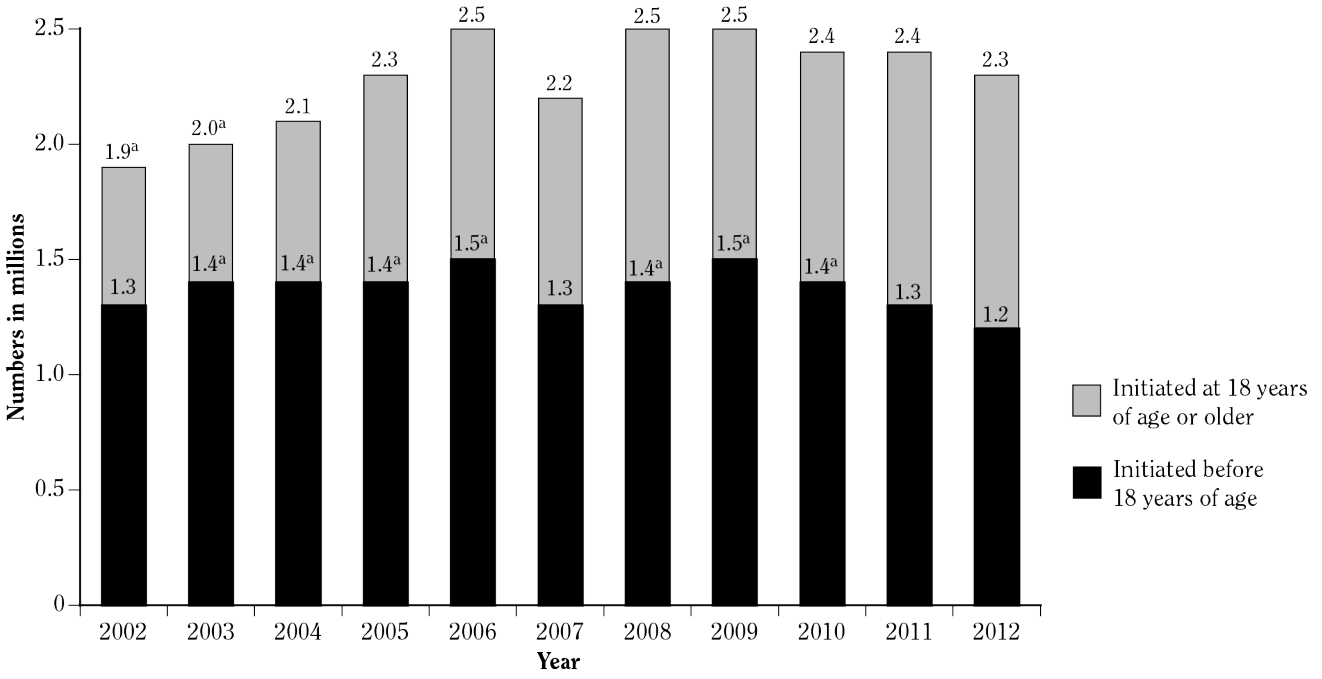
Despite decades of warnings on the dangers of smoking, nearly 42 million adults (Chapter 13) and more than 3.5 million middle and high school students continue to smoke cigarettes (USDHHS 2012). Significant disparities in tobacco use persist among certain racial/ethnic populations, and among groups defined by educational level, socioeconomic status, geographic region, sexual minorities (including individuals who are gay, lesbian, bisexual, and transgender, and individuals with same-sex relationships or attraction), and severe mental illness. The majority (88%) started smoking before 18 years of age, and nearly all first use of cigarettes occurs before 26 years of age (USDHHS 2012). The fraction of smoking initiation occurring after 18 years of age has been increasing over the past decade (Figure 3).

