Children's Health

Environmental Health: Homes and Communities

Continuing Education Contact Hours *updated

by Barbara Sattler, DrPH, RN; Brenda M. Afzal, MS, RN; Marian E. Condon, MS, RN; Erin K. Belka, BS; Tonya M. McKee, BA

Expiration Date: December 31, 2007. No CE contact hours (CH) will be given after this date.

Table of Contents

- Abstract and Objectives
- Children's Special Vulnerabilities
- The Right to Know: Access to Information About Chemicals in Our Environment
  - Chemical Risk Management Plans
  - Food and Agricultural Process and the Right to Know
- Indoor Air Quality
- Mold/Mildew
  - Is Sampling for Mold Needed?
- Environmental Tobacco Smoke
- Radon
- Carbon Monoxide in The Home
  - CO Poisoning Symptoms
  - Carbon Monoxide Detectors
- Lead
- Mercury
  - Cultural Beliefs/Practices
- Pesticides
  - Integrated Pest Management
- Drinking Water
  - Tap Water Testing
- Sun Safety for Children
  - UV Index
- Conclusion
- References
- Resources

Abstract and Objectives

We like to think that our homes are a safe haven. However, in recent years we have been discovering that certain products, designs, and even the siting of our homes can create health risks. When families moved into a new development in Waynesville, NC, called "Barber Orchard," they were ecstatic about their new surroundings - the fresh air, mountain views, and clean water. When one of the new residents had his well water tested, their dream homes took on a different character. The water was reflective of the years of pesticide use on the former orchard on which their homes were sited; it contained DDT, DDE, and benzene hydrochlorides (Manual, 2000). The soil was contaminated with lead and arsenic, also the result of pesticide applications. The Environmental Protection Agency (EPA) sent in an emergency response team, removed topsoil, and advised residents to install carbon filters on their water systems.

Sometimes, we unintentionally bring pollution into our homes. In the homes of middle-income families with small children, vacuum dust was found to have pesticide concentrations 10-100 times greater than those found in the surface soils surrounding their houses (Lewis et al, 1994). In the agricultural area of Washington State, 47 of 48 farm homes had chlorpyrifos (an organophosphate pesticide) measured in the house dust. The human health risks associated with chlorpyrifos are substantial (including headaches, dizziness, muscle twitching, vomiting, and blurred vision); hence, in 2000, the EPA eliminated the widely used pesticide for nearly all-household purposes.

The purpose of this independent study module (ISM) is to introduce the reader to basic concepts and issues associated with environmental health risks to children in homes and communities. In this ISM, some of the key hazardous exposures occurring in the home will be discussed. Indoor air quality, drinking water, lead, mercury, pesticides, radon, and UV radiation have been selected as topics of focus. A resource section provides a brief listing of resources; many of them are Web sites, which, in turn will link the reader to additional resources. The EPA's Web site is particularly helpful. The University of Maryland School of Nursing has a new web site, http://enviRN.umaryland.edu, with links to all of the web sites noted in this ISM.

Objectives

1. Describe children's special vulnerabilities to environmental pollutants in the home and community.

2. Identify two environmental hazards that may affect children's health.

3. Explain the nurse's advocacy role related to children's environmental health.

4. Specify two resources that can provide information related to children's environmental health.

5. Describe two pollutants that contribute to indoor air pollution, their sources, and associated health effects.

6. Describe two drinking water contaminants that are of special concern for children and the health effects that you might expect to see from exposure to 7. Discuss two methods of preventing carbon monoxide poisoning in the home.

7. Explore the action steps that can be taken to prevent overexposure to the sun and associated adverse health effects.

Children's Special Vulnerabilities

Children are not just little adults. They are different in many ways, particularly with regard to their exposures and responses to the environment. As nurses, we know that infants and young children breath more rapidly than adults. This increase in respiratory rate may translate into a proportionately greater exposure to air pollutants. While infants' lungs are developing, they may also be susceptible to environmental toxicants. Behaviors characteristic of early childhood also affect a child's exposure to toxicants. In the first years of life, the young child spends hours close to the ground where he or she may be exposed to toxicants in dust, soil, and carpets, as well as to pesticide vapors in low-lying layers of air (www.cehn.org/cehn/WhatisPEH.html).

Infants and young children drink more fluids per body weight than adults, potentially increasing the dose of contaminants (particularly pesticides) found in their drinking water, milk, and juices. "Consider the amount of water that an infant who receives formula reconstituted in boiled tap water drinks every day. The average infant consumes six ounces of formula per kilogram of body weight. For the average male adult, this is equivalent to drinking 35 cans of soda pop a day. If the water contains a contaminant, then infants will receive more of it relative to their size than will an adult" (Bearer, 1995). Children also eat more per body weight, and they eat different proportions of food. How many adults could eat the same amount of raisins pound-for-pound as the average two year-old? Children consume many more fruits and fruit juices than adults, which may result in larger doses of exposure to pesticide residues.

Children play on the floor, the grass, and the playground, placing them at increased risk for exposure to toxic chemicals that may be applied to or settle on the floors or ground, including lead-based paint dust, cleaning product residues, and horticultural/agricultural chemicals (fertilizers, herbicides, pesticides). The hand-to-mouth exploration of the infant and young child that helps them to learn about their world also places them at higher risk of exposures. This is particularly true in the case of lead-based paint dust when it is present in homes and schools. Because metabolic systems are still developing in children (and fetuses), their ability to detoxify and excrete toxins differs from that of adults. This difference is sometimes to the children's advantage, but more frequently they are not able to excrete toxins as well as adults, and thus are more vulnerable to them.

The rate at which children absorb nutrients from the gastrointestinal tract is different than the rate for adults, a fact that can impact their exposure to toxicants. For example, children have a greater need for calcium for bone development than do adults. As such, children will absorb more of this element when it is present in the gastrointestinal tract. When lead has been ingested into the gut, however, the body will absorb it in place of calcium. Consequently, an adult will absorb 10% of ingested lead, while a toddler will absorb 50% of ingested lead (Bearer, 1995). Some of the protective mechanisms that are well developed in adults, like the blood-brain barrier, are immature in young children, thereby making them more vulnerable to the effects of some toxic chemicals.

The Right to Know: Access to Information About Chemicals in Our Environment

Most of us have read the label on a foodpackage. We take for granted that we should have access to the information we seek on a food label such as the ingredients, the nutritional breakdown, and the calorie count. The food labeling law, one of the first major "right to know" laws in the U.S., was passed in 1958 in response to concerns about artificial coloring, preservatives, and other additives that were being placed in processed foods. It is administered by the federal Food and Drug Administration and the Department of Agriculture. Concerns about chemicals in our environment continued to be raised throughout the 1960s. Rachel Carson's seminal work, *Silent Spring*, brought to light new connections between exposures to manmade chemicals (particularly DDT) and their negative impact in nature.

In 1983, the Hazard Communication Standard, commonly known as the worker Right-to-Know, gave employees the right-to-know about the hazardous chemicals with which they work, including information about reproductive hazards that might be in their work environments. Some reproductive toxicants, such as lead, can increase the risk of developmental problems in children. The Hazard Communication Standard is administered by the U.S.

Occupational Safety and Health administration.

In 1986, a community right-to-know initiative provided information to community members regarding the pollution in their neighborhoods with the enactment of the Emergency Planning and Community Right to Know Act (EPCRA). This legislation identified a list of 600 chemicals that must be reported to the EPA if they are emitted into the air or water above a weight-based action level. This reporting is called the Toxic Release Inventory (TRI). This information is available to all citizens from the EPA via the EPA's web site www.epa.gov/enviro/index_java.html. Environmental Defense, an environmental organization, has published this TRI on a unique, user-friendly web site (www.scorecard.org) in which they provide information on the health risks associated with the reported chemicals, information on the chemical-producing entities, and guidance for further action and advocacy. Nurses can use this information when assessing an individual or community.

Chemical Risk Management Plans

When the Clean Air Act was reauthorized in 1990, a new directive required workplaces in which there are hazardous chemicals to predict the possible ways that there could be an accidental spill, leak, transportation accident, or other hazardous chemical-related event that would expose workers or the community. These risk management plans (RMPs) describe potential hazards and emergency response plans, and inform workers and the public about safety features. In addition, employers must provide a discussion of the methods by which such events are being prevented and the contingencies for response should an accidental release or spill occur. This information is to be reported to the EPA. This information is currently not available to the public.

Food and Agricultural Process and the Right to Know

In 1906, the Pure Foods Act and Meat Inspection Act began the modern era of American food and consumer protection. In 1938, the Federal Food, Drug and Cosmetic Act replaced the 1906 statute and required a label on processed, packaged food to include the name of the food, its net weight, and the name and address of the manufacturer. On certain products, ingredients were also required. It was not until 1973 that nutritional labeling began and in 1984, a sodium content requirement was added to the label.

The latest installment of labeling statutes is the 1990 National Labeling and Education Act, which requires nutritional labeling of most foods (except meat and poultry). Definitions were established for labeling language such as "fat free, lite, and healthy" and the health claims used on labels were further regulated.

Indoor Air Quality

"Although the U.S. has made great strides in cleaning up smog and soot in the nation's cities, outdoor air pollution still threatens the health of millions of Americans. In the last decade, indoor air quality has also been recognized as a significant concern. Levels of many common pollutants have been shown to be 2 to 5 times higher, and occasionally more than 100 times higher indoors than they are outdoors. The quality of the air we breathe, both indoors and out has a great impact on lung health. Fragile lung tissue is easily damaged by pollutants in the air, resulting in increased risk of asthma and allergies, chronic bronchitis, lung cancer and other respiratory diseases" www.lungusa.org/air). Lung disease is one of many health effects that may be associated with air quality.

