

Environmental Tobacco Smoke

Health Effects and Prevention Policies

Council on Scientific Affairs, American Medical Association

The US Environmental Protection Agency report released in January 1993, *Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders*, has stirred considerable discussion and interest in the issues surrounding tobacco and health. The report addresses major health effects of environmental tobacco smoke (ETS), concluding (1) that ETS is causally associated with lung cancer in nonsmoking adults and should be classified as a group A, or *known* human carcinogen, with approximately 3000 excess deaths yearly; (2) that ETS produces an increased risk of development of acute lower respiratory tract irritation, asthma, and acute lower respiratory tract infections in children exposed in the home; and (3) that ETS is associated with an increase risk of sudden infant death syndrome. Other studies implicate ETS in between 35 000 and 40 000 premature deaths each year from cardiovascular disease. The Council on Scientific Affairs (CSA) agrees that ETS should be classified as a human carcinogen, and strongly supports the findings of other groups concerning both lung cancer and ETS-induced respiratory tract illnesses in children. The CSA concludes that exposure to passive smoke, whether in utero or during infancy, is associated with an increased risk of sudden infant death syndrome. The CSA agrees that the available evidence suggests that ETS exposure leads to increased risk for cardiovascular disease. It is clear that these morbidity and mortality estimates represent a significant public health threat that demands attention from the health community as well as government regulatory agencies involved with health protection.

(*Arch Fam Med.* 1994;3:865-871)

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lower respiratory tract infections, middle ear effusions, asthma, and respiratory tract irritation in children exposed in the home; and (3) ETS is associated with an increase risk of sudden infant death syndrome (SIDS). The significance of the report extends far beyond its science, and its influence will shape public policy in a variety of ways. Some tobacco-control advocates think that its impact will rival the first report by the US Surgeon General on smoking and health in 1964.

This Council on Scientific Affairs (CSA) report reviews the scientific and public policy issues surrounding ETS for physicians and their patients, and emphasizes the public health impact imposed by

From the Group on Science and Technology, American Medical Association, Chicago, Ill.

Members of the Council on Scientific Affairs

Yank D. Coble, Jr, MD (*Chairman*), Jacksonville, Fla; Ronald M. Davis, MD, Lansing, Mich; C. Alvin Head, MD, Boston, Mass; John P. Howe III, MD, San Antonio, Tex; Mitchell S. Karlan, MD, Beverly Hills, Calif; William R. Kennedy, MD, Minneapolis, Minn; Patricia Joy Numann, MD, Syracuse, NY; Monique A. Spillman, Dallas, Tex; W. Douglas Skelton, MD (*Vice-Chairman*), Macon, Ga; Richard M. Steinhilber, MD, Cleveland, Ohio; Jack P. Strong, MD, New Orleans, La; Henry N. Wagner, Jr, MD, Baltimore, Md.

AMA Staff

James R. Allen, MD, MPH (*Secretary*); Robert C. Rinaldi, PhD (*Assistant Secretary*).

Staff author: Thomas P. Houston, MD, Chicago, Ill.

ETS and the benefits that should be realized by education and public policy action designed to counter its threat.

THE RISK OF LUNG CANCER AMONG NONSMOKERS DUE TO ETS

Several major reviews have been published regarding the health effects of ETS. The 1986 US Surgeon General's report,² a 1986 review by the National Research Council,³ and a review article⁴ published in Britain in the same year linked ETS to respiratory tract illnesses in children and to lung cancer in nonsmokers. The International Agency for Research on Cancer⁵ also found that ETS is associated with lung cancer. Since those studies appeared, other reports have been published that continue to affirm the carcinogenicity of ETS. The National Institute of Occupational Safety and Health⁶ reviewed the data concerning ETS in its *Current Intelligence Bulletin* series and concluded that ETS is "a potential occupational carcinogen" and that "simply eliminating tobacco use from the workplace" is the best method of dealing with this hazard. Another report,⁷ supported in part by R. J. Reynolds Nabisco, made a "best-estimate synthesis" of more than 2900 articles on passive smoking and concluded that "the weight of evidence is compatible with a positive association between resi-

dential exposure to ETS and the risk of lung cancer."

