

Indoor Air Pollution: An Introduction for Health Professionals

This guide by the Environmental Protection Agency provides an introduction to Indoor Air Pollution for health professionals - while very conservative in its position, does provide some helpful information. However, Sick Building Syndrome and Building Related Illness are, clearly, known to be associated with or cause long-term, chronic illness, and this is not yet mentioned. Psychogenic reasons should have been thrown out in light of this decade's research - yet these still remain in gov't documents online, developed in the early 1990's. We hope that science-based, not politics-based, information will be disseminated to the public by the EPA and other gov't health agencies under the Obama administration, as promised in President Obama's inaugural speech, "We will restore science to its rightful place". Sections related to mold and biologicals are excerpted and displayed, below (SMH).
Indoor Air Pollution: An Introduction for Health Professionals

<http://www.epa.gov/iaq/pubs/hpguide.html>

Co-sponsored by: The American Lung Association (ALA), The Environmental Protection Agency (EPA), The Consumer Product Safety Commission (CPSC), and The American Medical Association (AMA)

U.S. Government Printing Office Publication No. 1994-523-217/81322, 1994

[EPA 402-R-94-007, 1994]

Contents

- Introduction: new challenges for the health professional

- How to Use This Booklet

- Diagnostic Quick Reference: a Cross-reference from symptoms to pertinent sections of this booklet
- Diagnostic Checklist: additional questions for use in patient intake and medical history
- Environmental Tobacco Smoke (ETS): impacts on both adults and children; EPA risk assessment findings
- Other Combustion Products: carbon monoxide poisoning, often misdiagnosed as cold or flu; respiratory impact of pollutants from misuse of malfunctioning combustion devices

- Carbon Monoxide (CO)
- Nitrogen dioxide and Sulfur dioxide
- Animal Dander, Molds, Dust Mites, Other Biologicals: a contributing factor in building-related health complaints
- Tuberculosis
- Legionnaires Disease
- Allergic Reactions
- Hypersensitivity Pneumonitis

- Humidifier Fever
- Mycotoxins

- Volatile Organic Compounds (VOCs): common household and office products are frequent sources

- Formaldehyde
- Pesticides
- Heavy Metals: Airborne Lead and Mercury Vapors: lead dust from old paint; mercury exposure from some paints and certain religious uses
- Airborne Lead
- Mercury Vapor

- Sick Building Syndrome (SBS): what is it; what it isn't; what health care professionals can do
- Two Long-Term Risks: Asbestos and Radon: two highly publicized carcinogens in the indoor environment

- Asbestos
- Radon

- Questions That May Be Asked: current views on multiple chemical sensitivity, clinical ecologists, ionizers and air cleaners, duct cleaning, carpets and plants

- What is "multiple chemical sensitivity" or "total allergy"?
- Who are "clinical ecologists"?
- What are ionizers and other ozone generating air cleaners?
- Can other air cleaners help?
- Should I have my ducts cleaned?
- Can carpet make people sick?
- Can plants control indoor air pollution?

- For Assistance and Additional Information: resources for both health professionals and patients

- References

PDF Version (PDF, 33 pp, 224KB About PDF)

Several sections pertaining to mold:

<http://www.epa.gov/iaq/pubs/hpguide.html#mycotoxins>

Mycotoxins

Another class of agents that may cause disease related to indoor airborne exposure is the mycotoxins. These agents are fungal metabolites that have toxic effects ranging from short-term irritation to immunosuppression and cancer. Virtually all the information related to diseases caused by mycotoxins concerns ingestion of contaminated food⁴⁰. However, mycotoxins are contained in some kinds of fungus spores, and these can enter the body through the respiratory tract. At least one case of neurotoxic symptoms possibly related to airborne mycotoxin exposure in a heavily contaminated environment has been reported⁴¹. Skin is another potential route of exposure to mycotoxins. Toxins of several fungi have caused cases of severe dermatosis. In view of the serious nature of the toxic effects reported for mycotoxins, exposure to mycotoxin-producing agents should be minimized.