Indoor pollution sources that release gases or particles into the air are the primary cause of indoor air quality problems in homes. Studies from the United States and Europe show that people in industrialized nations spend more than 90 percent of their time indoors. For infants, the elderly, persons with chronic diseases, and most urban residents of any age, the proportion is probably higher. The places in which people spend substantial amounts of time - their homes, schools, and workplaces - are critical potential sources of indoor air pollutants. Well-

documented triggers of allergies and asthma include: pet dander, molds, dust mites, cockroaches, and environmental tobacco smoke. For more information on asthma and indoor air quality, see the July/August 2001 issue of *The American Nurse*. In addition, the EPA's Office of Indoor Air (www.epa.gov/iaq) and the American Lung Association (www.lungusa.org) have excellent web sites on these issues.

Mold/Mildew

Molds are microscopic fungi that comprise 25% of the earth's biomass. They can be found almost anywhere and can grow on virtually any organic substance, as long as moisture and oxygen are present. Molds can grow on wood, paper, carpet, foods, and insulation. Moisture encourages mold growth. "When moldy material becomes damaged or disturbed, spores (reproductive bodies similar to seeds) can be released into the air. Exposure can occur if people inhale the spores, directly handle moldy materials, or accidentally ingest them. Also, mold can sometimes produce chemicals called mycotoxins. Mycotoxins may cause illness in people who are sensitive to them. Large exposures are typically associated with certain occupations (e.g., agricultural work)" (New York City Department of Health, 2001). It is impossible to eliminate all mold and mold spores in the indoor environment. However, mold growth can be controlled indoors by controlling moisture.

Many types of molds exist and they all have the potential to cause health effects. Molds produce allergens that can trigger allergic reactions or asthma attacks. Health concerns are an important reason to prevent mold growth and to remediate/clean up any existing indoor mold growth. "The most common symptoms of overexposure are cough, congestion, runny nose, eye irritation, and aggravation of asthma. Depending on the amount of exposure and a person. s individual vulnerability, more serious health effects - such as fevers and breathing problems - can occur but are unusual" (New York City Department of Health, 2001).

EPA has a guide for homeowners, "A Brief Guide to Mold" at www.epa.gov/mold/moldbasics.html

Mold Prevention and Remediation Tips

Prevention

- Fix leaky plumbing and leaks in the home as soon as possible. Prevent moisture from condensation by increasing surface temperature or reducing the moisture level in air (humidity). To increase surface temperature, insulate or increase air circulation. To reduce the moisture level in air, repair leaks, increase ventilation (if outside air is cold and dry), or dehumidify (if outdoor air is warm and humid). Keep heating, ventilation, and air conditioning (HVAC) drip pans clean, flowing properly, and unobstructed. Vent moisture-generating appliances, such as dryers, to the outside where possible. Maintain low indoor humidity, below 60% relative humidity (RH), ideally 30- 50%, if possible. Clean and dry wet or damp spots within 48 hours. Provide drainage and slope the ground away from the foundation.
- Wash mold from hard surfaces and dry completely.

(Available at www.epa.gov/iaq/molds/prevention.html)

Remediation

- Always use gloves and eye protection when cleaning up mold. For extensive mold clean-up personal protective equipment (PPE) should be used. An explanation of what to wear when remediating mold can be found at: www.epa.gov/mold/whattowear.html .
- A variety of mold cleanup methods are available for remediating damage to building materials and furnishings. The specific method or group of methods used will depend on the type of material affected. EPA has a guide on mold remediation that while focusing on schools is useful in the home as well: www.epa.gov/mold/mold_remediation.html.
- Absorbent materials, such as ceiling tiles and carpet, may have to be replaced if they are contaminated with mold.

Is Sampling for Mold Needed?

In most cases, if visible mold growth is present, sampling is unnecessary. In specific instances, such as cases where litigation is involved, the source(s) of the mold contamination is unclear, or health concerns are a problem, consider sampling as part of the site evaluation. An experienced professional, such as an industrial hygienist, should be consulted to do the sampling. It is important to note that the results of sampling may have limited use or application. Sampling may help locate the source of mold contamination, identify some of the mold species present, and differentiate between mold and soot or dirt. Pre- and post-remediation sampling can also be useful in determining whether remediation efforts have been effective. After remediation, the types and concentrations of mold in indoor air samples should be similar to what is found in the local outdoor air. There are no EPA or other federal threshold limits for mold or mold spores. Keep in mind that air sampling for mold provides information only for the moment in time in which the sampling occurred, much like a snapshot.

Dust Mites

Dust mites are microscopic animals that are found in every home. They survive by consuming dead skin cells. They can be powerful triggers for asthma and allergies. Dust mites live in mattresses, pillows, carpets, fabric-covered furniture, bedcovers, clothes, and stuffed toys. Body parts and feces of dust mites can be asthma triggers. To protect members of the household from dust mites:

- Wash sheets and blankets once a week in hot water. Choose washable stuffed toys, wash them often in hot water, and dry thoroughly. Keep stuffed toys off beds. Cover mattresses and pillows in dust-proof (allergen-impermeable) zippered covers.
- Maintain low indoor humidity.

(Available at http://www.epa.gov/asthma/pdfs/asthma_eng.trifold.pdf)

Environmental Tobacco Smoke

Secondhand Smoke (SHS), or Environmental Tobacco Smoke (ETS) is a mixture of the smoke given off from the burning end of a cigarette, pipe, or cigar and the smoke exhaled from the lungs of smokers. "Chemicals present in ETS include irritants and systemic toxicants such as hydrogen cyanide and sulfur dioxide; mutagens and carcinogens such as benzo[a]pyrene, formaldehyde, and 4-aminobiphenyl; and the reproductive toxicants nicotine, cadmium, and carbon monoxide" (California Environmental Protection Agency, 1997). Exposure to environmental

tobacco smoke has been linked to a variety of adverse health effects, including eye, nose, and throat irritation; headaches; and lung cancer, and may contribute to heart disease. Specifically for children, there is an increased risk of lower respiratory tract infections, such as bronchitis and pneumonia; and ear infections (caused by build-up of fluid in the middle ear); increased severity and frequency of asthma episodes; and decreased lung function.

Health Effects Associated with Exposure to Environmental Tobacco Smoke

Effects Causally Associated with ETS Exposure

Developmental Effects:low birth weight or small for gestational age; Sudden Infant Death Syndrome. **Respiratory Effects:**acute lower respiratory effects in children; asthma induction and exacerbation in children; chronic respiratory symptoms in children; eye and nasal irritation in adults; middle ear infections in children. **Carcinogenic Effects:**lung cancer; nasal sinus cancer. **Cardiovascular Effects:** heart disease mortality; acute and chronic coronary heart disease morbidity.**Effects with Suggestive Evidence of a Causal Association with ETS ExposureDevelopmental Effects:**spontaneous abortion; adverse impact on cognition and behavior.**Respiratory Effects:**exacerbation of cystic fibrosis; decreased pulmonary function. **Carcinogenic Effects:**cervical cancer.

(Available at www.oehha.org/pdf/exec.pdf)

Nursing Actions

- Inform nonsmokers that they have a right to healthy and safe environments and that environmental tobacco smoke places their health in jeopardy. Promote and support smoke-free schools, day-care settings, workplaces, and homes (especially where children live). Develop information about effective smoking cessation programs. The ultimate goal for all smoking policies is to encourage complete smoking cessation. Educate people about the need to establish smoke-free public places and the need to regulate tobacco products.
- Teach smokers about the harmful effects of environmental tobacco smoke exposure on all individuals, especially their children.

(American Nurses Association, (1997))

Radon

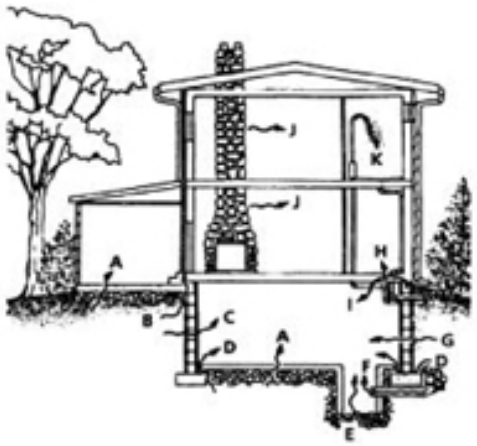
Radon is a naturally occurring radioactive gas found in soil that may seep into buildings from the surrounding soil. The EPA ranks indoor radon among the most serious environmental health problems facing us today. After smoking, it is the second leading cause of lung cancer in the United States, causing an estimated 14,000 lung cancer deaths a year U.S. Environmental Protection Agency, 1992). The combination of exposure to radon and smoking significantly increases the risk of cancer. Radon is emitted from the natural decay of uranium that is found in nearly all soils. Approximately one out of every 15 homes in the U.S. is estimated to have elevated radon levels. You cannot see, taste, or smell radon.

Radon decays into radioactive particles that can be trapped in the lungs where they damage lung tissue and may lead to lung cancer. The risk of developing lung cancer from radon exposure depends on: (1) the amount of radon

in the home (dose), (2) the amount of time spent in the home (duration), and (3) whether the individual is a smoker or has ever smoked (host factor).