The EPA report¹ reviewed these and other studies, and critically examined the data available in four cohort studies and 26 case-control studies on the link between ETS and lung cancer. The studies reviewed by the EPA approximately doubled the population size under study since the 1986 reports. The EPA conclusion that ETS causes lung cancer in nonsmokers is based on a total weight of evidence, including biologic plausibility, consistency of response, the broad-based nature of evidence, and dose-response associations. Since the release of the EPA report, four more studies⁸⁻¹¹ have been published that reaffirm the EPA conclusions regarding lung cancer.

The presence of carcinogens in ETS should not be in question, and it should not be surprising that such chemicals are abundant in ETS. Mainstream smoke contains more than 4000 identified substances,^{12,13} nearly four dozen of which are carcinogenic.^{5,13} Environmental tobacco smoke, composed of sidestream smoke from the smoldering cigarette, exhaled mainstream smoke, and other components that escape from the cigarette during smoking, contains many of these toxic and carcinogenic substances, and other components in ETS are cocarcinogenic tumor initiators or tumor accelerants.³ Examples of these recognized carcinogens include

nickel, benzene, polonium 210, benzo[*a*]pyrene, and formaldehyde. Sidestream smoke contains a higher concentration of some of these carcinogens than mainstream smoke, including the volatile amines and the nitrosamines.³

Theories of carcinogenesis generally involve repeated exposure over time to an irritant, chemical toxin, or radioactive particle leading to abnormal tissue growth that is identified as cancer. That ETS should be implicated in such a process is biologically plausible, given what is known about the dose and time factors involved in the effects of active smoking and its well-documented carcinogenesis. Absorption of tobacco-specific smoke constituents have been measured sufficiently in persons exposed to ETS to conclude that such exposure is ubiquitous and that the magnitude of the doses of those constituents establishes that ETS exposure constitutes a real risk.^{2,3,14,15}

The studies reviewed in the EPA report concentrated on spousal exposure to ETS in the home setting, with female never-smokers comprising the majority of the population examined. The 27 case-control studies used more than 3000 cases and 6000 controls; the four cohort studies followed up nearly 300 000 female never-smokers. The studies classified women as "exposed" or "unexposed" to ETS based on marriage to a smoker or other reports of smoking in the subject's environment. Sufficient data for dose-related exposure was available in 17 studies.

The EPA scientists accounted for smoker misclassification, study size, occupational and dietary factors, personal and family history of lung disease, heat and cooking sources, and other sources of potential error in their report. European studies on ETS are relatively small, accounting for only 5% of the weight of all studies. China's data are confounded by the frequent use of oil for cooking and coal for heating,

both of which are sources of indoor air pollution; coal use is implicated in carcinogenesis.

The EPA report has been criticized by the tobacco industry because of its use of a "one-tailed" test in its analysis of the epidemiologic data about ETS and cancer. The EPA used a one-tailed test with a standard 5% rejection region; this test's use is basic statistical theory, depending on whether an observed effect would lie in one direction only. The EPA report points out that this method is appropriate because of the knowledge that exists about active smoking and lung cancer and the high degree of similarity between mainstream and ETS constituents, making the potential for a protective effect from ETS (the second "tail") illogical.¹ An 18-member independent science advisory board convened by EPA reviewed the ETS report and conducted two public hearings as part of its process. The American Medical Association, the voluntary health agencies, and other health and scientific groups presented reviews of the report and the EPA methodology, endorsing the EPA report at the science advisory board hearings. The board unanimously concurred with the EPA methodology and findings. The National Cancer Institute has also endorsed the EPA report.

The EPA analysis showed that 24 of the 30 studies demonstrated an increased risk of lung cancer in those exposed to ETS; the increased risk in nine of the studies

were statistically significant (**Table**).¹ The proportion of studies that showed a statistically significant increase in lung cancer risk (nine of 30) is estimated by their scientists to be highly unlikely to have occurred by chance (probability <1:10 000).¹ Furthermore, they found that all 17 studies categorizing exposure to ETS with a dose-response factor demonstrated an increased risk of lung cancer, with nine of 17 showing statistical significance (probability due to chance less than one per million).¹

The review by Repace and Lowery¹⁶ of risk assessment studies concerning ETS found agreement of a similar order of magnitude (mean [\pm SD] of 5000 \pm 2400 cancer deaths per year) among eight of nine studies. The EPA report's risk analysis showed similar findings, that about 3000 excess deaths per year from lung cancer are attributable to ETS.¹

The above studies, conducted by different scientific organizations and researchers, have concluded that a causal relationship exists between ETS and lung cancer.