<http://www.epa.gov/iaq/pubs/hpguide.html#hypersensitivity%20pneumonitis>

Hypersensitivity Pneumonitis

Another class of hypersensitivity disease is hypersensitivity pneumonitis, which may include humidifier fever. Hypersensitivity pneumonitis, also called allergic alveolitis, is a granulomatous interstitial lung disease caused by exposure to airborne antigens. It may affect from one to five percent or more of a specialized population exposed to appropriate antigens (e.g., farmers and farmers' lung, pigeon breeders and pigeon breeders' disease)³⁷. Continued antigen exposure may lead to end-stage pulmonary fibrosis. Hypersensitivity pneumonitis is frequently misdiagnosed as a pneumonia of infectious etiology. The prevalence of hypersensitivity pneumonitis in the general population is unknown.

Outbreaks of hypersensitivity pneumonitis in office buildings have been traced to air conditioning and humidification systems contaminated with bacteria and molds³⁸. In the home, hypersensitivity pneumonitis is often caused by contaminated humidifiers or by pigeon or pet bird antigens. The period of sensitization before a reaction occurs may be as long as months or even years. Acute symptoms, which occur four to six hours postexposure and recur on challenge with the offending agent, include cough, dyspnea, chills, myalgia, fatigue, and high fever. Nodules and nonspecific infiltrates may be noted on chest films. The white blood cell count is elevated, as is specific IgG to the offending antigen. Hypersensitivity pneumonitis generally responds to corticosteroids or cessation of exposure (either keeping symptomatic people out of contaminated environments or removing the offering agents).

<http://www.epa.gov/iaq/pubs/hpguide.html#sbs>

SICK BUILDING SYNDROME

Key Signs/Symptoms

lethargy or fatigue

headache, dizziness, nausea

irritation of mucous membranes

sensitivity to odors

Diagnostic Leads

Are problems temporally related to time spent in a particular building or part of a building?

Do symptoms resolve when the individual is not in the building?

Do symptoms recur seasonally (heating, cooling)?

Have co-workers, peers noted similar complaints?

Remedial Action

Appropriate persons -- employer, building owner or manager, building investigation specialist, if necessary state and local government agency medical epidemiologists and other public health officials -- should undertake investigation and analysis of the implicated building, particularly the design and operation of HVAC systems, and correct contributing conditions. Persistence on the part of individual(s) and health care consultant(s) may be required to diagnose and remediate the building problems.

Comment

The term "sick building syndrome" (SBS), first employed in the 1970s, describes a situation in which reported symptoms among a population of building occupants can be temporally associated with their presence in that building. Typically, though not always, the structure is an office building.

Generally, a spectrum of specific and nonspecific complaints are involved. Typical complaints, in addition to the signs and symptoms already listed, may also include eye and/or nasopharyngeal irritation, rhinitis or nasal congestion, inability to concentrate, and general malaise-complaints suggestive of a host of common ailments, some ubiquitous and easily communicable. The key factors are commonality of symptoms and absence of symptoms among building occupants when the individuals are not in the building.

Sick building syndrome should be suspected when a substantial proportion of those spending extended time in a building (as in daily employment) report or experience acute on-site discomfort. It is important, however, to distinguish SBS from problems of building related illness. The latter term is reserved for situations in which signs and symptoms of diagnosable illness are identified and can be attributed directly to specific airborne building contaminants. Legionnaires' Disease and hypersensitivity pneumonitis, for example, are building related illnesses.

There has been extensive speculation about the cause or causes of SBS. Poor design, maintenance, and/or operation of the structure's ventilation system may be at fault⁵⁵. The ventilation system itself can be a source of irritants. Interior redesign, such as the rearrangement of offices or installation of partitions, may also interfere with efficient functioning of such systems.

Another theory suggests that very low levels of specific pollutants, including some discussed in the preceding pages, may be present and may act synergistically, or at least in combination, to cause health effects. Humidity may also be a factor: while high relative humidity may contribute to biological pollutant problems, an unusually low level -- below 20 or 30 percent -- may heighten the effects of mucosal irritants and may even prove irritating itself. Other contributing elements may include poor lighting and adverse ergonomic conditions, temperature extremes, noise, and psychological stresses that may have both individual and interpersonal impact.