How Radon Enters Buildings

A. Cracks in concrete slabs
B. Spaces behind brick veneer walls that rest on uncapped hollow-brick foundation
C. Pores and cracks in concrete blocks
D. Floor-wall joints
E. Exposed soil, as in a sump
F. Weeping (drain) tile, if drained to open sump
G. Mortar joints
H. Loose fitting pipe penetrations
I. Open tops of block walls
J. Building materials such as some rock
K. Water (from some wells)



If radon is present in well water, radon gas may be released into the air when the water is used for showering and other household uses. Research suggests that drinking water with high radon levels may also pose risks however, this risk is much lower than risks associated with breathing radon.

Testing is the only way to know if a home has an elevated radon level. The EPA and the Surgeon General recommend testing all homes below the third floor for radon. There are many kinds of low-cost "do-it-yourself" radon test kits that homeowners can purchase in hardware stores and other retail outlets. State radon offices also provide a list of trained contractors who conduct the tests. Nurses should test their homes and encourage neighbors and patients to test theirs.

How to Test for Radon

Short-Term Testing: The quickest way to test is with short-term tests. Short-term tests remain in your home for two days to 90 days, depending on the device. "Charcoal canisters," "alpha track," "electret ion chamber," "continuous monitors," and "charcoal liquid scintillation" detectors are most commonly used for short-term testing. Because radon levels tend to vary from day to day and season to season, a short-term test is less likely than a long-term test to tell you your year-round average radon level. If you need results quickly, however, a shortterm test followed by a second short-term test may be used to decide whether to fix your home.

Long-Term Testing: Long-term tests remain in your home for more than 90 days. "Alpha track" and "electret" detectors are commonly used for this type of testing. A long-term test will give you a reading that is more likely to tell you your home's year-round average radon level than a short-term test.

How to Use a Radon Test Kit
Follow the instructions that come with your test kit. If you are doing a short-term test, close your windows and outside doors and keep them closed as much as possible during the test. (If you are doing a short-term test lasting just 2 or 3 days, be sure to close your windows and outside doors at least 12 hours before beginning the test, too. You should not conduct short-term tests lasting just 2 or 3

days during unusually severe storms or periods of unusually high winds.) The test kit should be placed in the lowest lived-in level of the home (for example, the basement if it is frequently used, otherwise the first floor). It should be put in a room that is used regularly (like a living room, playroom, den or bedroom) but not your kitchen or bathroom. Place the kit at least 20 inches above the floor in a location where it won. t be disturbed - away from drafts, high heat, high humidity, and exterior walls. Leave the kit in place for as long as the package says. Once you. ve finished the test, reseal the package and send it to the lab specified on the package right away for study. You should receive your test results within a few weeks.

For additional information: www.epa.gov/iaq/radon/pubs/citguide.html#howtotest

Carbon Monoxide in the Home

Carbon monoxide is a colorless, odorless, tasteless poisonous gas. "Carbon monoxide is the leading cause of poisoning deaths in the U.S., with more than 3,800 people known to die annually from CO poisoning (accidental and intentional). In addition to known deaths, more than 10,000 individuals seek medical attention or miss at least one day of work because of a sub-lethal exposure" (Greiner, T., 1998). CDC data from 1996 indicates that there were 525 unintentional deaths due to carbon monoxide poisoning in the United States (CDC, 1999).

Carbon monoxide (CO) is produced by the incomplete combustion of carbon materials. Any flame or combustion device is likely to emit carbon monoxide. Carbon monoxide can get trapped inside an area when appliances do not work properly; a stove or furnace is not working properly due to a clogged chimney or vent; a car is left running in an enclosed space; or a charcoal grill is used in a closed area (United States Consumer Product Commission. (1993).

CO Poisoning Symptoms

Carbon monoxide combines with hemoglobin to form carboxyhemoglobin, which is incapable of carrying oxygen, resulting in tissue anoxia. The health threat from exposure to CO is especially serious for unborn babies, infants, and people with anemia or a history of heart or respiratory disease. At moderate levels, carbon monoxide can cause severe headaches, dizziness, confusion, and nausea. If these levels persist for a long time, death can occur. Low levels can cause shortness of breath, mild nausea, and mild headaches, and may have longer-term effects on health. These . flu like' symptoms are often mistaken for the flu or other illnesses, that may result in delayed or misdiagnosed treatment.

Chronic CO poisoning usually involves lower levels of the gas in the air and lower blood CO (COHb) concentrations. Chronic CO poisoning may not elicit the typical symptoms of (acute) CO poisoning such as headache, nausea, weakness, and dizziness. Mucous membranes of the body will almost never be cherry pink in chronic poisoning as they are in acute CO poisoning. Chronic CO poisoning is often misdiagnosed as chronic fatigue syndrome, a viral or bacterial pulmonary or gastrointestinal infection, a "run-down" condition, or immune deficiency. Patients occasionally present with polycythemia, increased hematocrit. Similar symptoms seen simultaneously in more than one person, and which decrease upon removal from an environment, are tip-offs that CO may be involved.

Carbon Monoxide Detectors

CO toxicity levels are usually expressed in airborne concentration levels read in parts per million (ppm) and

duration of exposure. CO detectors are designed to protect against acute high levels of carbon monoxide; they are NOT required or equipped to alarm at lower levels of CO. The Underwriters Laboratories (UL) standard requires detectors to alarm within 90 minutes when exposed to 100 ppm; 35 minutes when exposed to 200 ppm and 15 minutes when exposed to 400 ppm (www.homesafe.com/coalert/detect.htm).

The National Institute for Occupational Safety and Health (NIOSH) time-weighted average standard for CO exposure is 35 ppm, which is well below the lowest UL standard alarm trigger of 100 ppm. Also, both NIOSH and the Occupation Safety and Health Administration have set a standard for CO exposure at 200 ppm as an absolute ceiling that "should not be exceeded at any time" (U.S. Department of Health and Human Services, 1994).

There are several types of CO detectors on the market. However, they are not as reliable as smoke detectors and due to the colorless, odorless nature of CO, it is more difficult to identify the cause of a CO alarm. If you shop for a CO detector to warn of acute CO exposures, look for UL certification. Nongovernmental organizations such as Consumers Union (publisher of Consumer Reports), the American Gas Association, and Underwriters Laboratories (UL) can help you make an informed decision. Carefully follow manufacturers' instructions for its placement, use, and maintenance. While a UL-certified CO detector will alarm in the case of highlevel CO incidents, it will not alarm at low levels that could pose significant health risks. To prevent and address low level, chronic CO exposures, maintaining appliances and recognizing symptoms of possible poisoning are essential.

Important Tips

- Never burn charcoal inside a home, garage, vehicle, or tent.
- Never use portable fuel-burning camping equipment inside a home, garage, vehicle, or tent.
- Never leave a car running in an attached garage, even with the garage door open.
- Never service fuel-burning appliances without proper knowledge, skills, and tools. Always refer to the owner's manual when performing minor adjustments or servicing fuel-burning appliances.
- Never use gas appliances such as ranges, ovens, or clothes dryers for heating your home.
- Never operate unvented fuel-burning appliances in any room with closed doors or windows or in any room where people are sleeping.
- Do not use gasoline-powered tools and engines indoors. If use is unavoidable, ensure that adequate ventilation is available and, whenever possible, place engine unit to exhaust outdoors.

(Available from the Consumer Product Safety Commission at www.cpsc.gov/cpscpub/pubs/466.html)

If the CO Detector Alarm Goes Off:

- Check to see if any member of the household is experiencing symptoms of poisoning.
- If they are, get them out of the house immediately and seek medical attention.
- If no one is feeling symptoms, ventilate the building with fresh air; turn off all potential sources of CO oil or gas furnace, gas water heater, gas range and oven, gas dryer, gas or kerosene space heater and any vehicle or small engine.
- Have a qualified technician inspect fuel-burning appliances and chimneys to make sure they are operating correctly and that there is nothing blocking the fumes from being vented out of the house.

(Available at www.epa.gov/iaq/pubs/coftsht.html)

Lead

Lead is a poison. Childhood lead poisoning remains a major preventable environmental health problem in the United States. Children's still-developing nervous systems are particularly vulnerable to the toxic effects of lead, and their normal play and hand-to-mouth activities expose them to lead paint hazards and lead-contaminated dust and soil. According to the Center for Disease Control, estimates from the National Health and Nutrition Examination Survey indicated that Medicaid enrollees accounted for 83% of children aged 1-5 years who had elevated blood lead levels (CDC, (Dec 8, 2000). Despite longstanding requirements for blood lead screening in the Medicaid program, an estimated 81% of young children enrolled in Medicaid have not been screened with a blood lead test. Over 20% of the children tested in some U.S. counties had blood lead levels (BLLs) "& high enough to adversely affect learning and development" (CDC, 2000).

Lead is ubiquitous in the environment since the advent of industrialization. Major sources of environmental lead exposure are lead-based paint, lead contaminated soil, occupational exposures, and industrial pollution. Lead can be found in some foods and drinking water from both natural sources and man-made pollution, i.e., pipes and solder that contain lead. Lead-based paint remains the most common source of environmental lead exposure for children. The Consumer Product Safety Commission banned the manufacturing of most interior and exterior lead-based paint in 1978 however, leaded paint still remains a threat in many homes built before 1978. Also, lead-based paint is still available and currently used in industrial, military, and marine areas.

