

INDOOR AIR POLLUTION AND HEALTH

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Testimony of

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Thank you for the opportunity to speak before the Subcommittee today. My name is Jonathan M. Samet; I am a pulmonary physician and epidemiologist with long-standing research interest in the health effects of indoor air pollution. My research has emphasized the health effects of such common indoor air pollutants as environmental tobacco smoke, nitrogen dioxide released by gas stoves, and radon. I served as Consulting Scientific Editor for the 1986 Report of the Surgeon General on involuntary smoking, as a member of the Biological Effects of Ionizing Radiation (BEIR) IV Alpha Committee of the National Research Council, and as chairman of the recently completed Radon Dose Panel of the National Research Council. I am also a member of the Indoor Air Quality and Total Human Exposure Subcommittee of the EPA's Science Advisory Board, and Chairman of the Research Oversight Committee of the Health Effects Institute-Asbestos Research. Along with my colleague, John Spengler from the Harvard School of Public Health, I have edited a book on indoor air pollution for Johns Hopkins University Press titled Indoor Air Pollution: A Health Perspective.

The scope of health concerns in regard to indoor air pollution is wide, ranging from lack of comfort, annoyance and irritation, through medically significant morbidity, to death from acute exposures and infections. In the short time of this testimony I will address three pollutants--environmental tobacco smoke, nitrogen dioxide, and radon--to illustrate the nature of the health concerns associated with indoor air pollution, the need for research as a basis for protecting public health, and the obstacles we face in developing policies to protect against adverse effects of indoor air

pollution. More detailed discussions of these and other pollutants can be found in the reprints that I have provided with this testimony.

Environmental tobacco smoke refers to the mixture of sidestream smoke emitted by smoldering cigarettes and the mainstream smoke exhaled by active smokers. This mixture contains many of the same toxic substances and carcinogens that are found in the disease-producing mainstream smoke that causes heart disease, lung disease, and cancer in active smokers. Fortunately, concentrations of these compounds are present in environmental tobacco smoke at much lower concentrations than in mainstream smoke. Nevertheless, nicotine and other components of tobacco smoke can be measured in the air in rooms and buildings where smoking is taking place and nonsmokers exposed to environmental tobacco smoke have measurable quantities of nicotine and cotinine. Cotinine is a major metabolite of nicotine; in the absence of smoke exposure neither are present in body fluids. We thus know that nonsmokers inhale and absorb tobacco smoke and are involuntarily placed at risk by the smoking of others.

Exposure to environmental tobacco smoke has been widespread in homes, workplaces, and public and commercial buildings in the U.S. We now have strong and consistent evidence that the nearly inevitable exposure to environmental tobacco smoke in our country has adversely affected public health. The Surgeon General and the National Research Council have both judged that environmental tobacco smoke increases the occurrence of more severe respiratory infections in infants and young children, increases the frequency of respiratory symptoms in children and reduces their rate of lung

growth, and causes lung cancer in persons who have never smoked themselves. Data also suggest that exposure to environmental tobacco smoke increases the occurrence of ear problems and worsens asthma in children, and may contribute to heart disease mortality.

Although controversy remains concerning some health effects of exposure to environmental tobacco smoke, the existing evidence and the judgements of the Surgeon General and the National Research Council provide a sufficiently compelling rationale for controlling exposure. The most effective solution is obvious: the elimination of smoking indoors. What array of approaches would be needed to achieve this goal? Until active smoking is totally eliminated, broadly based strategies are needed including greater emphasis on public education to alert smokers as to the effects of smoking on their families in addition to workplace bans and clean indoor air legislation, which are already in place in some situations or under consideration.

Nitrogen dioxide is an oxidant gas released from combustion. In homes, its principal source is the burning of natural gas in ranges and ovens, but unvented space heaters may also contribute. Nitrogen dioxide is regulated in outdoor air as a "criteria" pollutant, yet we have now learned that in most locations indoor sources and concentrations are the principal determinants of personal exposures of most people. Exposure to nitrogen dioxide indoors is potentially of great public health significance since nearly half of U.S. homes have a gas stove and many homes have levels near or even above the federal standard set for outdoor air. Unvented space heaters may cause relatively high exposures when used

in enclosed spaces, particularly small rooms and tightly sealed mobile homes.

