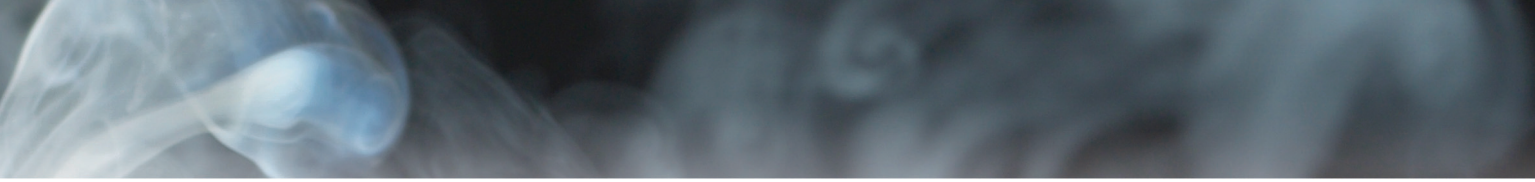
CDC's Tobacco Laboratory

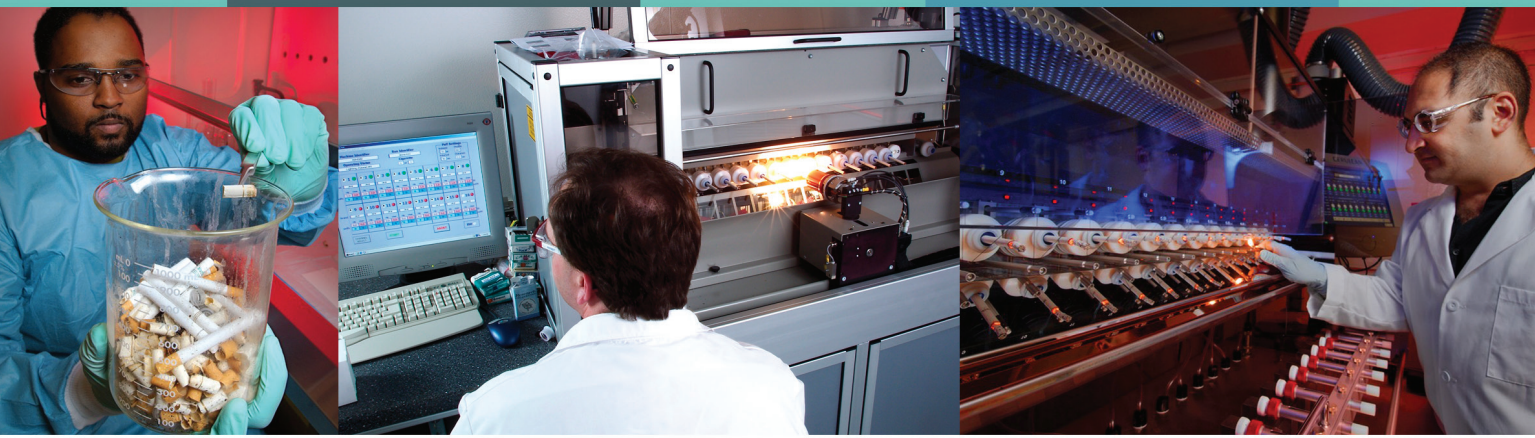
U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention

Division *of* Laboratory Sciences
National Center *for* Environmental Health



Updated October 2012

The Issue



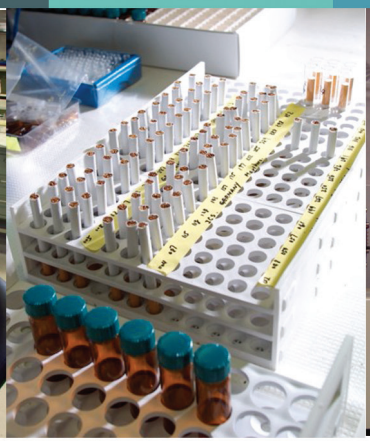
The Tobacco Epidemic

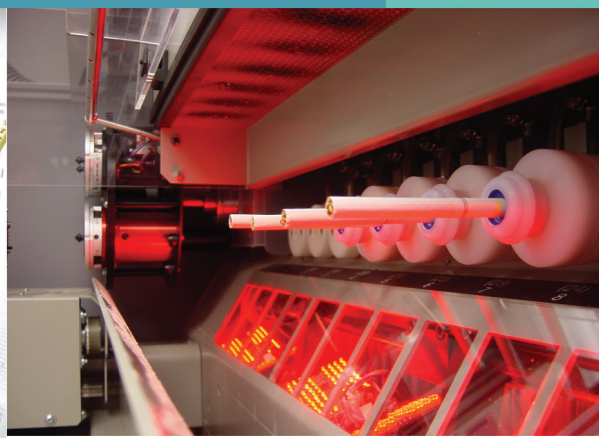
Tobacco use is the leading preventable cause of death in the United States. Smoking results in more than 400,000 premature deaths each year from conditions such as lung cancer, heart disease, and emphysema. Exposure to secondhand tobacco smoke causes 3,000 deaths from lung cancer each year, has immediate effects on the cardiovascular system, and causes coronary heart disease.