RESPIRATORY DISEASE IN CHILDREN EXPOSED TO ETS

Pediatric physicians have long been aware of the clinical evidence linking parental smoking with a variety of respiratory diseases in children. Exposure to ETS has been linked with increased medical care utilization by children for respiratory com-

plaints,¹⁷⁻¹⁹ more school absences, and increased health care costs for smoke-exposed children.^{17,19,20} These problems are especially troublesome in very young children and in those born prematurely or with low birth weight, many of whom may have been exposed to the toxins in tobacco smoke in utero.

The US Surgeon General,² the National Research Council,³ and the EPA¹ reports all reviewed the relevant literature and concurred that ETS is associated with excess risk of the above conditions among exposed children.

As with the lung cancer relationship to ETS exposure, there is biologic plausibility in the assumptions made in the conclusions of the reviews, since demonstrable measures of allergy (increased IgE levels among smoke-exposed children) and decreased pulmonary function exist in the at-risk group.^{1,3} Middle-ear disease may be mediated by decreased mucociliary function in the eustachian tubes similar to the effect of smoke on the lungs, or perhaps by the inflammatory effect of smoke constituents.

The studies that implicate cigarette smoke exposure as a causal factor in asthma are especially compelling, with increased utilization of medical care among smoke-exposed children and, as with the other illnesses studied, a dose-response relationship. The EPA report estimates that between 8000 and 26 000 new cases of asthma per year are attributable to ETS,¹ and that as many as 1 million asthmatic children could suffer acute exacerbations from ETS exposure yearly. In addition, it estimates that between 7500 and 15 000 hospitalizations for lower respiratory tract infections yearly (eg, pneumonia and bronchitis) may be attributable to ETS exposure.¹ Airway hyperreactivity, inflammatory changes in the airways, and the heightened allergic response by exposed children may be implicated in this problem. Since the

Summary of the Studies Reviewed by the Environmental Protection Agency (EPA), Pooled by Country*

Country (No. of Studies)	Combined Relative Risk (Range)	P
Greece (2)	2.01 (1.92-2.08)	<.01
Hong Kong (4)	1.48 (0.74-2.51)	<.01
Japan (5)	1.41 (1.07-2.55)	<.01
United States of America (11)	1.19 (0.68-2.01)	.02
Western Europe (4)	1.17 (1.01-1.97)	.22
China (4)	0.95 (0.77-2.16)	>.5

*Adapted from EPA report, Table 5.9.¹

EPA report, two studies^{21,22} and another comprehensive review²³ have been published that strengthen the links between ETS exposure and childhood asthma.

Parents, day care and nursery workers, physicians, teachers, and others who are in daily contact with children need to be made aware of these findings. Children's vulnerability to ETS and the difficulty they have in protecting themselves from a threat imposed by adults places the burden of reducing or eliminating ETS exposure on adults in protective capacities. Elimination of ETS exposure can help decrease the primary incidence and recurrence of respiratory tract illnesses in children.

ETS AND SIDS

Sudden infant death syndrome, sometimes known as crib death, describes the otherwise unexplained deaths of infants up to 1 year of age. The deaths usually occur during sleep and are unexpected; no other findings are present at autopsy. It is the leading cause of death between ages 1 month and 1 year, accounting for about 5000 deaths per year.²⁴ Maternal smoking (prenatal and postnatal) has been implicated as a risk for SIDS.

The EPA report reviewed much of the literature available at the time and concluded that "strong evidence" exists for an increased risk of SIDS among infants whose mothers smoke, independent of all other known risk factors for SIDS.¹ The studies that were reviewed showed an increased relative risk ranging from 1.6 to 5.1, with a dose-related enhancement of risk in four²⁵⁻²⁸ of the eight reports reviewed. A more recent review²⁹ of data from the National Maternal and Infant Health Survey differentiated exposure before and after delivery, and concluded that intrauterine and postnatal exposure to the effects of smoking are associated with an increased risk of SIDS.

