EPIDEMIOLOGY SECTION

Connecticut Epidemiologist

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Douglas S. Lloyd, M.D., M.P.H., Commissioner Vol. 4 No. 5

ISSUES IN ENVIRONMENTAL HEALTH
INDOOR AIR POLLUTION

Introduction

As an emerging public health issue of the 1980's indoor air pollution in non-occupational settings has been receiving increased attention in the media and the scientific communities. Homeowners and office workers have also become aware that the indoor environment may be a source of chemical compounds that can be hazardous to their health. It is likely that recent changes in our housing and our daily activities have caused increases in indoor air pollution which have resulted in this greater awareness of the problem.

Beginning in the early 1970's, increases in energy prices have caused changes in the way we construct and treat our indoor environments. Energy saving measures such as construction of superinsulated homes and use of energy-saving air handling units in office buildings have become common practices. Renovations to existing homes and offices have also served to increase the energy efficiency of those structures. The approaches utilized to achieve these energy savings include reducing the air exchanges, increasing insulation, and switching to alternative fuels. All three of these procedures can have an adverse effect on the indoor air quality. In new homes which have been heavily insulated and weatherized, fresh air exchange rates can be reduced to a level as low as 0.1 air changes per hour. Offices with automated air handling units can reduce the amount of fresh air being brought into the building to levels below one percent. The exclusion of incoming fresh air is one of the main causes for the increased occurrence of indoor air pollution episodes.

II. Sources

Several types of chemicals and materials have been identified in the indoor air as possible causes of adverse health effects. The sources of these chemicals and materials vary. However, most of them fall into four categories. 1) Combustion is a common source of many indoor air pollutants. These sources include cigarettes; furnaces burning oil, gas, or coal; unvented kerosene heaters; gas ovens; and wood burning stoves. 2) Many consumer products give off some chemical components at varying rates. Products which can release chemical compounds include carpeting, upholstery, particle board, cleaning compounds, new and recently dry cleaned clothes, plastic products, and furniture. 3) Insulation products such as urea-formaldehyde foam insulation, polyurethane, and asbestos have all been in identified as sources of indoor air problems. 4) An important source of indoor air contamination problems is the general lack of ventilation found in many of the indoor environments with the concomitant increase in all the indoor air contaminants including odors and carbon dioxide.

III. Pollutants

Carbon monoxide is one of the most acutely toxic indoor air pollutants. It is a byproduct of combustion which is colorless and odorless. The most common sources of carbon monoxide are unvented kerosene heaters, improperly functioning furnaces, wood burning stoves, and tobacco smoke.

Other sources of carbon monoxide include automobile exhaust which for several reasons enters an indoor environment. Effects of carbon monoxide can be seen at fairly low levels due to its ability to bind to hemoglobin and form carboxy hemoglobin which inhibits the uptake of oxygen in the blood. Early symptoms of carbon monoxide exposure include dizziness, headache, and loss of coordination. Continued exposure to high levels of carbon monoxide can and has resulted in death.

Nitrogen oxides and sulfur dioxide are two common indoor air contaminants. The major indoor source for these two compounds is unvented kerosene heaters. In addition gas burning ovens can produce high levels of nitrogen oxides. Both of these compounds have irritant effects on the respiratory system and may increase one's susceptibility to infectious diseases.

Pesticides are often found in the indoor environment. Application of pesticides both inside and outside the home can result in significant air levels in the house. Improper applications of compounds such as chlordane have resulted in indoor levels high enough to cause adverse health effects. Pesticides often have a distinctive odor which may act as a warning signal to the residents. Health effects seen with pesticides often involve the central nervous system, liver and kidney.

Formaldehyde is one of the more publicized indoor air contaminants in Connecticut. The formaldehyde source of greatest concern recently is urea-formaldehyde foam insulation. This product was blown into homes during the mid to late 1970's. Problems arose shortly after application of the insulation when free formaldehyde was released in significant quantities from the insulation into the indoor

air. Levels as high as 5 ppm were found in homes soon after the application of the insulation. Because of these problems the State of Connecticut banned the use of urea-formaldehyde foam insulation in 1981. However the insulation already in place in many homes can continue to give off formaldehyde for many years after application. Air levels of formaldehyde in homes insulated with urea-formaldehyde foam insulation during the 1970's are usually quite low today. However there are still occasional instances of levels which can cause adverse health effects.