Prevention

The only proven means to prevent death and disease from smoking is to stop smoking or to never start. Nonetheless, about one in five (20%) Americans continues to smoke, even though the adverse health effects are well known and prevention and cessation programs are readily available. An effective program to reduce death and illness from tobacco use must combine efforts to decrease tobacco use with efforts to reduce adverse health outcomes for smokers and people exposed to secondhand smoke.

Public Health Impact





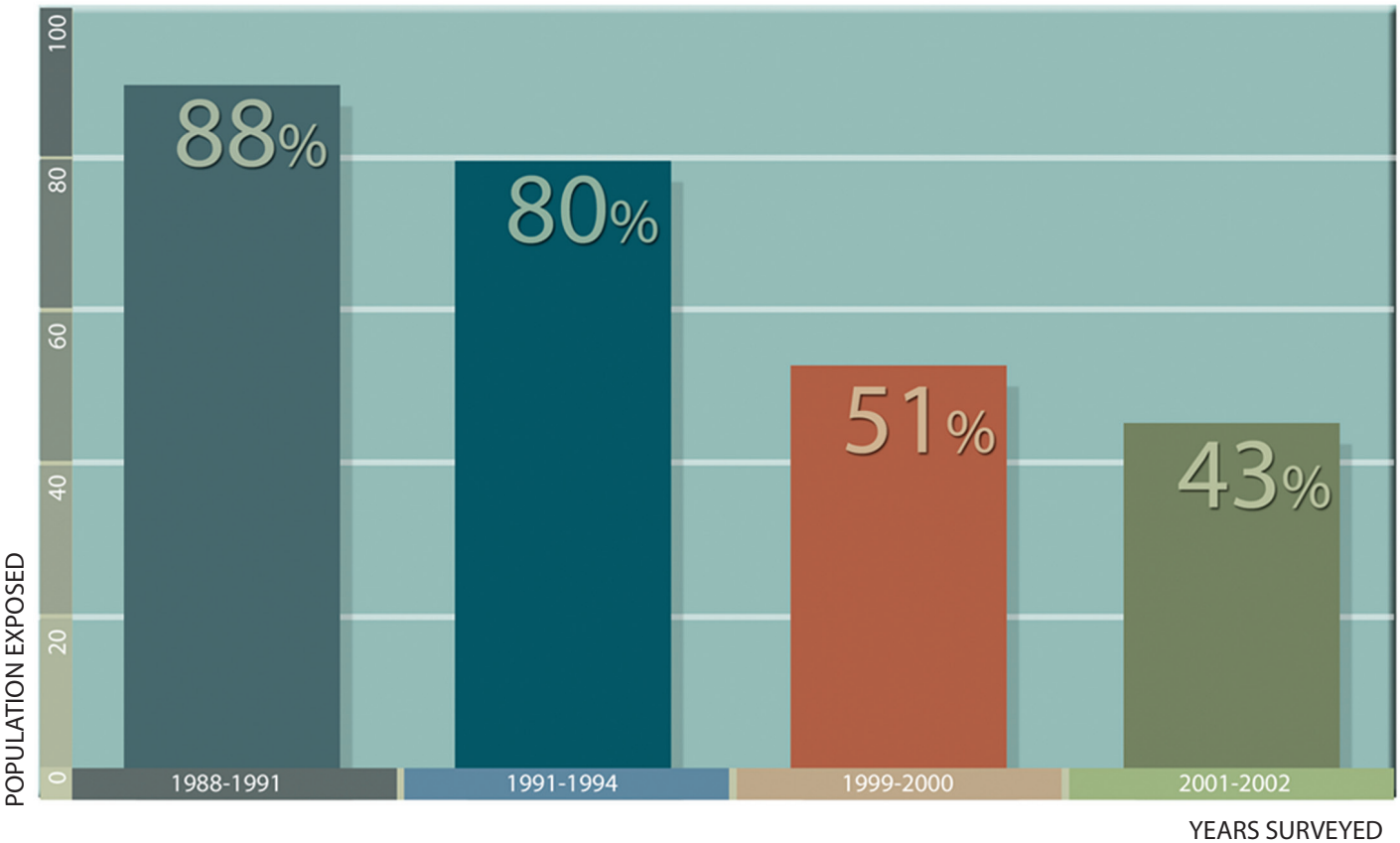
CDC's Response

CDC's Environmental Health Laboratory houses the Tobacco Laboratory, which examines both individual and population exposures to the chemicals in tobacco products. This laboratory is unique because it measures toxic and addictive substances in tobacco products, in smoke and other emissions, and in people who use tobacco products or are exposed to secondhand smoke. No other laboratory in the federal government has these capabilities.