Tobacco industry advertising and promotional activities cause youth and young adults to start smoking, and nicotine addiction keeps people smoking past those ages (Chapter 14) (USDHHS 2012). Each year, for every adult who dies prematurely from a smoking-related cause, more than two youth or young adults become replacement smokers (Chapter 13) (USDHHS 2012). Although the prevalence of current smoking among high school-aged youth has declined, the total number of youth and young adults who started smoking increased from 1.9 million in 2002 to 2.3 million in 2012 (Figure 3). However, progress has been made in reducing initiation among youth younger than 18 years of age, with the total number of youth who initiated smoking before age 18 declining from 1.5 million in 2009 down to 1.2 million in 2012.

While attention has focused primarily on cigarette smoking, this and recent Surgeon General's reports review health risks and emphasize the need to monitor patterns of use of all combusted tobacco products, particularly the use of cigarette-like cigars and roll-your-own cigarettes using pipe tobacco. Most commonly, these products are used along with cigarettes. According to recent trends, the percentage of adults, 18 years of age and older—who smoke either cigarettes, cigars, or roll-your-own cigarettes made with pipe tobacco—has remained relatively steady (25–26%) since 2009 and has declined only a small amount since 2002 (Table 2).

Although recent trends emphasize the need for continued and vigorous tobacco control efforts, significant

Figure 3 Cigarette initiation during the past year among persons 12 years of age and older, by age at first use, 2002–2012



Source: Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002–2012.
[a]Difference between this estimate and the 2012 estimate is statistically significant at the 0.05 level.

Table 2 Percentage of tobacco product use in the past month among persons 18 years of age and older, 2002–2012

Substance	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total tobacco products[a]	30.8[b]	30.2[b]	29.6[b]	29.9[b]	30.1[b]	29.2[b]	28.8[b]	28.1	27.8	26.9	27.3
Cigarettes[c]	25.8[b]	25.2[b]	24.7[b]	24.7[b]	24.8[b]	24.1[b]	23.7[b]	23.0[d]	22.6	21.7	22.0
Smokeless tobacco	3.5	3.4	3.1[b]	3.3	3.5	3.3	3.6	3.5	3.6	3.3	3.6
Cigars	5.5	5.5	5.8	5.8	5.7	5.5	5.5	5.4	5.4	5.2	5.4
Pipe tobacco	0.8	0.7[b]	0.8[d]	0.9	1.0	0.8	0.8[d]	0.8	0.9	0.8	1.0
Cigarettes[c] or cigars	28.5[b]	27.9[b]	27.6[b]	27.7[b]	27.7[b]	27.0[b]	26.4[b]	25.8[d]	25.5	24.6	24.8
Cigarettes,[c] cigars, or pipe tobacco	28.8[b]	28.2[b]	27.9[b]	28.0[b]	28.0[b]	27.3[b]	26.7[b]	26.1	25.8	24.9	25.2

Source: Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2002–2012.
[a]Tobacco products include cigarettes, smokeless tobacco (i.e., chewing tobacco or snuff), cigars, or pipe tobacco.
[b]Difference between estimate and 2012 estimate is statistically significant at the 0.01 level.
[c]Past month cigarette use is defined as smoking during the 30 days preceding the survey and smoking 100 cigarettes or more in a lifetime. Respondents with an unknown lifetime number of cigarettes smoked were excluded from the analysis.
[d]Difference between estimate and 2012 estimate is statistically significant at the 0.05 level.

achievements have been made during the past five decades. In fact, historic success in tobacco control is considered one of the top public health achievements of the twentieth century (Centers for Disease Control and Prevention [CDC] 1999; Ward and Warren 2007). Today, in the United States there are more former smokers than current smokers, and success rates for quitting have been increasing among recent birth cohorts (Chapter 13). Interest in quitting is high across all segments of society. Patterns of tobacco use are also changing, with more people smoking intermittently and smoking fewer cigarettes; however, there is an increase in the use of tobacco products other than cigarettes, often concurrent with cigarettes.