The prevalence of the problem is unknown. A 1984 World Health Organization report suggested that as many as 30 percent of new and remodeled buildings worldwide may generate excessive complaints related to indoor air quality⁵⁶. In a nationwide, random sampling of U.S. office workers, 24 percent perceived air quality problems in their work environments, and 20 percent believed their work performance was hampered thereby⁵⁷.

When SBS is suspected, the individual physician or other health care provider may need to join forces with others (e.g., clinicians consulted by an individual's co-workers, as well as industrial hygienists and public health officials) to adequately investigate the problem and develop appropriate solutions.

ANIMAL DANDER, MOLDS, DUST MITES, OTHER BIOLOGICALS

<http://www.epa.gov/iaq/pubs/hpguide.html#animal%20dander>

Key Signs/Symptoms

recognized infectious disease

exacerbation of asthma

rhinitis

conjunctival inflammation

recurrent fever

malaise

dyspnea

chest tightness

cough

Diagnostic Leads

Infectious disease:

Is the case related to the workplace, home, or other location?

(Note: It is difficult to associate a single case of any infectious disease with a specific site of exposure.)

Does the location have a reservoir or disseminator of biologicals that may logically lead to exposure?

Hypersensitivity disease:

Is the relative humidity in the home or workplace consistently above 50 percent?

Are humidifiers or other water-spray systems in use? How often are they cleaned? Are they cleaned appropriately?

Has there been flooding or leaks?

Is there evidence of mold growth (visible growth or odors)?

Are organic materials handled in the workplace?

Is carpet installed on unventilated concrete (e.g., slab on grade) floors?

Are there pets in the home?

Are there problems with cockroaches or rodents?

Toxicosis and/or irritation:

Is adequate outdoor air being provided?

Is the relative humidity in the home or workplace above 50 percent or below 30 percent?

Are humidifiers or other water-spray systems in use?

Is there evidence of mold growth (visible growth or odors)?

Are bacterial odors present (fishy or locker-room smells)?

Remedial Action

Provide adequate outdoor air ventilation to dilute human source aerosols.

Keep equipment water reservoirs clean and potable water systems adequately chlorinated, according to manufacturer instructions. Be sure there is no standing water in air conditioners. Maintain humidifiers and dehumidifiers according to manufacturer instructions.

Repair leaks and seepage. Thoroughly clean and dry water-damaged carpets and building materials within 24 hours of damage, or consider removal and replacement.

Keep relative humidity below 50 percent. Use exhaust fans in bathrooms and kitchens, and vent clothes dryers to outside.

Control exposure to pets.

Vacuum carpets and upholstered furniture regularly. Note: While it is important to keep an area as dust-free as possible, cleaning activities often re-suspend fine particles during and immediately after the activity. Sensitive individuals should be cautioned to avoid such exposure, and have others perform the vacuuming, or use a commercially available HEPA (High Efficiency Particulate Air) filtered vacuum.

Cover mattresses. Wash bedding and soft toys frequently in water at a temperature above 130oF to kill dust mites.

Comment

Biological air pollutants are found to some degree in every home, school, and workplace. Sources include outdoor air and human occupants who shed viruses and bacteria, animal occupants (insects and other arthropods, mammals) that shed allergens, and indoor surfaces and water reservoirs where fungi and bacteria can grow, such as humidifiers²³. A number of factors allow biological agents to grow and be released into the air. Especially important is high relative humidity, which encourages house dust mite populations to increase and allows fungal growth on damp surfaces. Mite and fungus contamination can be caused by flooding, continually damp carpet (which may occur when carpet is installed on poorly ventilated concrete floors), inadequate exhaust of bathrooms, or kitchen-generated moisture²⁴. Appliances such as humidifiers, dehumidifiers, air conditioners, and drip pans under cooling coils (as in refrigerators), support the growth of bacteria and fungi.

Components of mechanical heating, ventilating, and air conditioning (HVAC) systems may also serve as reservoirs or sites of microbial amplification²⁵. These include air intakes near potential sources of contamination such as standing water, organic debris or bird droppings, or integral parts of the mechanical system itself, such as various humidification systems, cooling coils, or condensate drain pans. Dust and debris may be deposited in the duct work or mixing boxes of the air handler.