Nearly one million children in the United States have elevated blood lead levels. This problem is especially acute in certain population groups. For example, among children living in pre-1946 dwellings (when the use of lead in paint was most common), the prevalence of lead poisoning is five times higher than among children living in homes built after 1973 (most of which do not have lead paint) (CDC, 1997). Interior surfaces that are likely sources of lead paint poisoning are trim-work, doorways, windowsills, and painted toys. Soil near painted buildings or roadways is often contaminated with lead and should be tested before being used for play areas or for planting edibles.

Hand-to-mouth activity and the efficiency of children's gastrointestinal absorption of lead-based paint dust place children at greater risk than adults (CDC, 1991). Adult lead exposure is a pediatric concern, as more than one million workers in more than 100 different occupations may be exposing their families to "take-home lead" if showers and changes of clothing are not provided at the end of a workday (ATSDR, 1992). Additionally, occupation exposures to pregnant women may cross the placenta and damage the developing nervous system of the fetus.

Physiological effects of lead toxicity are noted in virtually every system. The central nervous system, hematopoietic and renal system, and vitamin D metabolism are significantly affected. Symptoms of lead toxicity can range from non-specific complaints to irreversible and sometimes fatal damage to the central nervous system. Lower intelligence quotient (IQ), speech and language processing, and decreased attention span are common affects of lead poisoning in children. Symptomatic lead poisoning constitutes a medical emergency. Acute lead poisoning may be characterized by one or more of the following symptoms: headaches, clumsiness, anorexia, constipation, vomiting, agitation, bizarre behavior, apathy, and loss of developmental skills recently mastered. Central nervous system damage can progress to seizures and coma. Appropriate intensive care for very highlevel lead poisoning can prevent death, but severe permanent brain damage is likely despite treatment (CDC, 1991).

Even low levels of lead are harmful. Levels as low as 10 micrograms of lead per deciliter of blood (g/dL) are associated with decreased intelligence, behavior problems, reduced physical stature and growth, and impaired hearing (U.S. GAO, 1999; Needleman, 1996). A child is estimated to lose 2 IQ points for each 10 µg/dL increase in blood lead level. One study suggests that lead exposure may be associated with increased risk of juvenile delinquent behavior (Needleman, 1996; U.S. GAO, 1999).

Screening Homes for Lead Exposures

Nurses can perform dust sampling and/or train family and community members to sample for lead-based paint dust. There are also professional inspectors who can help homeowners make a lead assessment. The requisite "tools" for dust sampling are a tape measure, a baby wipe, and a sealed plastic bag.

Dust Wipe Sampling for Lead What rooms to sample?
Where children spend the most time (bedroom, kitchen, playroom, etc); at the most used entrance door; where there are areas of failing paint; in areas where renovation is under way or planned. **Spots in the room to sample:**
The inside windowsill; the window trough; the floor in front of the most used entrance.

Materials needed:

- Baby or hand wipes . use thin wipes that pull through a hole in the top of the container (avoid wipes with aloe, scent, or alcohol). Container (sealed plastic freezer bags, 35 mm film container, or centrifuge tube). A permanent marking pen; disposable gloves; a ruler or tape measure; and a mailing envelope.
- A form to identify and record samples.

How to take a sample:

- Throw out the first baby wipe, as it may be dry or dirty. Measure a 12-inch by 12-inch area. Using a moderate amount of pressure, wipe the 12-inch square in one direction, side to side, in a zigzag motion. Try to wipe the entire surface with a minimum of overlap. Fold the wipe, dirty side in, and wipe the same square in the same way in the opposite direction (top to bottom); Place the wipe in a sealed plastic bag and label. For the windowsill and trough follow the same procedure as above, but instead of a 12-inch square, wipe the entire sill. Measure length and width and label the bag with the information.
- Take a separate dust sample for the floor in front of the most used door. Do not take a composite sample.

Composite Samples:
Composite samples combine samples from several sites and provide an average exposure level. Composite sampling can help to rule out lead-safe houses and indicate the need for further evaluation in homes where elevated lead levels are found.

- Advantage - less expensive; Disadvantage - the composite will only give an average. Be certain the lab will accept composite samples. Put up to 4 wipes from different floor areas in one container. Do not put windowsill and floor wipes in same container. Where to send the samples A lab that is recognized by the National Lead Laboratory Accreditation Plan. A list of these labs can be obtained by calling 1-800-424-5323. A lab that will take composite tests. A lab that will accept samples in a sealed plastic bag. Some labs will only accept centrifuge tubes.
- A lab that charges $10 per individual or composite sample.

(Livingston, D. 1997)

Nurses' Role in Lead Poisoning Prevention

- Primary prevention efforts involve identifying and eliminating lead hazards before children are poisoned. Until this can be achieved, screening and follow-up of lead-poisoned children is essential. Tests for blood lead levels are recommended for children at ages 1 and 2, and more frequently for children if they are at higher risk. Any home built before 1978 should be tested for lead exposure. Nurses and homeowners can test for lead dust or the presence of lead in the paint.
- Education efforts can include the provision of information to parents regarding federal regulations (24 CFR Part 35, 40 CFR Part 745), which require that property sellers and landlords provide families with information about lead poisoning and about any known lead-based paint or lead hazards in a dwelling before its sale or lease.
- The only way to prevent lead poisoning is to remove the source of exposure. However, the process of removal often creates more exposure. If lead-based paint is in good condition (as in not chipped, flaking, or in areas of high friction), it is safer and easier to simply cover the area with non-lead based paint. The outermost paint surface should be lead-free. If there is lead-based paint underneath the intact paint, and the top surface is lead-free, there will not be an exposure unless the surface begins to deteriorate or if renovations or other activities are implemented that compromise the integrity of the paint.
- Nurses should educate parents and local health care providers about lead poisoning and the importance of screening homes and children. Excellent materials exist from the EPA (www.epa.gov/lead), the Alliance for Healthy Homes (formally the Alliance to End Childhood Lead Poisoning - www.aeclp.org/hhe/hhe_lead.htm), and the National Safety Council. A helpful publication titled "Lead in Your Home: a Parents Reference Guide" can be accessed from the brochure and training section of the EPA web site, www.epa.gov/lead/pubs/leadpbed.htm.

Fatal Pediatric Lead Poisoning

On March 29, 2000, a 2-year-old girl was seen at a community hospital emergency department with a low-grade fever and vomiting for approximately one day. The child had been well since arriving in New Hampshire from Egypt with her Sudanese refugee family 3 weeks earlier. Laboratory findings included a microcytic anemia (hemoglobin: 7.6 g/dL; lower limit of normal: 11.5 g/dL) with occasional basophilic stippling of red blood cells. A throat swab streptococcal antigenscreening test was positive. She was discharged from the emergency department with prescriptions for an antibiotic and antiemetic to treat her presumed strep throat. However, her vomiting worsened, and she was admitted to the same hospital on April 17, and then transferred to a tertiary-care hospital the next day. On April 19, approximately 5 hours after the transfer, she became unresponsive, apneic, and hypotensive. She was intubated and placed on a ventilator. Computerized tomography of the head showed diffuse cerebral edema and dilated ventricles. Later that day, the results of a blood test drawn on April 18 showed a BLL of 391 g/dL and an erythrocyte protoporphyrin level of 541 g/dL. Chelation therapy was initiated. Despite a decrease in her BLL to 72 g/dL and treatment for increased intracranial pressure, including surgical ventricular drainage, she remained comatose without spontaneous respirations, brain electrical activity, and intracranial blood flow. She was pronounced brain dead on April 21.

> An investigation revealed that after living in Egypt for approximately 18 months, on March 9, 2000, the family had moved to Manchester into an apartment constructed before 1920. A wall in a sibling's bedroom had multiple holes from which the patient had been seen removing and ingesting plaster. Two of seven samples of plaster with the adhering surface paint contained lead at levels of 5% 12%. Peeling paint (35% lead) was present on the balusters and floor (3% lead) of a porch outside the apartment entrance where the patient sometimes had played. She also had played near and looked out of a living room window that occasionally was opened during meal preparation. A wipe sample of dust from the window well showed 6732 µg lead/ft2, well above the hazardous level of 800 µg/ft2 (4). NHDHHS (New Hampshire Department of Health and Human Services) ordered the apartment owner to correct the lead hazards identified during the inspection. The patient's family relocated to another dwelling.
>
> (CDC. June 8, 2001).

Mercury

Mercury is another poisonous heavy metal that is a naturally occurring element. However, its increased presence in our environment is from a variety of human pollutant sources. Most mercury pollution is released into the air and then falls directly onto waterways or is deposited onto land where it can be washed into the water. Mercury concentrations in air are usually low and of little direct concern. But when mercury is in water, biological processes transform it into a highly toxic form - methyl mercury. Methyl mercury bioaccumulates in fish, with larger fish generally accumulating higher levels. Humans that consume fish are at the top of the food chain, and often exposed to fish with the highest concentration of mercury.

"Methyl mercury exposures to women of childbearing age are of great concern because a fetus is highly susceptible to adverse effects" (CDC, 2001). In the past year, the FDA and the EPA have both issued advisory warnings for pregnant women advising them to limit their consumption of certain types of fish. The FDA advisories are for commercial fish and the EPA's are for noncommercial fish. These advisories are based on the sometimes dangerously high levels of methyl mercury that are bioaccumulated in both fresh and saltwater fish. Fresh-water fish from contaminated waters have been shown to have particularly high levels of methyl mercury, posing potential risks for recreational anglers and people who regularly fish for food. A recent report by the National Academy of Sciences (NAS, 2000) confirms that methyl mercury is a potent toxin and concludes that children born to women who consume large amounts of fish when pregnant are at greater risk for changes in their nervous system that can affect their ability to learn.

