Cigarette smoking is the leading cause of preventable death in the United States and produces substantial health-related economic costs to society. \(^1\,^2\) This report presents the annual estimates of the disease impact of smoking in the United States during 1995-1999. CDC calculated national estimates of annual smoking-attributable mortality (SAM), years of potential life lost (YPLL), smoking-attributable medical expenditures (SAEs) for adults and infants, and productivity costs for adults. Results show that during 1995-1999, smoking caused approximately 440,000 premature deaths in the United States annually and approximately $157 billion in annual health-related economic losses. Implementation of comprehensive tobacco-control programs as recommended by CDC\(^3\) could effectively reduce the prevalence, disease impact, and economic costs of smoking.

The disease impact of smoking was estimated by using the Adult and Maternal and Child Health Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC) software. \(^4\) Smoking-attributable deaths were calculated by multiplying estimates of the smoking-attributable fraction (SAF) of preventable deaths by total mortality data for 18 adult and four infant cause of deaths. For adults, SAFs were derived by using relative risks (RRs) for each cause of death from the American Cancer Society’s Cancer Prevention Study-II (CPS-II; 1982-1988)\(^5\) and current and former cigarette smoking prevalence for two age cohorts: persons aged 35-64 years and persons aged \(\geq 65\) years. \(^6\) For infants, SAFs were calculated by using RRs of death for infants of women who smoked during pregnancy and maternal smoking rates from birth certificates for 46 states, the District of Columbia, and New York City (birth certificate data for 1995-1999 were not available for California, Indiana, South Dakota, and the remainder of New York). \(^7\) Smoking-attributable fire deaths\(^8\) were included in the SAM and YPLL estimates; SAM included lung cancer and heart disease deaths attributable to exposure to secondhand smoke. \(^9\) Smoking during pregnancy resulted in an average of 264,087 deaths among men and 178,311 deaths among women in the United States. Among adults, most smoking-related deaths were attributed to lung cancer (124,813), ischemic heart disease (81,976), and chronic airways obstruction (64,735). Smoking during pregnancy resulted in the death of 599 male and 408 female infants annually. Total annual SAM estimates include the deaths of 589 males and 377 females by residential fire during 1994-1998, \(^5\) and the deaths of 13,517 males and 22,536 females from lung cancer and heart disease attributable to exposure to secondhand smoke. \(^9\)

For men, the average number of annual smoking-attributable cancer deaths during 1995-1999 decreased by approximately 1,100 (to 102,812 deaths) from 1990-1994; the number of cardiovascular disease deaths fell by approximately 28,000 (to 90,906 deaths), and the number of respiratory disease deaths remained stable (53,713 deaths). For women, the average number of annual smoking-attributable cancer deaths during 1995-1999 increased by approximately 5,800 (to 54,664 deaths), the number of respiratory disease deaths increased by approximately 7,300 (to 44,429 deaths), and the number of cardiovascular disease deaths fell by approximately 5,400 (to 57,699 deaths). Compared with 1990-1994, during 1995-1999, the average number of annual smoking-attributable deaths from perinatal conditions fell from 926 to 598 for males and from 666 to 407 for females. Excluding adult deaths from secondhand smoke, each year SAM was responsible for an estimated 3,332,272 YPLL for men and 2,284,113 for women.
Adult male and female smokers lost an average of 13.2 and 14.5 years of life, respectively, because they smoked.

During 1995-1999, the average annual mortality-related productivity losses attributable to smoking for adults were $81.9 billion. In 1998, smoking-attributable personal health-care medical expenditures were $75.5 billion. For each of the approximately 46.5 million adult smokers in 1999, these costs represent $1,760 in lost productivity and $1,623 in excess medical expenditures. Smoking-attributable neonatal expenditures were $366 million in 1996, or $704 per maternal smoker ($8 per adult smoker). Maternal smoking accounted for 2.3% of total neonatal medical expenditures in 1996. The economic costs of smoking totaled $3,391 per smoker per year.

Reported by: JI Fellows, PhD, A Trosclair, MS, Office on Smoking and Health, EK Adams, PhD, CC Rivera, Div of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion, CDC.

CDC Editorial Note: During 1995-1999, a total of 442,398 persons in the United States died prematurely each year as a result of smoking. This number, which is higher than previous SAM estimates, reflects the inclusion of 35,053 secondhand smoking-attributable heart disease deaths and slightly higher smoking-related RRs for cancers, respiratory diseases, and infant conditions. The number of smoking-attributable deaths would have been greater if smoking prevalence among men, women, and pregnant women had not declined since the early 1990s.

Reported annual medical and productivity losses are larger than previous estimates of $53 billion and $43 billion, respectively. Among adults, the medical costs of smoking represented approximately 8% of personal health-care expenditures in 1998, which is consistent with the 6%-14% SAFs in previous studies. The larger productivity-loss figure reflects increases in the number of smoking-attributable deaths and in average earnings since the mid-1980s.