Biological agents in indoor air are known to cause three types of human disease: infections, where pathogens invade human tissues; hypersensitivity diseases, where specific activation of the immune system causes disease; and toxicosis, where biologically produced chemical toxins cause direct toxic effects. In addition, exposure to conditions conducive to biological contamination (e.g., dampness, water damage) has been related to nonspecific upper and lower respiratory symptoms. Evidence is available that shows that some episodes of the group of nonspecific symptoms known as "sick building syndrome" may be related to microbial contamination in buildings²⁶.

another fact sheet exists on Sick Building Syndrome, on the epa.gov website:

<http://www.epa.gov/iaq/pubs/sbs.html>

US EPA Sick Building Syndrome Fact Sheet Aug. 9, 2007

The updated US EPA fact sheet from 2007. Note that Sick Building Syndrome CAN result from molds, according to the US EPA.

Sick Building Syndrome (SBS) victims are often told that there is no such illness by physicians, other professionals, and especially those with liability concerns (school administrators, their attorneys and experts, facilities, and risk managers) who may be busily denying SBS, that the US EPA has identified this as an environmentally-caused syndrome related to building problems, for over a decade and a half. Print the page right off the EPA website to show the naysayers...

Indoor Air Facts No. 4 (revised): Sick Building Syndrome (SBS). U.S. Environmental Protection Agency.
<http://www.epa.gov/iaq/pubs/sbs.html>,

Last updated on Thursday, August 9th, 2007

EPA (Environmental Protection Agency, USA)

Indoor Air Facts No. 4 (revised) Sick Building Syndrome

Office of Air and Radiation

Office of Research and Development

Office of Radiation and Indoor Air (6609J)

Contents

Introduction

Causes of Sick Building Syndrome

Inadequate ventilation

Chemical contaminants from indoor sources

Chemical contaminants from outdoor sources

Biological contaminants

Building Investigation Procedures

Solutions to Sick Building Syndrome

Pollutant source removal or modification

Increasing ventilation rates

Air cleaning

Education and communication

Additional Resources

PDF version (PDF, 4 pp, 38KB, About PDF)

Introduction

The term "sick building syndrome" (SBS) is used to describe situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified. The complaints may be localized in a particular room or zone, or may be widespread throughout the building. In contrast, the term "building related illness" (BRI) is used when symptoms of diagnosable illness are identified and can be attributed directly to airborne building contaminants.

A 1984 World Health Organization Committee report suggested that up to 30 percent of new and remodeled buildings worldwide may be the subject of excessive complaints related to indoor air quality (IAQ). Often this condition is temporary, but some buildings have long-term problems. Frequently, problems result when a building is operated or maintained in a manner that is inconsistent with its original design or prescribed operating procedures. Sometimes indoor air problems are a result of poor building design or occupant activities.

Indicators of SBS include:

Building occupants complain of symptoms associated with acute discomfort, e.g., headache; eye, nose, or throat irritation; dry cough; dry or itchy skin; dizziness and nausea; difficulty in concentrating; fatigue; and sensitivity to odors.

The cause of the symptoms is not known.

Most of the complainants report relief soon after leaving the building.

Indicators of BRI include:

Building occupants complain of symptoms such as cough; chest tightness; fever, chills; and muscle aches

The symptoms can be clinically defined and have clearly identifiable causes.

Complainants may require prolonged recovery times after leaving the building.

It is important to note that complaints may result from other causes. These may include an illness contracted outside the building, acute sensitivity (e.g., allergies), job related stress or dissatisfaction, and other psychosocial factors. Nevertheless, studies show that symptoms may be caused or exacerbated by indoor air quality problems.

Causes of Sick Building Syndrome

A Word About Radon and Asbestos...

SBS and BRI are associated with acute or immediate health problems; radon and asbestos cause long-term diseases which occur years after exposure, and are therefore not considered to be among the causes of sick buildings. This is not to say that the latter are not serious health risks; both should be included in any comprehensive evaluation of a building's IAQ.