The burden of smoking-attributable disease and premature death and its high costs to the nation will continue for decades unless smoking prevalence is reduced more rapidly than the current trajectory. The evidence in this report shows that the nation may fail to achieve the *Healthy People 2020* objective of reducing the prevalence of smoking among adults to 12%. Model estimates suggest that if the status quo in tobacco control in 2008 were maintained, the projected prevalence of smoking among adults in 2050 could still be as high as 15% (Chapter 15). Trends in smoking rates among youth and adults show progress, but the prevalence of current smoking among youth and adults is only slowly declining and the actual number of youth and young adults starting to smoke has increased since 2002 (Figure 3). Additionally, the use of multiple tobacco products is increasingly common, especially among young smokers. Concerns remain that use of these new products may increase initiation rates among youth and young adults, delay quitting, and prolong the smoking epidemic.

The tobacco industry continues to position itself to sustain its sales by recruiting youth and young adults and by maintaining current smokers as consumers of all their nicotine-containing products including cigarettes (see Chapters 13, 14, and 15). As reviewed in Chapter 14, U.S. District Judge Gladys Kessler entered her final opinion and order on August 17, 2006, and found that the tobacco industry defendants violated the *Racketeer Influenced and Corrupt Organizations* (*RICO*) *Act* by lying, misrepresenting, and deceiving the public "including smokers and the young people they avidly sought as 'replacement smokers,' about the devastating health effects of smoking and environmental tobacco smoke" (*U.S. v. Philip Morris* 2006:852). The *Tobacco Control Act* incorporates as congressional findings of fact Judge Kessler's determinations that "the major United States cigarette companies continue to target and market to youth," that the companies sought to "encourage youth to start smoking subsequent to the signing of the Master Settlement Agreement

in 1998," and that they "have designed their cigarettes to precisely control nicotine delivery levels and provide doses of nicotine sufficient to create and sustain addiction while also concealing much of their nicotine-related research" (*Tobacco Control Act* 2009, §2(47) – (49)).

Therefore, this report addresses the question: what steps are needed to end the tobacco epidemic? There are different ways to achieve this vision. Should the emphasis be on ending cigarette use?; ending the use of the most harmful tobacco products while reducing the harm of remaining products?; or ending the use of all tobacco products?

The scientific findings of the 2012 Surgeon General's report (USDHHS 2012) show that there are evidence-based strategies that can rapidly drop initiation and prevalence rates of smoking among youth to single digits. To reach this target, these strategies need to be fully implemented and sustained with sufficient intensity and duration. Without such increased and sustained action, 5.6 million youth younger than 18 years of age in this country today are projected to die prematurely from a smoking-related illness. But millions of these projected deaths could be averted, making tobacco control a highest priority in our overall public health commitment and strategy.

The scientific evidence is incontrovertible: inhaling the combustion compounds from tobacco smoke, particularly from cigarettes, is deadly. It has been stated that "The cigarette is also a defective product, meaning not just dangerous but *unreasonably* dangerous, killing half its long-term users. And addictive by design" (Proctor 2013, p. i27). As the list of diseases caused by smoking has continued to increase, the updated estimate of the annual number of deaths attributable to smoking and exposure to secondhand smoke is now approaching 500,000 (Chapter 12). This increase has occurred despite decreases in per capita cigarette consumption and prevalence of smoking, emphasizing our enhanced understanding of the increased lethality of cigarettes. The high risks of cigarette smoking and the historic and current patterns of tobacco use in the United States lead to a primary conclusion of this report:

- The burden of death and disease from tobacco use in the United States is overwhelmingly caused by cigarettes and other combusted tobacco products; rapid elimination of their use will dramatically reduce this burden.

Could the use of cigarettes and other combusted tobacco products be rapidly reduced in this country? As noted above, evidence-based strategies that can rapidly drop youth initiation and prevalence rates down to single digits have already been identified and used (USDHHS 2012). Chapter 14 reviews a broad range of well-defined and effective interventions proven to reduce smoking rates if implemented and sustained at funding levels consistent with CDC's recommended levels (Figure 4).