HEART DISEASE

Just as active smoking has been causally associated with the genesis of lung cancer, it is also a major cause of premature morbidity and mortality from cardiovascular disease. Given the similarities in the toxic chemicals in mainstream smoke and in ETS, it seems inherently plausible that ETS exposure could lead to increased risk for heart disease. A recent experimental study³⁰ found that atherosclerosis was accelerated and that platelet function was adversely affected among ETS-exposed rabbits, independent of serum lipid levels and with a dose-response relationship. The authors suggest that the results are consistent with epidemiologic data about ETS and heart disease.

Glantz and Parmley³¹ reviewed 10 studies that link ETS to heart disease, finding that nonsmokers exposed in the home setting had an increased overall cardiovascular relative risk of 30%. Several of the larger studies³²⁻³⁶ show a dose-related response, with higher risk of death from heart disease positively related to the level of ETS exposure. More recently, Steenland³⁷ reviewed the available literature on cardiovascular risk and ETS and predicted that spousal exposure to ETS could be responsible for 15 000 to 19 000 excess premature deaths per year, if the risk estimate is assumed to be correct. Since ETS exposure in the workplace may lead to an even higher relative risk than home exposure,³⁸ the total excess premature heart disease deaths from ETS exposure could be as high as 35 000 to 40 000 yearly.³⁷ This figure is similar to estimates of ETS-induced cardiovascular mortality by Wells³⁹ and Glantz and Parmley.³¹

The American Heart Association Council on Cardiopulmonary and Critical Care⁴⁰ reviewed these and other data, and concluded that ETS exposure is "a major preventable cause of cardiovascular disease and death." Their review sup-

ports the higher (35 000 to 40 000) estimates of cardiovascular mortality, given the ratio of lung cancer to cardiovascular disease from active smoking, the wide range of deleterious cardiovascular effects from ETS exposure, and the multiple potential points of exposure to ETS besides the home.

The CSA agrees that the available evidence strongly suggests that ETS exposure leads to increased risk for cardiovascular disease.

PUBLIC POLICY IMPLICATIONS

From the perspective of patient and physician advocacy, several important public policy issues are at stake. The EPA report, although not a regulatory document, will lend great support to public health officials, governmental regulatory agencies, and medical organizations as they attempt to inform and protect their constituencies with respect to ETS. Adoption of the report's policy implications will further the trend in our society toward social unacceptability of smoking, and especially of the involuntary, unwanted exposure to a known cause of illness and death.

While education will likely be the main vehicle for influencing ETS exposure in the home, regulatory and legislative action may be more likely to curtail ETS exposure in the workplace. Hundreds of cities and counties throughout the United States have enacted "clean indoor air" ordinances that affect the workplace, restaurants, and other public places. This activity increased since the release of the EPA report's draft version in 1990. As of October 1993, for example, laws have been enacted that completely eliminate smoking in restaurants (14 cities), in workplaces (11 cities), or in both of these areas (24 cities and counties).⁴¹ Worksite data in a California survey revealed that nonsmoker exposure to ETS ranges widely. A low exposure rate of 9.3% was experienced in smoke-free work

sites; 23.2% reported exposure when work-area smoking restrictions were in place but smoking was allowed in public areas; 46.7% reported exposure when smoking was not banned in work areas; and 51.4% reported exposure when smoking restrictions were not in place in the work site.⁴² In addition, some occupations such as employees of restaurants and bars have significantly higher ETS exposures than do office workers or those exposed in the home; these employees may suffer increased risks of lung cancer as a result.⁴³ Protection from ETS exposure risks for nonsmoking employees should be accomplished by creation of smoke-free workplaces, including restaurants and bars.

At the federal level, the Occupational Safety and Health Administration is responsible for protection from hazards in the workplace, including occupational carcinogens. The EPA and the National Institute of Safety and Health reports and other recent data concerning ETS and preventable disease and death should become the building blocks on which the Occupational Safety and Health Administration takes action to eliminate smoking in the workplace. The American Medical Association is currently active in efforts supporting proposed Occupational Safety and Health Administration regulations to ban smoking in the workplace.