Tobacco smoke contains more than 7,000 chemical components, and at least 250 of these chemicals are known to harm human health. By looking at all aspects of tobacco use and exposure, scientists in the Tobacco Laboratory are able to obtain a more accurate understanding of how smokers, non-smokers (through secondhand smoke), and smokeless tobacco users are exposed to harmful chemicals. In the early 1990's, the Tobacco Laboratory produced data showing that 88% of the nonsmoking population was exposed to tobacco smoke (Figure 4.1). This finding was used as a justification for restricting smoking in public buildings. The Tobacco Laboratory continued to monitor tobacco exposure over time, and follow up measurements showed a dramatic reduction in secondhand smoke exposure in all segments of the population as a result of these interventions.

Figure 4.1

Trends in exposure* of nonsmokers† to secondhand smoke in the U.S. population, National Health and Nutrition Examination Survey 1988-2002 (Pirkle et al., 2006)



* Serum cotinine ≥ 0.05 nanograms per milliliter
†Aged ≥ 4 years

Tobacco Research Model

CDC's Tobacco Laboratory uses five key approaches to guide comprehensive research on the health impact of tobacco use. Specifically, CDC analyzes tobacco products, tobacco smoke, and other emissions; determines how people use tobacco products; and measures tobacco exposure markers in people's bodies. In the future, CDC's research will develop short-term markers to study how using tobacco products changes cells in the body and how this affects disease (e.g. cancer, heart disease).

Tobacco Product Design and Content

Tobacco Smoke and Other Emissions

Tobacco Product Use

Tobacco Markers in the Body

Future Tobacco Research

Tobacco Product Design and Content

To understand how tobacco products are designed and what they contain, the Tobacco Laboratory:

- Develops laboratory methods to study cigarette design, contents, and emissions.
- Analyzes tobacco products from around the world, looking at differences in the product content and design as compared with American products.
- Performs research on smokeless tobacco, hand rolled tobacco, clove cigarettes, counterfeit cigarettes, bidis, dissolvable products, and water pipe tobacco.

More Information:

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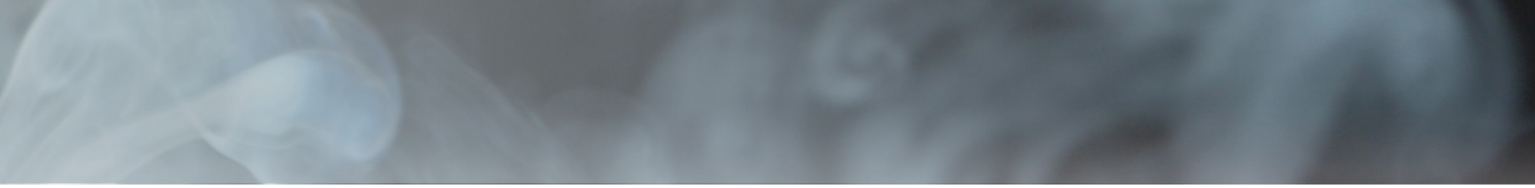
Tobacco Smoke and Other Emissions

To analyze tobacco smoke and other emissions, the Tobacco Laboratory:

- Uses smoking machines to collect both the particulate matter and gases in mainstream cigarette smoke generated according to international standards.
- Examines how product design influences smoke delivery to people.
- Collects smoke under various smoking conditions to examine how differences in smoking alters the delivery of toxic and addictive substances. People smoke cigarettes in different ways; even individuals vary how they smoke from cigarette to cigarette depending on many factors such as the product type, nicotine addiction, metabolic differences, and activities. As a result, there are large, natural variations in the amount of chemicals a smoker receives.



More Information:

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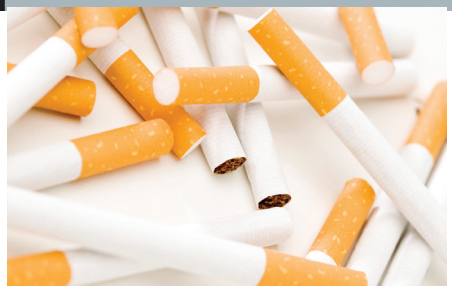
Polzin GM, Zhang L, Hearn BA, Tavakoli AD, Vaughan C, Ding YS, et al. Effect of charcoalcontaining filters on gas phase volatile organic compounds. Tob Control. 2008;17(Suppl 1):i10-6.

Watson CH, Trommel J, Ashley DL. Solid-phase microextraction-based approach to determine free-base nicotine in trapped mainstream cigarette smoke particulate matter. J Agric Food Chem. 2004;52:7240-5.