A recent report (Houlihan, 2000), titled "Brain Food: What women should know about mercury contamination of fish," asserts that the new fish advisories issued by the FDA, though a step in the right direction, are not protective enough. The report recommends that tuna steaks, sea bass, oysters, marlin, halibut, pike, walleye, and largemouth bass be added to the FDA's list of fish that should not be eaten by pregnant and nursing women or women of childbearing age. In addition, they recommend that the FDA advise women to eat no more than one meal per month of the following fish species combined: canned tuna, white croaker, mahi mahi, blue mussel, eastern oyster, cod, pollock, haddock, salmon from the Great Lakes, blue crab from the Gulf of Mexico, channel catfish (wild, not farmed), and lake whitefish.

EPA and FDA Fish Advisories

Fish can be an important source of nutrition for the pregnant woman, developing baby, and young child. However, the following recommendations should be considered when choosing the type and amount of fish to consume.

According to the EPA, if a woman is pregnant or could become pregnant, is nursing a baby, or if feeding a young child, limit consumption of freshwater fish caught by family and friends to one meal per week. For adults, one meal is six ounces of cooked fish or eight ounces uncooked fish; for a young child, one meal is two ounces of cooked fish or three ounces uncooked fish. Many states collect data on mercury levels in fish from local waters. Check with state or local health departments for specific advice on local waters where family and friends are fishing. In addition, the Food and Drug Administration (FDA) has issued advice on mercury in fish bought from stores and restaurants, which includes ocean and coastal fish as well as other types of commercial fish. The FDA advises that women of childbearing age and pregnant women, nursing mothers, and young children should not eat shark, swordfish, king mackerel, or tilefish. FDA also advises that women of childbearing age and pregnant women may eat an average of 12 ounces of fish purchased in stores and restaurants each week. Therefore, if in a given week a woman eats 12 ounces of cooked fish from a store or restaurant, then she should not eat fish caught by family or friends that week. This is important to keep the total level of methyl mercury contributed by all fish at a low level.

(Information is available at http://vm.cfsan.fda.gov/~dms/admehg.html.)

The EPA and the states are working to reduce mercury pollution in the environment, but because methyl mercury is very persistent, it will be many years before methyl mercury levels in fish and the environment are reduced.

Coal burningpower plants are the single largest source of mercury pollution. Another significant source of mercury is from medical waste incineration because of the large quantities of mercury typically used in health care. The latter source is one in which nurses can have a direct influence. A national coalition of health care providers and others called Health Care Without Harm has launched an international campaign to eliminate mercury from use in the health care sector. The American Nurses Association is one of the more than 300 organizations involved in the campaign. See www.noharm.org for more information on mercury reduction in health care settings. In addition, Hospitals for a Healthy Environment is a partnership program that also focuses in part on mercury reduction in hospitals. Their web site is www.h2e-online.org.

Table: Hunt for Mercury at Home

Hunt for Mercury at Home

(This is not intended as an inclusive list.)

Product	Description	What to do	Mercury free alternative
Thermometers	Silver liquid in tube	Bring to hazardous waste facility	Alcohol or digital thermometer

Thermostats	All non-electrical models	When it needs replacing, call the national thermostat recycling program.	Electronic "set back" models can help on energy bills.
Fluorescent lights	Light bulbs in the form of long tubes	Continue to use these, but recycle them at hazardous waste facility.	None, although some new bulbs the have less mercury than others.
Old Alkaline Batteries	Bought before 1990	Bring to hazardous waste facility.	Rechargeable batteries
Mercurochrome	An old antiseptic	Bring to hazardous waste facility.	New antiseptics do not contain mercury.
Maze toys	Contain a blob of mercury	Bring to hazardous waste facility.	Mercury-free games
Old toys that light up or make noise	May contain mercury button batteries	Bring to hazardous waste facility.	Toys that don't light up or make noise
Shoes that light up when walking	Bought before June 1990	Bring to hazardous waste facility.	Sneakers that don't light up
Chemistry sets	May contain mercury products	Bring to hazardous waste facility.	Other mercury-free toys
Contact lens solution	May contain Thimerosal	Check the label and then use it up.	Other brands that don't contain or other mercury compounds any mercury compounds
Vials of mercury	Small containers of mercury used for ceremonial purposes	Bring to hazardous waste facility.	None

Cultural Beliefs/Practices

Mercury has unique significance in some cultural practices. "Persons who use metallic mercury in ethnic folk medicine and for religious practices are at risk. Metallic mercury is sold under the name 'azogue' in stores (sometimes called botanicas) that specialize in religious items used in Esperitismo (a spiritual belief system native to Puerto Rico), Santeria, and voodoo. The use of azogue in religious practices is recommended in some Hispanic communities by family members, spiritualists, card readers, and santeros. Typically, azogue is carried in a sealed pouch prepared by a spiritual leader or sprinkled in the home or automobile. Some botanica owners suggest mixing it in bath water or perfume and placing it in devotional candles" (Centers for Disease Control and Prevention, 1997). In addition, there is some use of mercury-containing skin care products (soap, makeup, products to lighten skin and hair) by Asian and African cultures. One study of a population in Tanzania discovered very high concentrations in women who used soaps and creams containing high concentrations of mercury (Glahder, 1999).

Nursing Actions

- Nurses should assess individuals and communities for the cultural use of mercury and educate the individual or community about potential health risks. Nurses should make a dietary assessment of those at increased risk for mercury poisoning (young children, pregnant women, and women of childbearing age) using EPA and FDA fish advisories. To assess the mercury content in household chemicals and products, consult the mercury audit at www.epa.gov/grtlakes/bnsdocs/merccomm/merccomm.pdf. Do not throw mercury products in the trash, which will either be incinerated or land filled, either of which release the mercury back to the environment. Contact the local government hazardous waste division (usually housed in the department of the environment, the fire department or health department) and ask where the mercury can be safely disposed of. The mercury from one thermometer (roughly the size of an M&M candy) is enough to contaminate a 20-acre lake.
- If a mercury spill occurs, there are specific methods that should be used for clean up. It will require the evacuation of persons and animals from the contamination site, the use of special equipment and ventilation, and the need to assess the health effects on people who have come in contact with the contamination site. In addition, cordon off the spill area so that mercury is not accidentally tracked throughout the building. For an explanation of the components of this process, go to www.noharm.org .

Accident Spill Response

Detailed instructions of how to clean up mercury spills can be found on the EPA web site www.epa.gov/epaoswer/hazwaste/mercury/spills.htm.

Pesticides

"Pesticides are substances intended to destroy, control or repel pests, such as insects, weeds, fungi, rodents, and bacteria. Depending upon the dose, pesticides may cause a range of harm such as cancer, acute or chronic injury to the lungs, nervous, reproductive and endocrine and immune system damage and may accumulate in the environment. Children **may** be at greater risk of pesticide exposure than adults because pound for pound of body weight, children not only consume more fruits and fruit juices and breathe more, but they also have a more rapid metabolism than adults and they play on the floor and lawn where pesticides are commonly applied" (US EPA Region 8:).

There is a growing body of scientific data about the harmful effects that pesticides have on children's health, both acute and chronic. Routes of exposure to pesticides include inhalation, ingestion, and dermal penetration. Eighty percent of exposures to pesticides occur indoors; measurable levels of up to a dozen pesticides have been found in the air inside of homes (U.S. EPA, 1988). Acute affects of exposure include eye and throat irritation, skin rashes, nausea, vomiting, diarrhea, headaches, flulike symptoms, upper respiratory distress, and in extreme cases, death. Chronic affects, those that appear long after exposure, include an increased risk of some types of cancer, reproductive impairment, and neurological damage (U.S. EPA, Region 8:). Several studies have noted the relationship between childhood cancers (brain cancer, Ewing's sarcoma, Wilm's tumor, acute lymphoblastic leukemia, non-Hodgkin's lymphoma) and pesticide exposures (McBride, 1998; Daniels, 1997; Buckley, 2000; Meinert, 2000; Infante-Rivard, 1999). The potential risks illustrated by these studies suggest a need for a precautionary approach when dealing with pesticide exposures generally, but especially with children.

The EPA is responsible for registering all pesticides and is currently conducting a review of older pesticides to ensure adherence to current scientific standards under the Food Quality Protection Act (FQPA). FQPA, signed into law in 1996, sets a tougher standard for pesticide use on food, with a focus on children's environmental health. There are more than 20,000 registered pesticide products, each formulated for a specific use or uses. In fact, the biocides that are now included in many hand-cleaning products are registered pesticides.

Pest Prevention Tips

- Clean up spills and crumbs right away. Keep food in sealed containers. Eat at the table instead of walking around with food. Clean dirty dishes right away and drain the dish water. Keep a tight lid on trash and empty it often. Don't leave pet food out overnight. Wipe water off counters and fix leaky faucets. Check boxes and bags for insects before bringing them into the house. Get rid of stacks of paper.
- Caulk cracks or openings around baseboards and behind the kitchen and bathroom counters.