At high concentrations, nitrogen dioxide can cause widespread damage to the lung; at levels found in homes, health effects of concern have included increased respiratory infection, respiratory symptoms, reduction of lung function, and worsening of asthma. Although the health effects of exposure to nitrogen dioxide have been extensively investigated, confident conclusions concerning the effects of this widespread indoor exposure cannot yet be reached. A number of epidemiologic studies have addressed the health status of children and adults, comparing those living in homes with gas and electric homes; this set of studies has provided mixed and inconsistent evidence.

Thus, with regard to indoor nitrogen dioxide we are faced with widespread exposure to a potentially hazardous indoor pollutant, but have inadequate understanding of health effects. More research is an obvious need, but funding sources targetted at indoor air pollution are limited. A federal agency should be charged with developing a research agenda for indoor air pollution and given sufficient funding to accomplish needed investigations on nitrogen dioxide and other pollutants for which the scientific evidence is inadequate. Although nitrogen dioxide exposure is potentially a significant public health problem, Funding from agencies which look at research questions from a biologic perspective, like the National Institutes of Health, may be difficult to achieve for research addressed at describing societal risks.

Radon, a naturally occurring gas produced by the decay of uranium-238, is ubiquitous in indoor environments. Well-documented excess occurrence of lung cancer in radon-exposed underground miners, animal studies, and cohesive experimental evidence have established radon as a human carcinogen. The problem of indoor radon, first recognized as early as the 1950s, has received substantial media attention and scientific investigation since the mid-1980s when the scope of the radon problem in the U.S. first received widespread public recognition. Our experience with the problem of indoor radon provides warnings concerning the difficulties of translating scientific information on health hazards into public policy.

The scientific evidence on radon and lung cancer is extensive, providing information on the quantitative risks of lung cancer in underground miners, the levels of exposure in homes, and the potential differences in risk between homes and mines. Some homes have remarkably high levels, even higher than permitted in a working uranium mine, and risk projections of as many as 10,000 to 20,000 lung cancer deaths annually attributable to radon have been made. Radon can be measured inexpensively and techniques are available for reducing radon concentrations in existing homes and limiting concentrations in new homes. The Environmental Protection Agency has advocated testing of most homes and has provided action guidelines for acceptable concentrations.

In spite of the certainty of the scientific evidence showing that radon is a human carcinogen, the Environmental Protection Agency's Radon Program has been extremely controversial; the importance of indoor radon as a carcinogen has been questioned because epidemiologic research on indoor exposure has not provided strong evidence of increased lung cancer risk, a failure likely to reflect difficult methodologic problems. Elements of the EPA's Radon Program that have been questioned merit consideration. The Agency's risk projections on the numbers of lung cancer cases attributable to radon have sparked continued debate; the estimates, which are based on many assumptions, have become a focus of discussion, shifting emphasis unduly away from the presence of a carcinogen indoors. The Agency has called for widespread testing but only a small percentage of homeowners have tested for radon. Does the failure to achieve more widespread testing indicate cynicism about environmental hazards, difficulty in educating the public, cost, the invisible and natural nature of radon, or other factors? The action guidelines set by the Agency have also sparked controversy with debate concerning the magnitude of the hazard, the relative importance of smoking and radon, the accuracy of the measurements, and the cost-benefit ratio. We appear to lack a framework for integrating personal and population risks of disease, feasibility of control, and costs of control. Remarkably, this controversy surrounds a pollutant projected to cause far more deaths than most pollutants regulated by the Environmental Protection Agency.

In closing, these three pollutants illustrate obstacles to providing protection against the health effects of indoor air pollution: lack of scientific data, difficulty in reaching the public and achieving adequate public understanding of indoor air pollution, a need for a variety of regulatory approaches, and an inadequate conceptual framework for developing policy. Sound research covering exposure assessment, health effects, control, policy, and public education is needed. Because the problem of indoor air pollution extends into our homes and other private locations, education will be fundamental in controlling exposure to indoor air pollution and attendant health effects. Radon illustrates our limited understanding of communicating indoor air quality risks to the public. Strong leadership and the development of comprehensive legislation on indoor air pollution would facilitate our efforts to address this increasingly important public health problem.