See www.epa.gov/radon and www.epa.gov/asbestos

The following have been cited causes of or contributing factors to sick building syndrome:

Inadequate ventilation: In the early and mid 1900's, building ventilation standards called for approximately 15 cubic feet per minute (cfm) of outside air for each building occupant, primarily to dilute and remove body odors. As a result of the 1973 oil embargo, however, national energy conservation measures called for a reduction in the amount of outdoor air provided for ventilation to 5 cfm per occupant. In many cases these reduced outdoor air ventilation rates were found to be inadequate to maintain the health and comfort of building occupants. Inadequate ventilation, which may also occur if heating, ventilating, and air conditioning (HVAC) systems do not effectively distribute air to people in the building, is thought to be an important factor in SBS. In an effort to achieve acceptable IAQ while minimizing energy consumption, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) recently revised its ventilation standard to provide a minimum of 15 cfm of outdoor air per person (20 cfm/person in office spaces). Up to 60 cfm/person may be required in some spaces (such as smoking lounges) depending on the activities that normally occur in that space (see ASHRAE Standard 62-1989).

Chemical contaminants from indoor sources: Most indoor air pollution comes from sources inside the building. For example, adhesives, carpeting, upholstery, manufactured wood products, copy machines, pesticides, and cleaning agents may emit volatile organic compounds (VOCs), including formaldehyde. Environmental tobacco smoke contributes high levels of VOCs, other toxic compounds, and respirable particulate matter. Research shows that some VOCs can cause chronic and acute health effects at high concentrations, and some are known carcinogens. Low to moderate levels of multiple VOCs may also produce acute reactions. Combustion products such as carbon monoxide, nitrogen dioxide, as well as respirable particles, can come from unvented kerosene and gas space heaters, woodstoves, fireplaces and gas stoves. For more information, see VOCs; Carbon Monoxide; Formaldehyde; Nitrogen Dioxide; Respirable Particles.

Chemical contaminants from outdoor sources: The outdoor air that enters a building can be a source of indoor air pollution. For example, pollutants from motor vehicle exhausts; plumbing vents, and building exhausts (e.g., bathrooms and kitchens) can enter the building through poorly located air intake vents, windows, and other openings. In addition, combustion products can enter a building from a nearby garage.

Biological contaminants: Bacteria, molds, pollen, and viruses are types of biological contaminants. These contaminants may breed in stagnant water that has accumulated in ducts, humidifiers and drain pans, or where water has collected on ceiling tiles, carpeting, or insulation. Sometimes insects or bird droppings can be a source of biological contaminants. Physical symptoms related to biological contamination include cough, chest tightness, fever, chills, muscle aches, and allergic responses such as mucous membrane irritation and upper respiratory congestion. One indoor bacterium, *Legionella*, has caused both Legionnaire's Disease and Pontiac Fever. For more information, see Biologicals and Mold.

These elements may act in combination, and may supplement other complaints such as inadequate temperature, humidity, or lighting. Even after a building investigation, however, the specific causes of the complaints may remain unknown.

[Top of page](#)

Building Investigation Procedures

The goal of a building investigation is to identify and solve indoor air quality complaints in a way that prevents them from recurring and which avoids the creation of other problems. To achieve this goal, it is necessary for the investigator(s) to discover whether a complaint is actually related to indoor air quality, identify the cause of the complaint, and determine the most appropriate corrective actions.

An indoor air quality investigation procedure is best characterized as a cycle of information gathering, hypothesis formation, and hypothesis testing. It generally begins with a walkthrough inspection of the problem area to provide information about the four basic factors that influence indoor air quality:

the occupants

the HVAC system

possible pollutant pathways

possible contaminant sources.

Preparation for a walkthrough should include documenting easily obtainable information about the history of the building and of the complaints; identifying known HVAC zones and complaint areas; notifying occupants of the upcoming investigation; and, identifying key individuals needed for information and access. The walkthrough itself entails visual inspection of critical building areas and consultation with occupants and staff.

The initial walkthrough should allow the investigator to develop some possible explanations for the complaint. At this point, the investigator may have sufficient information to formulate a hypothesis, test the hypothesis, and see if the problem is solved. If it is, steps should be taken to ensure that it does not recur. However, if insufficient information is obtained from the walk through to construct a hypothesis, or if initial tests fail to reveal the problem, the investigator

should move on to collect additional information to allow formulation of additional hypotheses. The process of formulating hypotheses, testing them, and evaluating them continues until the problem is solved.