Integrated Pest Management

"Integrated pest management (IPM) is an increasingly useful approach to minimizing pesticide use while providing longterm pest control. It integrates both chemical and non-chemical methods to provide the least toxic alternative for pest control" (American Academy of Pediatrics, 1999). Traditional pest control has relied heavily on pesticides as the first plan of attack. Integrated Pest Management differs in that it does not automatically rely on pesticide application. For more information on IPM see: www.epa.gov/pesticides/ipm.

The EPA has recently phased out or eliminated the use of some pesticides that do not provide an adequate margin of protection for children

Chlorpyrifos (Dursban) - On June 8, 2000, the EPA announced an agreement with chemical manufacturers to eliminate the widely used pesticide for nearly allhousehold purposes. Under the agreement, production will cease and there will be a phase-out of the home and garden uses of this insecticide by the end of the year, but the agreement will allow existing stocks to be depleted. It will continue to be used on food (except tomatoes), golf courses, green houses, and for mosquito and fire ant control. New home treatment for termites will continue until Dec. 2005. **Diazinon** - The EPA has recently announced an agreement to phase out Diazinon for indoor uses beginning March 2001, and for all lawn, garden and turf uses by December 2003.

Methyl Parathion - An EPA risk assessment indicated that this pesticide could not meet the FQPA safety standard for children. On August 2, 1999, the EPA announced that it had accepted (from the manufacturer) a voluntary cancellation of the use of methyl parathion on crops that contribute to a child's diet. According to the EPA, removing these crop uses brings the estimated dietary risk for children down to an acceptable risk for children and all others in the U.S. population. In addition, cancelled non-food uses include: ornamentals, grasses grown for seed, mosquito use, and nursery stock. This pesticide is hazardous for workers who handle or apply the pesticide as part of their occupation. Precautions should be taken to protect workers in the field and their families at home from exposure to this pesticide.

Nursing Actions

- During home visits, assess pest status and the use and storage of pesticides. Inform patients about banned and phased-out pesticides. Discourage lawn services that routinely spray pesticides. Teach proper disposal of pesticides. (Contact the hazardous waste management division of the state department of the environment for the location of the closest hazardous waste collection point).
- Teach clients how to prevent pests.

Pesticide Product Recalls

The EPA continually works to reduce the risks to human heath and the environment by requiring pesticide registrants to report any potential problems with EPA registered pesticide products. EPA works with registrants to recall products whenever products are deemed faulty or substandard or could potentially cause injury to consumers or harm to the environment.
** Currently, there are no product recall announcements. **

Previously recalled products:

- AllerCare™ Products - human health concerns. Voluntary recall on January 14, 2000. AllerCare™ Dust Mite Powder
- AllerCare™ Dust Mite Allergen Spray for Carpet and Upholstery

Pull 'N Spray Pesticide Containers - container problems

- Scott's Ortho® Ready-to-Use Home Defense™ Indoor & Outdoor Insect Killer
- Monsanto's Roundup® Ready-to-Use Weed & Grass Killer (sold in 1.33 gallon plastic containers with a pump and application wand that clicks into a T-handle.)

(Available at www.epa.gov/pesticides/factsheets/alpha_fs.htm)

Drinking Water

Water is essential to life and comprises 60- 70% of body weight. Children drink more water per body weight than adults. While the United States has made great efforts to provide safe and healthy water, not all drinking water is contaminant-free. Children, because of their special physiological vulnerabilities and increased consumption of water, may be particularly sensitive to contaminants found in their drinking water. Contaminants may be microbial (virus, bacteria, protozoa), chemical, or radiological. Nurses need to be aware of the quality of their patients' and community's drinking water and counsel those patients who may be more vulnerable to the contaminants in their water.

"Each year in the U.S., millions of pounds of industrial and agricultural chemicals are released into the environment, either through intentional or uncontrolled discharges. Ground water and surface water bodies that serve as our drinking water sources are vulnerable to contamination by these chemicals as a result of runoff of agricultural and household chemicals, industrial waste discharges, and uncontrolled releases from sources such as

landfills and leaking underground storage tanks" (Physicians for Social Responsibility, 2000). Preventing source water contamination should be incorporated as a community education concern.

In addition to chemical contaminants, pathogenic microbes account for an estimated 900,000 waterborne infections annually (American Society for Microbiology, 1999). The majority of waterborne disease incidence may be underestimated because not all outbreaks are recognized, investigated, or reported. Children exposed to microbial contaminants in drinking water may experience a range of gastrointestinal symptoms depending on their immune status and virulence of the microbe. Symptoms range from mild gastric distress to explosive diarrhea. Several microbial contaminants cause more than gastrointestinal symptoms. Exposure to the coxsakie and echo-viruses can lead to meningitis and encephalitis. In 1999, an outbreak of Ecoli 0157-H7 from contaminated drinking water led to nine deaths in New York from toxic hemolytic uremic syndrome.

Chemical contaminants of particular concern for children include pesticides, heavy metals, nitrates, and disinfection by-products. Infants under the age of 6 months who are exposed to elevated levels of nitrites in drinking water (due to contamination from fertilizer use or sewage runoff) are at risk for developing "blue baby syndrome" (methemoglobinemia), a rare but life-threatening illness. Nurses, as primary health providers in the community, must be able to field questions about water quality and guide vulnerable populations to informed decisions.

The introduction of disinfectants to the drinking water supply was one of the greatest public health successes of the 20th century. Public drinking water is often disinfected by the addition of chlorine to the water during the treatment process. While chlorine is effective in controlling many microorganisms, it forms organic chlorine compounds referred to as disinfection byproducts (DBP) when it reacts with organic matter found in water distribution pipes. Epidemiological studies indicate that there may be an increased risk of miscarriage in women and developmental effects to the fetuses of pregnant women exposed to high levels of these byproducts (King, Dodds & Allen, 2000; Moline, et al, 2000; Swan, et al, 1998).

Although lead paint and dust are the primary source of exposure to lead, lead in drinking water can contribute up to 20 percent of this amount. Lead can leach out of household plumbing (lead pipes and lead solder) or from older public water distribution pipes made of lead. In addition, boiling water for more than one minute may raise the concentration of lead and other heavy metals present in the water.

If lead is found in drinking water there are several options that should be considered:

- First, have blood lead level tests performed on any children living in the home. Attempt to identify and eliminate the source.
- Do not use water containing lead for mixing a baby's formula.
- Consider a water treatment device or an alternative drinking water source.
- Reverse osmosis treatment devices will remove approximately 85% of the lead; distillation systems can remove about 99%. If these systems are used, then all water used for drinking or cooking must come from the treated faucet.
- Replace lead pipes and solder.
- If it is not feasible to remediate or if a temporary solution is needed, then flushing the water system before using the water for drinking or cooking may be an option. If the water from a particular faucet has not been used for several hours, the cold-water tap should be run until it becomes as cold as it will get. Each faucet should be flushed before using. This may not be an effective method in high-rise buildings.
- Avoid cooking with or consuming water from hot water taps because hot water dissolves lead more readily than cold.

A 1996 Amendment to the Safe Drinking Water Act allows consumers and their health care providers to have access to information concerning the quality of their drinking water. This Amendment requires public water system providers to produce and make available to consumers a *Right to Know or Consumer Confidence Report (CCR)*. These reports are issued annually and must provide information on how to contact the water provider; the source of drinking water (river, reservoir, aquifer); any contaminants detected and their health effects; and compliance with federal drinking water standards. If people have not received their reports, they can call their water company or talk with their landlord to receive a copy. The reports include a recommendation for people with compromised immune systems to consult with their health care provider regarding appropriate precautions to take to avoid infection in the event of microbial contamination. Therefore, it is important to be informed about drinking water and who is more susceptible to microbial illness. The EPA has a web site where many local CCRs can be found at www.epa.gov/safewater/dwinfo.htm. A water supplier must notify its customers by newspaper, mail, radio, TV, or hand-delivery if water does not meet EPA or state standards or if there is a waterborne disease.

Largest Waterborne E. coli O157:H7 Outbreak in United States History

Three-year-old Rachel Aldrich died after being infected with the toxic Ecoli O157:H7 strain at a fair. Hundreds of others, including Rachel's sister, Kaylea, became ill in the outbreak. The New York Department of Health identified 71 people who were hospitalized during the outbreak. Of these, 14 developed hemolytic uremic syndrome (HUS), a severe complication of E. coli O157:H7 infection that can lead to kidney failure. An investigation by epidemiologists-scientists who study the causes and transmission of disease-identified 781 persons with confirmed or suspected illness (persons who developed symptoms) related to this outbreak. Of these, 127 cases of E. coli and 45 cases of Campylobacter were confirmed by culture.

(Available at www.health.state.ny.us/nysdoh/commish/2000/ecoli.htm).

Alternative Sources of Drinking Water

There are several alternatives to drinking tap water when a water source is considered unsafe either because of a chemical, microbial, or radionuclide contamination, or because an individual is considered too vulnerable to drink tap water. Alternatives include boiled water, bottled water, and treated or filtered water.