The Americans With Disabilities Act is another avenue for relief from ETS exposure. "Disability" is defined under the Act as "... a physical impairment that limits one or more of the major life activities..." "Physical impairments" include conditions that affect the respiratory and cardiovascular systems. "Major life activities" include breathing and working. It would appear that protection from ETS for asthmatics, for example, is just as reasonable to expect as physical access to buildings for persons confined to wheelchairs.

The public perceives risk differ-

ently when it recognizes the difference between an assumed risk and one that is imposed without the control or consent of those who may be affected. This is important because a well-informed public will, in many jurisdictions, help decide how to reduce the risk of ETS. One of the principal means of eliminating the risk will be further efforts to limit exposure by restricting where tobacco can be smoked. Ballot initiatives, local and state clean indoor air legislation and regulation, and voluntary adoption of smoke-free workplace policies to enhance health protection from the lethal effects of cigarette smoke exposure are examples of remedies that can be used to control ETS.

It is imperative that the public, physicians, employers, and public policy makers become educated about the problems posed by ETS. Families with children and their physicians, for instance, must clearly understand the risks of childhood exposure to ETS and act accordingly. Employers can be educated about their responsibilities to the public and to their employees regarding ETS, since the Americans With Disabilities Act as well as potential employee grievances under workers' compensation laws might be brought to bear in cases of ETS exposure.

A variety of public and private initiatives are under way that should help make this risk communication message more personally meaningful. These include communication campaigns by the EPA, the Centers for Disease Control and Prevention's Office on Smoking and Health, the American Heart Association, and Americans for Nonsmokers' Rights. The American Medical Association is collaborating actively with several of these groups in this effort.

The tobacco industry continues to deny the relationship between smoking and ill health, and is employing a massive public relations campaign to press its arguments. During June 1994, tobacco companies began purchasing full-

page newspaper advertisements refuting the dangers of ETS, for example. The tobacco industry fears that public sentiment about ETS will accelerate the pace toward a smoke-free society, thereby eroding its profit margins in this country. Widespread adoption of public policy measures that protect against the hazards of ETS will be a significant defeat for them. Because the EPA report and other information about ETS strengthens the hand of the health community regarding the adverse health effects of tobacco use, broadening the hazards to include the nonsmoking majority, the tobacco industry and its apologists will continue to oppose policy changes based on ETS-related science. Arguments that can be used to refute their claims have been published previously.⁴⁴ The industry's position also suffers from a serious lack of credibility, given the industry's history of misinformation about tobacco use and health.

Tobacco is lethal, not only to those who use it directly but to those who have not assumed those risks. Exposure to ETS is implicated in many thousands of premature deaths annually: about 3000 from lung cancer¹ and between 35 000 and 40 000 from cardiovascular disease.^{29,30} It also causes significant morbidity from respiratory diseases in children.^{1,3,17-21} It is clear that these morbidity and mortality estimates represent a significant public health threat that demands attention from individual physicians, organized medicine, and government regulatory agencies involved with health protection.

RECOMMENDATIONS

The following statements were adopted by the AMA House of Delegates at its annual meeting in Chicago, Ill, in June 1994:

1. The CSA agrees that ETS should be classified as a human carcinogen, and strongly supports the findings of the US Surgeon Gen-

eral,² the National Research Council,³ the National Institute of Safety and Health,⁵ and the EPA¹ concerning lung cancer and ETS-induced respiratory tract illnesses in children.

2. The strength of the available evidence leads CSA to conclude that passive smoke exposure, whether in utero or during infancy, is associated with an increased risk of SIDS.

3. The CSA agrees that the available evidence, while not yet as abundant as that relating ETS with lung cancer, strongly suggests that ETS exposure leads to increased risk for cardiovascular disease.

4. Physicians and other tobacco control advocates, including the associations that represent them, should be vigilant for attempts by the tobacco industry to refute the health risks of ETS and their attempts to impede measures to protect the non-smoking majority from ETS. Whenever possible, physicians and medical societies at every level should take a leadership role in defending the health of the public from the risks associated with ETS exposure and political assaults by the tobacco industry in this area.

WHAT PHYSICIANS CAN DO ABOUT ETS

Physicians should be aware that a variety of activities can translate personal knowledge about ETS into action for public education and policy changes. A few suggestions follow.