Tobacco Product Use

To understand how tobacco products are used (topography), the Tobacco Laboratory:

- Looks at how much smoke people draw from cigarettes. This can increase the nicotine they are getting, regardless of how the package is labeled.
- Studies products to assess how cigarette design influences the ways people use tobacco products.
- Looks at racial and genetic differences in smoking behavior and how the body breaks down nicotine (nicotine metabolism) and at how these influence adverse health effects from tobacco use.
- Looks at the transfer of smokeless product ingredients to people.
- Examines the factors that influence the uptake of nicotine and other chemicals.

More Information:

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Watson CH, McCraw J, Polzin G, Ashley DL. Development of a method to assess cigarette smoke intake. Environ Sci Tech. 2004; 38:248-53.

Tobacco Markers in the Body

To study the types and levels of tobacco markers in the body, the Tobacco Laboratory:

- Develops laboratory methods to measure tobacco exposure in human blood, saliva, serum, urine, hair, and meconium.
- Examines the effects of tobacco-related chemicals in at-risk populations (i.e., older adults, pregnant women, and children).
- Performs short-term studies looking at different populations affected by tobacco exposure.
- Measures markers related to tobacco use, such as cotinine and the tobacco-specific nitrosamine NNAL, and produces population-based reference levels segmented by age, sex, and race or ethnicity; this information is then published in CDC's National Report on Human Exposure to Environmental Chemicals.
- Partners with other leaders in the field of tobacco and smoking research, such as the Roswell Park Cancer Institute, the Mayo Clinic, and the University of California at San Francisco, to study specific chemicals in tobacco products and in people.

More Information:

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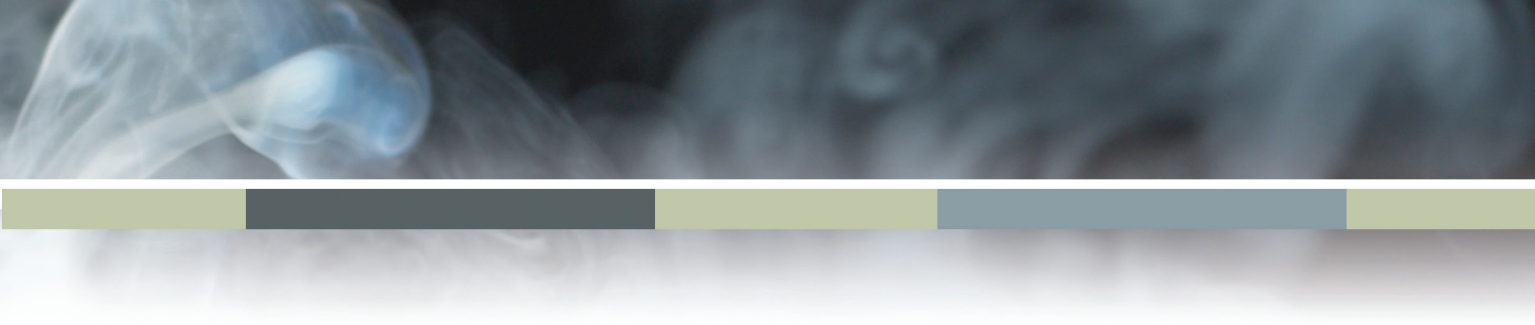
Seyler T, Bernert JT. Analysis of urinary 4-aminobiphenyl and selected metabolites in smokers and nonsmokers by tandem mass spectrometry. Biomarkers. 2011 May;16(3):212-21.

Xia Y, Bernert JT, Jain RB, Ashley DL, Pirkle JL. Tobacco-specific nitrosamine 4- (methylnitrosamino)-1-(3-pyridyl)-1-butanol (NNAL) in smokers in the united states: NHANES 2007-2008. Biomarkers. 2010 Nov 29.

Future Tobacco Research

In the future, the Tobacco Laboratory plans to:

- Look more closely at the effects of tobacco exposure on human biomarkers and other physiologic processes.
- Develop short-term markers of the long-term adverse health effects of tobacco use.
- Identify other chemicals in tobacco or product design features that boost or maintain addiction.
- Develop tests to measure major cancer-causing chemicals, pesticides, and other toxic chemicals–such as lead, chromium, heterocyclic amines, and cyanide–in tobacco products, tobacco smoke, and/or people exposed to tobacco.
- Examine individual smoking patterns to aid in developing optimized cessation strategies.



CDC works 24/7 keeping America safe from health, safety and security threats, both foreign and domestic. Whether diseases start at home or abroad, are chronic or acute, curable or preventable, human error or deliberate attack, CDC fights it and supports communities and citizens to prevent it. CDC is the nation's health protection agency –saving lives, protecting people from health threats, and saving money through prevention.

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