Boiled Water Most harmful microbes found in water will be killed if water is allowed to reach a full rolling boil for one minute. However, boiling water for more than one minute may concentrate some chemicals (such as lead, arsenic and nitrates) and may cause some chemical contaminants to be released in the steam where they then can be inhaled. **Bottled Water**

More than half of all Americans drink bottled water; about a third of the public consumes it regularly. The National Resource Defense Counsel (Natural Resource Defense Council, (February, 1999),) completed a 4-year study to evaluate the quality of bottled water. They found that bottled water regulations are inadequate to assure consumers of safety. At least a third of the bottled water tested violated a state standard or guideline for microbials. The Food and Drug Administration (FDA) is responsible for good manufacturing practices for bottled water; however, it does not have jurisdiction

over intra-state commerce of bottled water, which exempts roughly 60-70% of bottled water from FDA regulation. In addition, FDA regulations do not apply to carbonated water. The following organizations can provide information on bottled water:

- NSF International (877/8-NSF-HELP)
- International Bottled Water Association www.bottledwater.org

Water Filters There are a variety of water treatment units on the market. No one filter removes all sources of contamination; therefore it is important to identify the contaminant(s) of concern before recommending or investing in a filtration device for the home. For help in picking a unit, contact either of these independent non-profit organizations: (Water treatment units certified by these organizations will indicate certification on their packaging labels.)

- NSF International (877-8-NSF-HELP) tests and certifies home water treatment units Water Quality Association (630-505-0160; www.wqa.org) classifies units according to the contaminants they remove as well as listing units that have earned its approval.
- Underwriters Laboratory (www.ul.com) also certifies some home water treatment units. Water treatment units certified by these organizations will indicate certification on their packaging or labels.

Tap Water Testing

Although public water utilities are required to test for regulated contaminants and report the results, there may be instances when consumers may want additional information. For example, consumers may want to check for lead in the water. Water utilities are not required to check the lead level at each endpoint. In addition, most states have some regulations regarding the water testing of new wells; however, there are seldom requirements for periodic retesting. Private wells are not regulated by the EPA as public utilities are, although EPA does recommend that private wells be tested annually. The *right to know* statutes do not apply to personal wells. Therefore, consumers with private wells should have them checked ANNUALLY for bacteria and SOME chemical contaminants, such as nitrates. Information for private well owners about how to protect a private water supply with links to a list of state certified drinking water laboratories can be found at www.epa.gov/safewater/pwells1.html. In addition, most state health departments can provide a list of state-certified independent water testing laboratories. Prices for water testing vary according to the type and number of contaminants being tested for.

NSF International

The NSF International is an organization that tests and verifies that products they certify meet all the requirements of specified standards and that manufacturers' claims are true. NSF does not recommend, rate, or compare products. An NSF mark indicates assurances that the product will perform as claimed. NSF will issue a certification to water bottlers that meet the basic FDA requirements. If the product meets the NSF standards, the bottled water label should indicate it on the label. In addition, NSF will issue certifications for water treatment devices if they meet NSF standards. More information about this service can be found at www.nsf.org.

Sun Safety for Children

Children spend lots of time outdoors. While some exposure to sunlight can be enjoyable and healthy, too much can be dangerous. Overexposure to ultraviolet (UV) radiation can cause serious health effects including skin cancer and other skin disorders, eye damage and cataracts, and immune system suppression. "The rate of malignant melanoma is currently rising faster than that of any other cancer. In 1935, the lifetime risk of an individual in the U. S. developing melanoma was 1 in 1,500. By 1980, the risk had increased to 1 in 250, and in 2000, the risk was 1 in 71. In other words, the risk of developing malignant melanoma has more than doubled in the past decade and increased more than 20-fold over the past half century. It is projected that the risk will rise to 1 in 50 by the year 2010" (Rigel, 2001). Incidence rates are more than 10 times higher in whites than in blacks. (American Cancer Society, Cancer Facts & Figures, 1999.) "Children are of particular concern because 80% of the average person's lifetime sun exposure occurs before the age of 18" (American Academy of Dermatology, 2000).

While necessary for our existence, the sun also can threaten our health with its UV radiation. UV radiation comes in several forms (UV-A, UV-B, and UV-C) and affects human health in different ways. In particular, children (and others) must be protected from UV-A and UV-B, which penetrate the earth's stratospheric ozone layer. Due to the depletion of the ozone layer, increased levels of harmful UV radiation are likely to penetrate. These heightened levels may cause the incidence and severity of UV-related health effects to rise, particularly given current sun-protection practices in the United States. Since the condition of the ozone layer is not expected to improve significantly in the near future, sun behaviors must change in order to protect our future health.

Many believe that only lighter-skinned people need to be concerned about the effects of overexposure to the sun. Though it is true that darker skin has more natural pigment, which acts as a protectant, the skin is still susceptible to many of the damaging effects of UV radiation. The incidence of skin cancer is lower in dark-skinned people, but it still occurs and is often not detected until later stages when it is more dangerous. The risk of other UVrelated health effects, such as cataracts, premature aging of the skin, and immune suppression, is not dependent upon skin type. The good news is that UV-related health effects are largely preventable by instituting sun-protection practices early and consistently. Additional information on health effects and action steps for sun protection can be found at www.epa.gov/sunwise.

UV Index

The UV Index provides a daily forecast of the expected risk of overexposure to the sun. The Index predicts UV intensity levels on a scale of 0 to 10+, where 0 indicates a minimal risk of overexposure and 10+ means a very high risk. Calculated on a next-day basis, the UV Index takes into account clouds and other local conditions that affect the amount of UV radiation reaching the ground in different parts of the country.

Index Number	Exposure Level
0-2	Minimal
3-4	Low
5-6	Moderate
7-9	High
10+	Very High

Watch for UV Index reports in your local newspapers and on television. Information on the daily UV index can usually be found in the newspaper. In addition, the UV Index is available for all communities across the United States in a zip code searchable format at www.epa.gov/sunwise.

Protect Children from Overexposure to UV Radiation

Limit Time in the Midday Sun
The sun's rays are strongest between 10 a.m. and 4 p.m. Whenever possible, limit exposure to the sun during these hours.

Seek Shade
Staying under cover is one of the best ways to protect a child from the sun. Remember the shadow rule: Watch Your Shadow. No Shadow, Seek Shade! **Always Use Sunscreen**
Apply a broad-spectrum sunscreen of a Sun Protection Factor (SPF) of at least 15 or higher liberally on exposed skin and reapply every 2 hours when working or playing outdoors. Even waterproof sunscreen can come off when you towel off, sweat, or spend extended periods of time in the water. **Wear a Hat**
A hat with a wide brim offers good sun protection to eyes, ears, face, and the back of the neck . areas particularly prone to overexposure to the sun. **Cover Up**
Wear tightly woven, loose-fitting, and full-length clothing. **Wear Sunglasses that Block 99-100% of UV Radiation**
Sunglasses that provide 99-100% UVA and UVB protection will greatly reduce sun exposure that can lead to cataracts and other eye damage. Check the label when buying sunglasses. **Avoid Sunlamps and Tanning Parlors**
The light source from sunbeds and sunlamps damages the skin and unprotected eyes. It's a good idea to avoid artificial sources of UV light.

Watch for the UV Index

Conclusion

In our homes, there are a number of environmentally related health threats that can be avoided by good assessment activities and the removal of the threats. All homes should be tested for the presence of radon. In homes where fuel powers the heating system, furnaces should be inspected annually. Carbon monoxide detectors should be considered for homes where gas fuels the furnace or stoves. Homes built before 1978 should be tested for lead-based paint. Nurses, as role models for their families and communities, should be the first to know whether such environmental health threats exist in their own homes and then include such assessments when they do home visits or prepare new moms for their return home or recovering patients' return from hospital stays.

So many of the environmental health threats in homes can endanger children and their ability to learn. Working with day care settings and schools to incorporate environmental health education can help to improve the community's knowledge about preventable environmental diseases. Nurses are uniquely qualified members of the community to initiate such educational and awareness programs.

According to a Roper poll on public knowledge, attitudes and behavior contracted by the National Environmental Education and Training Foundation (The National Environmental Education & Training Foundation and Roper Starch Worldwide. 1999), health care providers are among the most trusted sources of information about certain environmental health issues. It demands that we, as nurses, educate ourselves about the relationship between environmental exposure and potential human health effects so as to honor this trusted position that we hold with our patients and the community. There are many great resources that nurses can access for additional information. A variety of web sites including EPA's, the National Library of Medicine's, and the University of Maryland School of Nursing's, all present information that has been screened for accuracy, as well as many more resources suggested

in this independent study module.

Equally important, nurses need to be at the tables where environmental health policies are being made - locally, at the state level, and nationally. The ANA has passed several resolutions, such as The Reduction of Health Care Production of Toxic Pollution Resolution (www.nursingworld.org/osh/hodpoll.htm), that focus on environmental health and have the potential for a significant presence on environmental health issues. Individual nurses and nursing professional organizations have a great potential to affect environmental health and make a difference in creating environmental health policies and practices that are protective for all, including our most vulnerable populations.

References

American Academy of Dermatology, (April 26, 2000). "Children at risk: Protecting our children from skin cancer", www.aad.org/public/News/NewsReleases/Press+Release+Archives/Pediatric+Dermatology/ProtectChild.htm

American Academy of Pediatrics, Committee on Environmental Health. (1999), "Handbook of Pediatric Environmental Health", Elk Grove Village, IL: American Academy of Pediatrics.

American Cancer Society, (2001). "Cancer facts and figures", www.cancer.org

American Nurses Association, (1997), Position statement: "Environmental tobacco smoke" www.nursingworld.org/readroom/position/social/scenvtob.htm.

American Society for Microbiology, (1999). "Microbial pollutants in our nation's water", Washington DC: ASM.

Bearer, C. 1995), "Environmental Health Hazards: How Children Are Different From Adults", Future of Children Summer Fall 1995;5(2):11-26.