Formaldehyde is a common compound found in many consumer products. Some major sources of formaldehyde are particle board, pressed wood and plywood. These products are of special concern in mobile homes which have a large amount of these wood products in them and in homes that are built very tightly. Formaldehyde is an upper respiratory tract irritant and can also cause eye and skin irritation. There are animal data indicating that formaldehyde may also be a carcinogen. Human epidemiological data on its carcinogenicity are still not conclusive.

Radon is a naturally occurring radioactive element found in the earth's crust. Recent studies indicate that high levels of radon can be found inside some homes. This is a concern because the radioactive decay of radon after it has been inhaled has been shown to increase the risk of lung cancer. It has been estimated that anywhere from 20-100 percent of all lung cancers not associated with cigarette smoking may be caused by radon exposure. Radon enters the home from the ground through either well water or the foundation. The gas is odorless and colorless and can only be measured by use of special detectors. Measures to reduce the amount of radon in homes include sealing of the basement foundation, treatment of the well water before it enters the home and ventilation of the basement.

Tobacco smoke is often not considered an indoor air pollutant. However epidemiological studies have shown that second hand cigarette smoke may be one of the biggest health risks associated with indoor air pollution. Children whose parents smoke have been shown to have higher rates of respiratory illness than children whose parents do not smoke. More than 2000 compounds have been identified in cigarette smoke. Some of the compounds found in higher concentrations include carbon monoxide, carbon dioxide, polyaromatic hydrocarbons and respirable particles.

Improper ventilation in large buildings can cause unacceptable odors and increased levels of carbon dioxide and other compounds. These odors are due to a concentration of chemicals and particles being released into the indoor environment. Increasing building occupancy and cigarette smoking can add to odor and health problems. One method for estimating the general indoor air quality is by monitoring carbon dioxide levels. Increasing carbon dioxide levels above background indicates inadequate ventilation and an accumulation of other indoor air contaminants. Outdoor air levels of carbon dioxide usually range around 300-400 ppm. Levels of over 1,000 ppm carbon dioxide indoors indicate that ventilation is inadequate. Health effects due to improper ventilation include respiratory irritation, skin irritation, headache, nausea, and many other vague complaints. This set of symptoms has sometimes been referred to as "tight building syndrome".

Asbestos containing materials are found in many public buildings and homes. Disturbance of these materials or "asbestos fallout" from these materials can result in significant air levels of asbestos fibers. The significance of these levels of asbestos is still unclear because the number of fibers found in the indoor environment is relatively low compared to the number of fibers found in occupational settings where asbestos' adverse effects have been proven. Removal or encapsulation of asbestos material can reduce or remove the exposure hazard. However, improper asbestos abatement procedures can result in exposures much higher than existed previously.

IV. Investigation Procedures

Investigation of all indoor air pollution episodes can be broken down into a five basic steps.

1. The first and most important step in the investigation should be a thorough visual inspection of the entire building question. This inspection is intended to identify any obvious sources of air pollution and importantly includes a careful inspection of the ventilation system. In many cases inspection and repair of the ventilation system will solve the problem by simply providing adequate fresh air.

2. Although rarely used in most indoor air investigations, air sampling can sometimes provide useful information if visual inspection and ventilation adjustments fail to improve air quality. Air sampling for contaminants is a very specific process. Different sampling procedures and laboratory analysis may be required for each suspect compound. Data obtained from air monitoring are difficult to interpret because compounds are usually found in low levels and "background" compounds are present in large numbers. Indoor air monitoring can be a very timely and costly procedure if the suspect compound cannot be identified.

3. Epidemiological methods have been used to investigate indoor air problems and may be occassionally useful in guiding interventions when initial measures fail to solve the problem. Unfortunately the symptoms described in indoor air pollution episodes are often too vague and are masked by too many other underlying conditions to provide useful information.