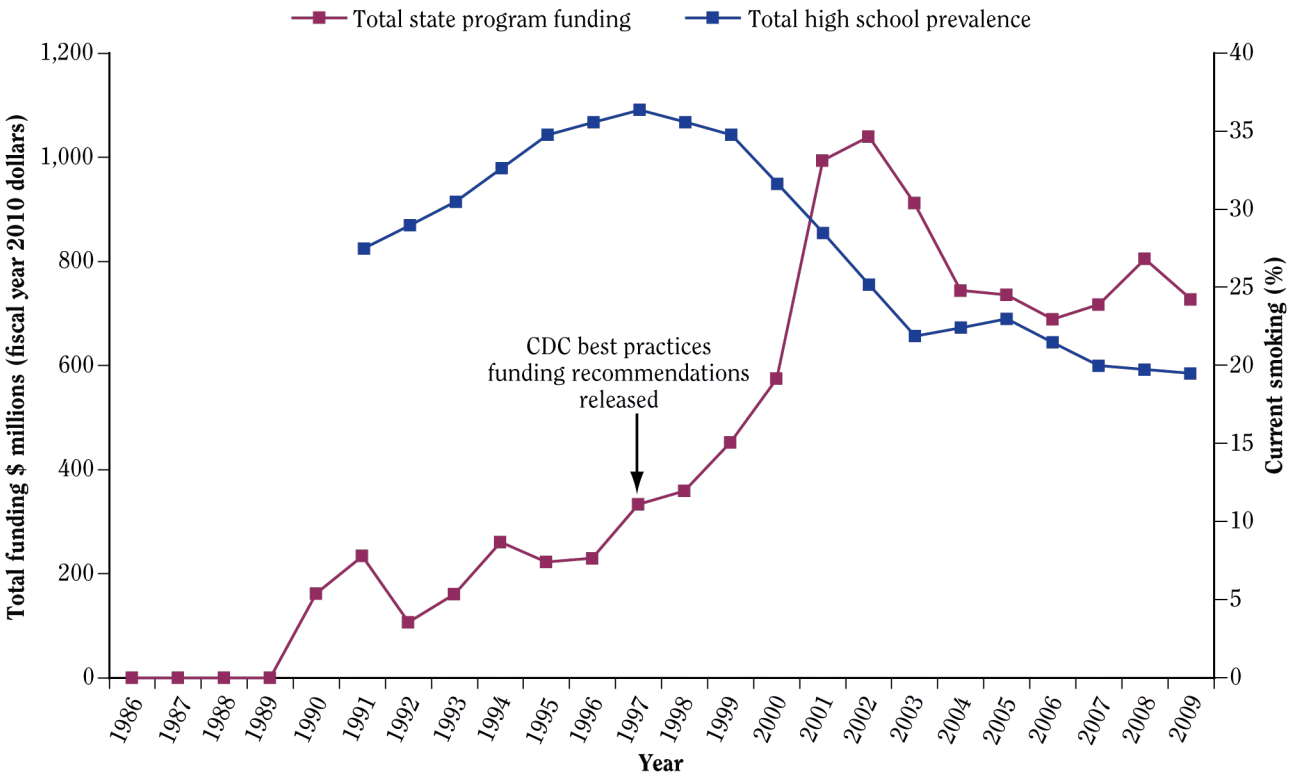
This and previous reports outline effective programs and policies: raising the retail price of cigarettes and other tobacco products, smokefree indoor air policies, high-impact media campaigns, full access to cessation treatments, and funding of comprehensive statewide tobacco control programs at the CDC recommended levels.

However, these five actions are not all that needs to be done. In considering options for reducing the health burden caused by smoking, many additional recommended actions have been defined in evidence reviews and guidance documents discussed in this report. For example, selected state experience suggests that all levels of government can enhance revenue collection and minimize tax avoidance and evasion through several promising policy approaches, such as implementing a high-tech cigarette tax stamp, improving tobacco licensure management, and making the stamps harder to counterfeit. These state practices could also be expanded to the national level with a track and trace system. A track and trace system, in the tobacco control context, is a system that can track goods from manufacture to distribution to sale, identifying points in the supply chain where taxes should be paid and confirm payment. Implementing such systems would also simultaneously retain the positive public health effects of taxation and protect product regulation in the market.