1. Make sure your patients understand the risks associated with ETS exposure, at home and in the workplace. If parents of your pediatric or adolescent patients smoke, help them understand that no smoking in the home is essential to their children's health. Baby-sitters or those who work in the home should not smoke indoors. In a similar fashion, if one adult partner in a home smokes, the other should be supported in seeking clean indoor air. Merely confining smoking to one

room of the house will not confer protection from ETS.

2. Parents should insist on smoke-free environments for children at day-care and preschool facilities. A recently passed federal law requires smoke-free facilities for all schools receiving federal funding. Work with parents, school boards, community leaders, and other groups to make sure that children breathe clean air.

3. Support efforts to make public places and workplaces smoke-free. Testify at local or state hearings when bills are brought forward that ban smoking in public places and in the workplace. Physicians have the trust of the community regarding public health issues such as this, and can easily deflect misinformation promulgated by the tobacco industry. Advocating tobacco-free indoor air standards on behalf of your patients can be a very positive experience.

4. Let your elected state and federal representatives hear from you about ETS and tobacco control, in general. Physicians strongly support public policy changes in a variety of areas of tobacco control but are seldom involved as advocates for change. A simple letter or telephone call regarding legislation, a chat when a legislator is "back home" listening to constituents, or a letter to the editor of your local newspaper can be very effective in creating changes in how legislators at all levels view tobacco issues.

Accepted for publication July 13, 1994.

This report is not intended to be construed or to serve as a standard of medical care. Standards of medical care are determined on the basis of all the facts and circumstances involved in an individual case and are subject to change as scientific knowledge and technology advance and patterns of practice evolve. This report reflects the scientific literature as of June 1994.

Portions of this report were accepted by the AMA House of Delegates as an informational report of the Council on Scientific Affairs at the AMA Interim Meeting, New Or-

leans, La, December 5-8, 1993. The recommendations were adopted by the House of Delegates as AMA policy statements at the annual meeting in Chicago, Ill, June 12-16, 1994.

Reprint requests to the Group on Science and Technology, American Medical Association, 515 N State St, Chicago, IL 60610 (James R. Allen, MD, MPH).

RESOURCE LIST ON ETS

American Academy of Otolaryngology-Head and Neck Surgery: One Prince St, Alexandria, VA 22314; (703) 836-4444. *Offering:* Brochures, posters, media materials/camera-ready art for office, community campaigns, and school-based presentations about tobacco, including ETS. Free.

American Cancer Society. *Offering:* A variety of reprints, posters, and other materials concerning the health effects of smoking, ETS, and smokeless tobacco. Other informal booklets on tobacco and health are also available from local ACS units.

American Health Association: 7272 Greenville Ave, Dallas, TX 75231-4596; (214) 705-1549. *Offering:* Two video segments on ETS, to be used for educating the general public as well as business about the benefits of smoke-free environments.

American Society of Addiction Medicine: 5225 Wisconsin Ave, NW, Suite 409, Washington, DC 20015; (202) 244-8948. *Offering:* An annual clinical conference on nicotine dependence. Nicotine Addiction Committee serves as a resource for a wide variety of tobacco-related matters.

Americans for Nonsmokers' Rights: 2530 San Pablo Ave, Suite J, Berkeley, CA 94702; (510) 841-3032. *Offering:* Information and activism concerning local tobacco control ordinances, ETS issues, and related subjects. Newsletters.

US Environmental Protection Agency: Indoor Air Quality Information Clearinghouse, PO Box

37133, Washington, DC 20013-7133; (800) 438-4318.

National Institute of Occupational Safety and Health (NIOSH): 4676 Columbia Pkwy, Cincinnati, OH 45226-1998; (800) 35-NIOSH.

Office on Smoking and Health: Centers for Disease Control and Prevention, Mailstop K-50, 4770 Buford Hwy NE, Atlanta, GA 30341-3724; (404) 488-4705.

Pertschuk M, Shopland DR, eds. *Major Local Tobacco Control Ordinances in the United States: A Detailed Matrix of the Provisions of Workplace, Restaurants, and Public Places Smoking Ordinances*. Washington, DC: US Dept of Health and Human Services, National Institutes of Health publication 93-3532. A recent compilation of national data on the subject; includes model legislation for all levels.

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