4. In office or public building settings other factors need to be investigated with indoor air complaints. The conditions under which the office workers must function play an important part in their impression of their environment. Improper lighting, high noise levels, and improper temperature control can all increase discomfort levels experienced by the workers and can increase the number of complaints.

5. Once an investigation has identified a potential source, remediation measures should then be taken. The success or failure of remediation in terms of alleviating the compliants is often used as positive identification of the pollution source. Increased ventilation should be the first measure tried. Other measures include source removal, source enclosure, and source treatment.

V. Indoor Air Regulations/Guidance

There are currently very few federal or state standards for indoor air pollution. However informal guidelines and guidance are provided by the Connecticut Department of Health Services (DHS). It has been estimated that the Department receives between 1,500 calls or complaints on indoor air pollution every year. More than 50% of the calls concern asbestos or formaldehyde. If you have a question on indoor air pollution you may call your local health department or the Toxic Hazard Section, DHS at 566-8167 or the Environmental Health Section 566-1259.

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CIGARETTE SMOKING: THE BOTTOM LINE

- Estimated medical costs and loss of productivity due to smoking amounted to $47 billion in 1980. Medical costs were estimated at $11 billion; loss of productivity, at $36 billion. (American Health Foundation)

- Workers who smoke have an absenteeism rate 30% to 40% higher, and have a 50% greater chance of hospitalization than their nonsmoking colleagues. (National Center for Health Statistics)

- Estimates indicate that when compared to nonsmokers, smokers spend nearly 150 million more days in bed and 81 million more days off the job than do persons who have never smoked. (National Center for Health Statistics)

- It has been estimated that 146 million workdays per year are lost in the US alone because of smoking-related diseases. (World Smoking & Health, Spring 1984, p. 36)

- Some workers smoke actively, some passively. Unfortunately, the hazards for those who involuntarily take in their colleagues' smoker's sidestream — which contains relatively high concentrations of known carcinogens — can be significant. In San Diego, evidence has been found of small airway obstructions in nonsmokers employed for 20 or more years in enclosed working areas in which smoking was permitted; the impairment was equivalent to that found among smokers who inhaled up to ten cigarettes per day. (World Smoking & Health, Spring 1984, pp. 2,46)

- Employers are spending on the average almost $300 extra per smoker each year in insurance claims alone. (American Council of Life Insurance)

- One study of job-related accidents found that the total accident rate among smokers is twice that of nonsmokers, precipitated by loss of attention, preoccupation of the hand, eye irritation, and coughing. (ACLI)

- Smoking-related disorders, including heart disease and other illnesses, cause 340,000 premature deaths each year and cost the nation $27 billion in medical care. (American Cancer Society)

- Jess Bell, head of the Cleveland-based Bonne Bell Inc., has a long-standing offer of $250 to any employee who stops smoking for at least six months. However, if the employee resumes smoking within a year, he or she must pay back $500. (Cleveland Plain Dealer, February 12, 1984)

- One study estimates that the measurable annual social cost of smoking per capita is on the order of $200. Medical care necessitated by smoking-related illness translates into an annual economic burden on the typical nonsmoking, working-age adult in excess of $100 in taxes and health insurance premiums to pay for the health care needs of the victims of smoking. (NYSMJ, December 1984, Kenneth E. Warner, p. 1273)

- In 1980, the medical costs for cancer exceeded $10 billion. Cancers of all types required 26 million days of care in short-stay hospitals and 27 million visits to physicians for diagnosis and treatment. (Oncology Times, May 1984)

- Each smoker costs his or her employer over $4,000 a year, according to figures compiled by William L. Weis, assistant professor at the Albers Graduate School of Business, Seattle, Washington. The breakdown of his estimate is as follows:

  Absenteeism runs 2.2 more days each year, at a cost of $110 a day (based on a personnel cost of $20,000 per employee).

  Medical-care benefits are used 50% more by smokers than by nonsmokers, at an annual cost of $230.

  Earnings are lost to the employer because of the smoker's sickness and/or early death, at a cost of $765.

  Accidents cost an estimated $45.

  Fire insurance costs go up an estimated $45.

  Lost productivity for smoking breaks, etc., is estimated at $1,820.