There is no question that these proven interventions need to be fully implemented and sustained at recommended levels. In addition to initiatives of the federal government, other factors in society can significantly affect social norms. Portrayals of tobacco use in U.S. films appear to have rebounded upward in the past 2 years (Chapter 14). In 2012, youth were exposed to an estimated 14.9 million in-theater tobacco-use impressions[1] in youth-rated films (Polansky et al. 2013). Youth who are exposed to images of smoking in movies are more likely to smoke; those who get the most exposure to onscreen smoking are about twice as likely to begin smoking as those who get the least exposure (USDHHS 2012). Actions that would eliminate the depiction of tobacco use in movies, which are produced and rated as appropriate for children and adolescents, could have a significant effect on preventing youth from becoming tobacco users.

[1]One impression equals one tobacco use incident on screen viewed by one audience member.

Figure 4 Total funding for state tobacco control programs, 1986–2010 (adjusted to fiscal year 2010 dollars)



Source: Project ImpacTEEN; University of Illinois at Chicago; CDC, Youth Risk Behavior Survey, 1991–2009. Current smoking defined as high school students who smoked on ≥1 of the past 30 days—United States.
Note: **CDC** = Centers for Disease Control and Prevention.

Faced with the challenge of achieving a vision of a society free of tobacco-related death and disease, a discussion has begun within the field of tobacco control about what has come to be called the tobacco "end game" in the published literature. This literature considers strategies that could be used in addition to the expanded implementation of the proven tobacco control interventions, to accelerate declines in the use of cigarettes and other combusted tobacco products and end the epidemic of disease and premature death caused by tobacco.

Chapter 15 discusses various end game strategies; the feasibility and applicability are reviewed. It has been suggested that an integrated national tobacco control strategy should be considered—based on a foundation of enhanced implementation of the proven strategies (taxation, smokefree areas, increased barrier-free cessation support, warning labels, public health campaigns, and restrictions on advertising, promotions, and sponsorship) into which the most feasible end game strategies are included (van der Eijk 2013). Examples of end game options which could complement the proven interventions in accomplishing our overall goal of a society free of tobacco-related death and disease include but are not limited to:

1. Reducing the nicotine content to make cigarettes less addictive (Benowitz and Henningfield 2013); and

2. Greater restrictions on sales, particularly at the local level, including bans on entire categoies of tobacco products (Berrick 2013; Malone 2013).

End game strategies might be aided by future approaches and devices for nicotine delivery that better substitute for the cigarette. As discussed in Chapter 14, various new products are increasingly being introduced into the market. In 2012 Lorillard acquired Blu Electronic Cigarettes, in 2013 R.J. Reynolds Tobacco Com-

pany introduced VUSE electronic cigarettes in limited markets, and Altria announced that it will introduce an electronic cigarette in 2014 (Esterl 2013; Lorillard 2013; Reynolds American 2013; Wells Fargo Securities Research 2013). Additionally, other electronic nicotine delivery systems have been developed and marketed by companies with little or no experience in developing and marketing traditional tobacco products (WHO 2009; Henningfield and Zaatari 2010; Cobb and Abrams 2011). As these new products are entering the marketplace rapidly, significant questions remain about (1) how to assess the potential toxicity and health effects of the more than 250 electronic cigarette brands; (2) the magnitude of reduced risk from electronic cigarettes versus continuing use of conventional cigarettes for individual smokers; (3) the need to weigh the potential individual benefits versus population risks; (4) how the advertising and marketing of these new products should be regulated; and (5) even assuming that electronic cigarettes could be sufficiently safe to the users and offer net public health benefits, there are significant questions about the manner in which they should be regulated (Benowitz 2013). Further research and attention to the consequences as well as regulatory measures will be necessary to fully address these questions. However, the promotion of electronic cigarettes and other innovative tobacco products is much more likely to be beneficial in an environment where the appeal, accessibility, promotion, and use of cigarettes are being rapidly reduced.

The following are chapter-specific conclusions from Section 3 of the report.

Chapter 12: Smoking-Attributable Morbidity, Mortality, and Economic Costs

1. Since the first Surgeon General's report on smoking and health in 1964, there have been more than 20 million premature deaths attributable to smoking and exposure to secondhand smoke. Smoking remains the leading preventable cause of premature death in the United States.