Buckley, J., Meadows, A., Kadin, M., Le Beau, M., Siegel, S., & Robison, L. (2000), "Pesticide exposures in children with non-Hodgkin lymphoma", Cancer 89(11), 2315-12.

California Environmental Protection Agency: Office of Environmental Health, Hazard Assessment. (September, 1997), "Health effects of exposure to environmental tobacco smoke", www.oehha.org/air/environmental_tobacco/finalets.html#download

Centers for Disease Control and Prevention (CDC), (1997), "Update: Blood Lead Levels- United States 1991-1994, Morbidity and Mortality Weekly Report", 46, (7), 141-11146 and erratum in 46(26), p 607. U.S. Department of Health and Human Services/Public Health Service

CDC. (October, 1991), "Preventing lead poisoning in young children: A statement by the Centers for Disease Control", Report No. 99-2230. Atlanta, Georgia: US Department of Health and Human Services, Public Heath Service.

CDC. (May, 1997), "ATSDR and EPA warn the public about continuing patterns of metallic mercury exposure", www.atsdr.cdc.gov/alerts/970626.html

CDC. (2000), "Blood lead levels in young children--United States and selected states, 1996-1999", MMWR, 49:

1133-7.

CDC. (Dec 8, 2000), "Recommendations for Blood Lead Screening of Young Children Enrolled in Medicaid: Targeting a Group at High Risk", MMWR, 49(RR14), 1-13. www.cdc.gov/mmwr/preview/mmwrhtml/rr4914a1.htm

CDC. (2001), "Blood and hair mercury levels in young children and women of childbearing age -- United States, 1999", Morbidity and Mortality Weekly, 50(8), 140-143.

CDC. (June 8, 2001), "Fatal pediatric lead poisoning---New Hampshire", MMWR, 50(22);457-9. www.cdc.gov/mmwr/PDF/WK/MM5022.PDF.

Daniels, J., Olshan, A., & Savitz, D. (1997), "Pesticides and childhood cancers", Environmental Health Perspectives, 105(10), 1068-77.

Greiner, T. (1998), "Carbon Monoxide: The Current Situation", www.abe.iastate.edu/human_house/aen196.asp

Glahder, C., Appel, P., & Asmund, (1999), "Mercury in Soap in Tanzania", Ministry of Environment and Energy: National Environment Research Institute. (NERI Technical Report No. 306). www.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/fr306.pdf

Houlihan, J. & Wiles, R. (2001), "Brain Food: What women should know about mercury contaminatiuon of fish", Washington DC: Environmental working Group & U.S. PIRG Education Fund and the State Pirgs.

Infante-Rivard, C, Labuda, D., Krajinovic, M. & Sinnett, D. (1999), "Risk of childhood leukemia associated with exposure to pesticides and gene polymorphisms", Epidemiology, 10(5), 481-7.

King, W., Dodds, L. & Allen, A. (2000), "Relation between stillbirth and specific chlorination by-products in public water supplies", Environmental Health Perspectives, 108(9), 883-886.

Lewis, R.G., Fortmann, R.C., Camann, D.D. (1994), "Evaluation of methods for the monitoring of the potential exposure of small children to pesticides in the residential environment", Archives of Environmental Contaminant Toxicology 26:37-46.

Livingston, D. (1997), "Maintaining a Lead Safe Home", (Rev. ed.). Baltimore, MD: Community Resources.

Manual, J.S. (2000), "Land Use: A toxic house in the country", Environmental Health Perspectives, 8(3), 115.

McBride, M. (1998), "Childhood cancer and environmental contaminants", Canadian Journal of Public Health, 89 (1), 53-62.

Meinert, R., Schuz, J. Kalersch, U., Kaatsch, P., & Michaelis, J. (2000), "Leukemia and non-Hodgkin's lymphoma in childhood and exposure to pesticides: results of a register-based case-control study in Germany", American Journal of Epidemiology, 151(7), 639-46.

Moline, J., Golden, A., Bar-Chama, N., Smith, E., Rauch, M., Chapin, R., Perreault, S., Schrader, S., Suk, W., & Landrigan, P. (2000), "Exposure to hazardous substances and male reproductive health: A research framework", Environmental Health Perspectives, 108(9), 803-813.

National Academy of Sciences (NAS): National Research Council. (2000), "Toxicological Effects of Methyl mercury", National Academy Press. Washington, DC.

The National Environmental Education & Training Foundation and Roper Starch Worldwide. (1999), "The national report card on safe drinking water, knowledge, attitudes, and behaviors", Washington, DC: Author.

Natural Resource Defense Council, (February, 1999), "Bottled water: Pure drink or pure hype," New York: NRDC.

Needleman, H., Riess, J., Tobin, M., Biesecker, G., & Greenhouse, J. (1996), "Bone lead levels and delinquent behavior", Journal of the American Medical Association, 275: 363-369.

New York City Department of Health: Environmental & Occupational Disease Epidemiology. (Feb, 2001), "Facts about mold", www.co.missoula.mt.us/EnvHealth/epimold.html

Physicians for Social Responsibility; (2000), "Drinking water and disease: What health care providers should know", Washington, DC: Author.

Rigel, D. (2001), "Melanoma update. 2001", Skin Cancer Foundation Journal, XIX, 13-14.

Swan, S., Waller, K., Hopkins, B., Windham, G., Fenster, L., Schaefer, C., & Neutra, R. (1998), "A prospective study of spontaneous abortion: Relation to amount and source of drinking water consumed in early pregnancy", Epidemiology 9,2, 126-133.

United States Consumer Product Commission. (1993), "Protect your family and yourself from CO poisoning", (US Consumer PSC No 0-356-764). Washington, DC: Government Printing Office.

United States Environmental Protection Agency. (September, 1988), "The Inside Story: A Guide to Indoor Air Quality", Washington, DC: Office of Air and Radiation, EPA.

U.S. Environmental Protection Agency. (September, 1992), "A Citizen's Guide to Radon (third edition) The Guide to Protecting Yourself and Your Family From Radon", Office of Air and Radiation. www.epa.gov/iaq/radon/pubs/citguide.html

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Institute for Occupational Safety and Health. (June, 1994), "NIOSH Pocket Guide to Chemical Hazards", (DHHS Publication No. 94-116). Washington, DC: Author.

U.S. Environmental Protection Agency: Region 8, "Pesticides, Toxic Chemicals & Children", www.epa.gov/Region8/humanhealth/children/pesticides.html

U.S. General Accounting Office. (1999), "Lead poisoning, federal health care programs are not effectively reaching at-risk children", GAO/HEHS-99-18. Washington, DC: Author.

Centers for Disease Control and Prevention. (1999), "Deaths from carbon monoxide poisoning in the United States, 1988-1996", www.coheadquarters.com/CDC/table.COdeaths1.htm

Resources

http://enviRN.umaryland.edu a one-stop shop created by the University of Maryland School of Nursing for nurses interested in environmental health.

United States Environmental Protection Agency (EPA)

- Safe Drinking Water Hotline - 1-800-426-4791
- Safe Water Web Site - www.epa.gov/safewater
- Surf Your Watershed. Database - www.epa.gov/surf
- Info on private wells - www.epa.gov/safewater/pwells1.html
- Office of Pesticides, telephone - 703-305-5017
  Web site - www.epa.gov/pesticides
- National Directory of IPM in schools www.epa.gov/reg5foia/pest/matilla/ipm_dir.html
- Children's page - http://yosemite.epa.gov/ochp/ochpweb.nsf/homepage
- The National Lead Information Center - 1-800-424-LEAD
- EPA Lead Programs - www.epa.gov/lead
- National Pesticide Telecommunications Network - 1-800-858-7378
- Health effects information on individual pesticides - www.epa.gov/pesticides/reregistration/status.htm
- UV Protection - www.epa.gov/sunwise
- Indoor air quality - www.epa.gov/iaq

Children's Environmental Health Network - Online resource guide: www.CEHN.org

Center for Health, Environment and Justice - www.chej.org

National Center for Environmental Health (NCEH), Centers for Disease Control and Prevention (CDC) NCEH
Provides expertise in environmental pesticide surveillance and disease outbreak investigations
Web site: www.cdc.gov/nceh/default.htm

The National Library of Medicine (NLM) has an excellent source of information on exposures in our everyday lives and the associated health risks entitled ToxTown, it provides easy access to information about common exposures in the home, schools, hospitals, on farms, and in a variety of settings within the community. Web site: www.toxtown.nlm.nih.gov The NLM also has a new " Household Goods" site that allows you to consider the potential hazards in cleaning products, pet care products, pesticides, and cosmetics, commonly used in the home, as well as several other categories of common products. Web site: www.nlm.nih.gov/medlineplus/householdproducts.html

Consumer Product Safety Commission - www.cpsc.gov

Agency for Toxic Substance Disease Registry (ATSDR)For fact sheets and information on pesticides
Web site: www.atsdr.cdc.gov/toxfaq.html
Information Center: toll-free at 1-888-422-8737 or e-mail ATSDRIC@cdc.gov
Emergency Response Hotline: 404-639-4270

Preventing Harm - This is a resource and action center on children and the environment: www.preventingharm.org

Health Care Without Harm - www.noharm.org

Hospitals for a Healthy Environment - www.h2e-online.org

The American Lung Association - 1-800-LUNG-USA - www.lungusa.org

The Alliance for Healthy Homes- www.afhh.org