Although air sampling for contaminants might seem to be the logical response to occupant complaints, it seldom provides information about possible causes. While certain basic measurements, e.g., temperature, relative humidity, CO₂, and air movement, can provide a useful "snapshot" of current building conditions, sampling for specific pollutant concentrations is often not required to solve the problem and can even be misleading. Contaminant concentration levels rarely exceed existing standards and guidelines even when occupants continue to report health complaints. Air sampling should not be undertaken until considerable information on the factors listed above has been collected, and any sampling strategy should be based on a comprehensive understanding of how the building operates and the nature of the complaints.

[Top of page](#)

Solutions to Sick Building Syndrome

Solutions to sick building syndrome usually include combinations of the following:

Pollutant source removal or modification is an effective approach to resolving an IAQ problem when sources are known and control is feasible. Examples include routine maintenance of HVAC systems, e.g., periodic cleaning or replacement of filters; replacement of water-stained ceiling tile and carpeting; institution of smoking restrictions; venting contaminant source emissions to the outdoors; storage and use of paints, adhesives, solvents, and pesticides in well ventilated areas, and use of these pollutant sources during periods of non-occupancy; and allowing time for building materials in new or remodeled areas to off-gas pollutants before occupancy. Several of these options may be exercised at one time.

Increasing ventilation rates and air distribution often can be a cost effective means of reducing indoor pollutant levels. HVAC systems should be designed, at a minimum, to meet ventilation standards in local building codes; however, many systems are not operated or maintained to ensure that these design ventilation rates are provided. In many buildings, IAQ can be improved by operating the HVAC system to at least its design standard, and to ASHRAE Standard 62-1989 if possible. When there are strong pollutant sources, local exhaust ventilation may be appropriate to exhaust contaminated air directly from the building. Local exhaust ventilation is particularly recommended to remove pollutants that accumulate in specific areas such as rest rooms, copy rooms, and printing facilities. (For a more detailed discussion of ventilation, read Fact Sheet: Ventilation and Air Quality in Offices)

Air cleaning can be a useful adjunct to source control and ventilation but has certain limitations. Particle control devices such as the typical furnace filter are inexpensive but do not effectively capture small particles; high performance air filters capture the smaller, respirable particles but are relatively expensive to install and operate. Mechanical filters do not remove gaseous pollutants. Some specific gaseous pollutants may be removed by adsorbent beds, but these devices can be expensive and require frequent replacement of the adsorbent material. In sum, air cleaners can be useful, but have limited application.

Education and communication are important elements in both remedial and preventive indoor air quality management programs. When building occupants, management, and maintenance personnel fully communicate and understand the causes and consequences of IAQ problems, they can work more effectively together to prevent problems from occurring, or to solve them if they do.

[Top of page](#)

Additional Information

For more information on topics discussed in this Fact Sheet, contact your state or local health department, a non-profit agency such as your local American Lung Association, or the following:

National Institute for Occupational Safety and Health

www.cdc.gov/niosh/homepage.html

US Department of Health and Human Services

4676 Columbia Parkway (Mail Drop R2)

Cincinnati, Ohio 45226

Public Relations Office

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

www.ashrae.org/

1791 Tullie Circle, NE,

Atlanta, Georgia 30329

Building Owners and Managers Association International

www.boma.org/

1250 Eye Street, NW,

Washington, DC 20005

[Top of page](#)

[Local Navigation](#)[Indoor Air Home](#)

For these links go to: <http://www.epa.gov/iaq/pubs/sbs.html>,

[About Us](#)

[Basic Information](#)

[Where You Live](#)

[A to Z Subject Index](#)

[Frequent Questions](#)

[IAQ Publications](#)

[Recursos En Español](#)

[Related Links](#)

[Glossary](#)

[IAQ Hotlines](#)

[Media/PSAs](#)

[Children's Health](#)

[Indoor Air Topics](#)

[Asthma](#)

[IAQ Tools for Schools](#)

[IAQ Design Tools for Schools](#)

[Molds & Moisture](#)

[Radon](#)

[Secondhand Smoke/ Smoke-free Homes](#)

[IAQ in Homes](#)

[IAQ in Large Buildings](#)

Green Buildings

EPA Home Privacy and Security Notice Contact Us

Last updated on Thursday, August 9th, 2007.<http://www.epa.gov/iaq/pubs/sbs.html>