2. Despite declines in the prevalence of current smoking, the annual burden of smoking-attributable mortality in the United States has remained above 400,000 for more than a decade and currently is estimated to be about 480,000, with millions more living with smoking-related diseases.

3. Due to the slow decline in the prevalence of current smoking, the annual burden of smoking-attributable mortality can be expected to remain at high levels for decades into the future, with 5.6 million youth currently 0 to 17 years of age projected to die prematurely from a smoking-related illness.

4. Annual smoking-attributable economic costs in the United States estimated for the years 2009–2012 were between $289–332.5 billion, including $132.5–175.9 billion for direct medical care of adults, $151 billion for lost productivity due to premature death estimated from 2005–2009, and $5.6 billion (in 2006) for lost productivity due to exposure to secondhand smoke.

Chapter 13: Patterns of Tobacco Use Among U.S. Youth, Young Adults, and Adults

1. In the United States, the prevalence of current cigarette smoking among adults has declined from 42% in 1965 to 18% in 2012.

2. The prevalence of current cigarette smoking declined first among men (between 1965 and the 1990s), and then among women (since the 1980s). However, declines in the prevalence of smoking among adults (18 years of age and older) have slowed in recent years.

3. Most first use of cigarettes occurs by 18 years of age (87%), with nearly all first use by 26 years of age (98%).

4. Very large disparities in tobacco use remain across racial/ethnic groups and between groups defined by educational level, socioeconomic status, and region.

5. In the United States there are now more former smokers than there are current smokers. More than half of all ever smokers have quit smoking.

6. The rate of quitting smoking among recent birth cohorts has been increasing, and interest in quitting is high across all segments of society.

7. Patterns of tobacco use are changing, with more intermittent use of cigarettes and an increase in use of other products.

Chapter 14: Current Status of Tobacco Control

1. The evidence is sufficient to conclude that there are diverse tobacco control measures of proven efficacy at the population and individual levels.

2. The evidence is sufficient to conclude that advertising and promotional activities by the tobacco companies cause the onset and continuation of smoking among adolescents and young adults.

3. Tobacco product regulation has the potential to contribute to public health through reductions in tobacco product addictiveness and harmfulness, and by preventing false or misleading claims by the tobacco industry of reduced risk.

4. The evidence is sufficient to conclude that litigation against tobacco companies has reduced tobacco use in the United States by leading to increased product prices, restrictions on marketing methods, and making available industry documents for scientific analysis and strategic awareness.

5. The evidence is sufficient to conclude that increases in the prices of tobacco products, including those resulting from excise tax increases, prevent initiation of tobacco use, promote cessation, and reduce the prevalence and intensity of tobacco use among youth and adults.

6. The evidence is sufficient to conclude that smokefree indoor air policies are effective in reducing exposure to secondhand smoke and lead to less smoking among covered individuals.

7. The evidence is sufficient to conclude that mass media campaigns, comprehensive community programs, and comprehensive statewide tobacco control programs prevent initiation of tobacco use and reduce the prevalence of tobacco use among youth and adults.

8. The evidence is sufficient to conclude that tobacco cessation treatments are effective across a wide population of smokers, including those with significant mental and physical comorbidity.

Chapter 15: The Changing Landscape of Tobacco Control—Current Status and Future Directions

1. Together, experience since 1964 and results from models exploring future scenarios of tobacco control indicate that the decline in tobacco use over coming decades will not be sufficiently rapid to meet targets. The goal of ending the tragic burden of avoidable disease and premature death will not be met quickly enough without additional action.

2. Evidence-based tobacco control interventions that are effective continue to be underutilized and implemented at far below funding levels recommended by the Centers for Disease Control and Prevention. Implementing tobacco control policies and programs as recommended by *Ending the Tobacco Epidemic: A Tobacco Control Strategic Plan* by the U.S. Department of Health and Human Services and the *Ending the Tobacco Problem: A Blueprint for the Nation* by the Institute of Medicine on a sustained basis at high intensity would accelerate the decline of tobacco use in youth and adults, and also accelerate progress toward the goal of ending the tobacco epidemic.