The findings in this report are subject to at least five limitations. First, the reported SAM figures were derived from smoking rates in the current year, whereas actual smoking-attributable deaths were the result of smoking in previous decades, when smoking rates were higher. Second, RRs were adjusted for the effects of age but not for other potential confounders. However, CPS-II data showed that education, alcohol, and other confounders had negligible additional impact on SAM estimates for lung cancer, chronic obstructive pulmonary disease, ischemic heart disease, and cerebrovascular disease. Third, deaths attributable to cigarette smoking, pipe smoking, and smokeless tobacco use were not included. Fourth, productivity losses did not include the value of lost work time from smoking-related disability, absenteeism, excess work breaks, and secondhand smoke-related disease morbidity and mortality. Finally, the neonatal medical costs of maternal smoking underestimate the probable true costs of smoking-attributable conditions among children because the future medical costs for infants affected by maternal smoking and the current costs of treating newly diagnosed secondhand smoke-related conditions among children aged 1-4 years were not included.

Cigarette smoking continues to be the principal cause of premature death in the United States and imposes substantial costs on society. For each of the approximately 22 billion packs sold in the U.S. in 1999, $3.45 was spent on medical care attributable to smoking, and $3.73 in productivity losses were incurred, for a total cost of $7.18 per pack. These costs provide a strong rationale for increasing funding for comprehensive tobacco-use interventions to the levels recommended by CDC. In California, decreases in smoking prevalence have resulted in reduced lung cancer and heart disease death rates. These results offer evidence of the potential benefits of expanding comprehensive tobacco-control programs in an effort to reduce current smoking prevalence by 50% by 2010.

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*SAFs for each disease are calculated by using the following equation: SAF = \([p_0 + p_1(RR_1) + p_2(RR_2)] - 1\) / \(p_0 + p_1(RR_1) + p_2(RR_2)\) where \(p_0\) = percentage of never smokers (persons who have never smoked \(>100\) cigarettes), \(p_1\) = percentage of current smokers (persons who have smoked \(>100\) cigarettes and now smoke every day or some days), \(p_2\) = percentage of former smokers (persons who have smoked \(>100\) cigarettes and do not currently smoke), \(RR_1\) = relative risk for current smokers relative to never smokers, and \(RR_2\) = relative risk for former smokers relative to never smokers.

Suspected Cutaneous Anthrax in a Laboratory Worker—Texas, 2002

MMWR. 2002;51:279-281

1 figure omitted

On March 6, 2002, CDC's National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from the director of Laboratory A to assist in the evaluation of a worker who had been diagnosed with cutaneous anthrax. Laboratory A, a provisionally approved Labo-
Laboratory Response Network level B laboratory, had been processing environmental samples for Bacillus anthracis in support of CDC investigations of the bioterrorist attacks in the United States during fall 2001. Since March 7, CDC has interviewed the ill laboratory worker and other workers at the laboratory and conducted environmental assessments of the workplace. This report summarizes the epidemiologic and environmental investigation of this case, which indicates that the likely source of exposure was the surface of vials containing B. anthracis isolates that the worker placed in a freezer on March 1. Laboratory workers handling specimens of B. anthracis should follow recommended procedures to minimize the risk of B. anthracis transmission and anthrax.

The laboratory worker was one of three employees of Laboratory A who had primary responsibility for processing environmental B. anthracis specimens. Neither this worker nor any of the other approximately 40 employees of Laboratory A had received anthrax vaccine. The laboratory worker did not handle B. anthracis-containing samples or cultures during February 19-28. On February 28, he cut a small bump on his right jaw while shaving, which bled briefly and then became itchy and irritated. On March 1, he assisted a co-worker moving vials containing aliquots of confirmed B. anthracis isolates from the biological safety cabinet (BSC) in the main laboratory to the freezer in an adjacent room. The co-worker had transferred the isolates from blood agar plates to the vials by collecting the growth with a swab. The co-worker removed the vials from the BSC and handed them to the patient. Without gloves, the patient took the vials from the co-worker, placed the vials in the freezer, and then washed his hands with soap and water. During the next 2-3 days, the worker’s facial wound increased in size and developed a scab. He also reported right cervical adenopathy, a low-grade fever, and swelling and erythema on his right cheek and neck. The patient’s health-care provider obtained a swab of the area underneath the scab and of the area under a vesicle, without cleansing the skin first. The health-care provider made a presumptive diagnosis of cutaneous anthrax and the patient was administered a 2-week course of ciprofloxacin.

The culture of this specimen was positive for B. anthracis on testing at Laboratory A and CDC. Because of culture results, the patient was admitted to the hospital on March 5 and treated with intravenous ciprofloxacin and doxycycline pending antimicrobial susceptibility testing. The lesion developed the characteristic eschar of cutaneous anthrax. A chest radiograph performed on admission demonstrated possible fullness of the mediastinum, but computed tomography of the chest was normal. The isolate was susceptible to ciprofloxacin and doxycycline, and the patient continued receiving ciprofloxacin. The patient’s symptoms improved during hospitalization, and he was discharged on March 9. Serologic studies for antibodies to B. anthracis are planned.