  Damage or maintenance for smoke pollution costs $1,000.

[Adapted from Texas Preventable Disease News, 1985,45:1-2.]

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AIDS UPDATE

PREVENTING TRANSMISSION OF HTLV-III/LAV: STERILIZATION, DISINFECTION, HOUSEKEEPING, AND WASTE DISPOSAL

Sterilization and disinfection procedures currently recommended for use (1,2) in health-care and dental facilities are adequate to sterilize or disinfect instruments, devices, or other items contaminated with the blood or other body fluids from individuals infected with HTLV-III/LAV. Instruments or other nondisposable items that enter normally sterile tissue or the vascular system or through which blood flows should be sterilized before reuse. Surgical instruments used on all patients should be decontaminated after use rather than just rinsed with water. Decontamination can be accomplished by machine or by hand cleaning by trained personnel wearing appropriate protective attire (3) and using appropriate chemical germicides. Instruments or other nondisposable items that touch intact mucous membranes should receive high-level disinfection.

Several liquid chemical germicides commonly used in laboratories and health-care facilities have been shown to kill HTLV-III/LAV at concentrations much lower than are used in practice (4). When decontaminating instruments or medical devices, chemical germicides that are registered with and approved by the U.S. Environmental Protection Agency (EPA) as "sterilants" can be used either for sterilization or for high-level disinfection depending on contact time; germicides that are approved for use as "hospital disinfectants" and are mycobactericidal when used at appropriate dilutions can also be used for high-level disinfection of devices and instruments. Germicides that are mycobactericidal are preferred because mycobacteria represent one of the most resistant groups of microorganisms; therefore, germicides that are effective against mycobacteria are also effective against other bacterial and viral pathogens. When chemical germicides are used, instruments or devices to be sterilized or disinfected should be thoroughly cleaned before exposure to the germicide, and the manufacturer's instructions for use of the germicide should be followed.

Laundry and dishwashing cycles commonly used in hospitals are adequate to decontaminate linens, dishes, glassware, and utensils. When cleaning environmental surfaces, housekeeping procedures commonly used in hospitals are adequate; surfaces exposed to blood and body fluids should be cleaned with a detergent followed by decontamination using an EPA-approved hospital disinfectant that is mycobactericidal. Individuals cleaning up such spills should wear disposable gloves. Information on specific label claims of commercial germicides can be obtained by writing to the Disinfectants Branch, Office of Pesticides, Environmental Protection Agency, 401 M Street, S.W., Washington, D.C., 20460.

In addition to hospital disinfectants, a freshly prepared solution of sodium hypochlorite (household bleach) is an inexpensive and very effective germicide (4). Concentrations ranging from 5,000 ppm (a 1:10 dilution of household bleach) to 500 ppm (a 1:100 dilution) sodium hypochlorite are effective, depending on the amount of organic material (e.g., blood, mucus, etc.) present on the surface to be cleaned and disinfected.

Sharp items should be considered as potentially infective and should be handled and disposed of with extraordinary care to prevent accidental injuries. Other potentially infective waste should be contained and transported in clearly identified impervious plastic bags. If the outside of the bag is contaminated with blood or other body fluids, a second outer bag should be used. Recommended practices for disposal of infective waste (2) are adequate for disposal of waste contaminated by HTLV-III/LAV. Blood and other body fluids may be carefully poured down a drain connected to a sanitary sewer.

[Adapted from MMWR 1985;34:681-695]

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COMMUNICABLE DISEASES REPORTED

CONNECTICUT

WEEKS 1 - 50

(thru December 13, 1985)

Name	1985 To Date	1984 To Date	% Change From 1984
AIDS	80	53	+ 50.9
GONORRHEA	7989	8921	- 10.4
SYPHILIS P&S	204	185	+ 10.2
MEASLES	3	14	- 78.5
RUBELLA	1	1	0.0
TUBERCULOSIS	148	164	- 9.7
HEPATITIS A	129	74	+ 74.3
HEPATITIS B	326	325	+ 0.3
SALMONELLOSIS	1013	832	+ 21.7
SHIGELLOSIS	119	107	+ 11.2

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