3. New "end game" strategies have been proposed with the goal of eliminating tobacco smoking. Some of these strategies may prove useful for the United States, particularly reduction of the nicotine content of tobacco products and greater restrictions on sales (including bans on entire categories of tobacco products).

Accelerating the National Movement to Reduce Tobacco Use

These key conclusions of this report provide evidence that calls for dramatic action:

- The current rate of progress in tobacco control is not fast enough. More needs to be done.

- High levels of smoking-attributable disease and death costs will persist for decades into this twenty-first century unless more rapid progress is made in tobacco control. The current burden is unacceptable.

- The almost 500,000 annual premature deaths due to smoking and exposure to tobacco smoke are far too many. Even 100,000 or 200,000 annual attribut¬able deaths are far too many; yet this is a realistic projection of the burden well into the middle of this twenty-first century if more rapid progress is not made in tobacco control.

- The burden of death and disease from tobacco use in the United States is overwhelmingly caused by cigarettes and other combusted tobacco products; rapid elimination of their use will dramatically reduce this burden.

There are important lessons to be learned from other successes in public health. In confronting worldwide epidemics caused by smallpox and polio, the eradication of the diseases was the clear objective. From this single-minded focus, the best strategies and actions based on public health science and practice were applied, evaluated, refined, and sustained for decades. The results are now evident: smallpox was eradicated decades ago and polio is on the verge of elimination. The nation should firmly commit to this goal of creating a society free of tobacco-related death and disease by engaging all sectors of society to an equally single-minded focus.

In the last 50 years, the smoking rate in the United States has been cut by more than one-half (from 42.7% in 1965 to 18% in 2012). The Strategic Action Plan, *Ending the Tobacco Epidemic: A Tobacco Control Strategic Action Plan for the U.S. Department of Health and Human Services* (USDHHS 2010a), provides a critical framework to guide and coordinate efforts to reduce the smoking rate to less than 10% for both youth and adults in 10 years, averting millions of smoking-related deaths. This national commitment will require increased and sustained action to rapidly eliminate the use of cigarettes and other forms of combustible tobacco products. As end game strategies are being developed, the following actions should be implemented:

- Counteracting industry marketing by sustaining high impact national media campaigns like the CDC's Tips from Former Smokers campaign and FDA's youth prevention campaigns at a high frequency level and exposure for 12 months a year for a decade or more;

- Raising the average excise cigarette taxes to prevent youth from starting smoking and encouraging smokers to quit;

- Fulfilling the opportunity of the Affordable Care Act to provide access to barrier-free proven tobacco use cessation treatment including counseling and medication to all smokers, especially those with significant mental and physical comorbidities;

- Expanding smoking cessation for all smokers in primary and specialty care settings by having health care providers and systems examine how they can establish a strong standard of care for these effective treatments;

- Effective implementation of FDA's authority for tobacco product regulation in order to reduce tobacco product addictiveness and harmfulness;

- Expanding tobacco control and prevention research efforts to increase understanding of the ever changing tobacco control landscape;

- Fully funding comprehensive statewide tobacco control programs at CDC recommended levels; and

- Extending comprehensive smokefree indoor protections to 100% of the U.S. population.

Former WHO Director General Gro Brundtland was correct in 1999 in stating the need to evaluate current action from the perspective of our grandchildren and their children (Asma et al. 2002). As future generations look back on our current actions and knowledge of the tobacco epidemic, will current efforts show the commitment to public health and social justice set forth in our national plans and objectives?

This nation's decades-long battle against the tobacco epidemic has successfully prevented millions of premature deaths that would otherwise have occurred—an historic achievement by any measure. On the fiftieth anniversary of the landmark 1964 Surgeon General's report, this nation must rededicate itself not only to carrying forward the successful tobacco control efforts that have long been under way, but also to expanding and accelerating those efforts in full recognition of the challenge that remains.

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