On March 5, Laboratory A’s certified industrial hygienist (CIH) performed environmental sampling of both Laboratory A and the patient’s residence. Seven wipe samples were taken at the laboratory (i.e., the top of the vials the patient had handled, the key to the freezer where the vials were placed, the doorknob of the freezer room, the centrifuge where specimens are prepared, the two BSCs where specimens are handled, and surfaces in the patient’s office in Laboratory A), seven were taken at the patient’s residence. The CIH then cleaned surfaces and equipment throughout the laboratory and the patient’s residence by using a disinfectant containing a phenolic and a quaternary ammonium compound, which are not sporicidal. The environmental samples were analyzed in Laboratory A. All samples were negative except the wipe sample collected from tops of the vials that the patient had handled, which was positive for B. anthracis. Confirmation of the vial top specimens at CDC is planned.

Workers reported that specimens processing of environmental samples suspected of containing B. anthracis is done under Biosafety Level 3 (BSL-3) conditions. These samples, including swab, wipe, dust (collected onto filter media by a vacuum), and air samples, are opened in a Class II, Type A BSC in a room designated for acid-fast bacillus specimens (AFB room). Personal protective equipment (PPE) for procedures performed in this room includes disposable, fluid-resistant laboratory coats, gloves, and either a NIOSH-certified N95 or P100 disposable, filtering-facepiece respirator, which are disposed of into a biohazard container before exiting the room. Work with purified B. anthracis cultures is performed in a separate BSC located in the main laboratory room. PPE at this workstation consists of gloves and a laboratory coat. Aliquots of confirmed isolates of B. anthracis are placed in vials and stored in a locked freezer in a room located off the main laboratory. A 10% bleach solution is routinely used to decontaminate surfaces after processing specimens potentially containing B. anthracis. However, because bleach caused labels to become dislodged, storage vials had been sprayed with 70% isopropyl alcohol instead of being wiped with bleach. By the time of the CDC site visit, Laboratory A personnel had obtained labels for storage vials that would not dislodge with bleach.

On March 7 and 8, CDC interviewed Laboratory A workers; none reported illness among other employees or their family members. CDC also conducted environmental sampling at Laboratory A on March 7, consisting of 40 surface wipe and 36 air samples. Wipe samples obtained with sterile polyester/rayon pads, moistened with sterile water, were collected from various surfaces in the laboratory and in the adjacent office area, including desks, flooring, door knobs, BSCs, heating, ventilation, air-conditioning return air grills, and laboratory equipment (including the centrifuge and shaker used for processing environmental samples). Air samples were collected in three locations in the laboratory: the AFB room, the area adjacent to the BSC used for anthrax work.

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The findings of this investigation indicate that the worker at Laboratory A likely developed cutaneous anthrax because of skin exposure to a contaminated surface. The health hazard evaluation also identified additional steps Laboratory A should take to ensure worker safety. Because *B. anthracis* can cause lethal infections and can form infectious aerosols, CDC and the National Institutes of Health recommend that laboratories producing quantities or concentrations of *B. anthracis* (i.e., culturing the organism for diagnostic purposes) apply practices appropriate to BSL-3 conditions.1 BSL-3 practices emphasize primary and secondary barriers to protect personnel in contiguous areas from exposure to potentially infectious aerosols. A vigorous program of routine decontamination with a 10% bleach solution is needed to kill viable *B. anthracis* spores on laboratory surfaces and vials. Alcohol is not sufficient to eliminate viable *B. anthracis* spores from contaminated surfaces.2 Gloves should be used whenever handling material that contains or might contain *B. anthracis*, and skin defects should be covered with an impermeable occlusive bandage while working in the laboratory. Work should be manipulated so that all *B. anthracis* sample manipulations are performed in a single room with most procedures performed in a BSC. Access to such rooms should be limited to laboratorians directly working with the samples.

The Advisory Committee on Immunization Practices developed guidelines for routine vaccination with anthrax vaccine.3 This suspected case of laboratory-acquired cutaneous anthrax highlights the need for anthrax vaccination, in addition to standard laboratory safety procedures, for laboratorians who work routinely with *B. anthracis* specimens. CDC will work with state and local health departments to identify and vaccinate these laboratory workers.

This case is defined by CDC as a suspected case of cutaneous anthrax rather than a confirmed case4 because processing of the swab of the lesion at the same laboratory where the suspected exposure occurred introduces the possibility of contamination of the patient's sample with *B. anthracis* from the laboratory. However, this patient's clinical syndrome and environmental exposure are consistent with cutaneous anthrax.4 CDC will update the surveillance status of this case as the results of other laboratory tests (e.g., serologic tests) become available.

Any exposure leading to a suspected case of cutaneous anthrax requires a public health investigation to identify other exposures in the same setting that might have led to other cases of cutaneous or inhalational anthrax. Local public health authorities should be notified immediately and appropriate laboratory procedures followed when treating clinicians suspect anthrax. This investigation did not identify inhalation exposures, and CDC does not recommend prophylaxis for the prevention of cutaneous anthrax. Active surveillance for cutaneous and inhalational disease should be ongoing among laboratorians working with *B. anthracis*.

Acknowledgment

This report is based on data contributed by D Mattorano, MS, B King, MPH, D Booher, Div of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health, CDC.

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