

Environmental Health



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ADDITIONAL RESOURCES

-  **Evolve Website** <http://evolve.elsevier.com/Stanhope>
 - Healthy People 2020
 - WebLinks—Of special note see the link for these sites:
 - Envirottools
 - www.enviRN.org: Alliance of Nurses for Healthy Environments
 - National Library of Medicine online toxicology tutorial

- Case Studies
- Glossary
- Answers to Practice Application

Appendix

- Appendix F.3: Comprehensive Occupational and Environmental Health History

OBJECTIVES

After reading this chapter, the student should be able to do the following:

1. Explain the relationship between the environment and human health and disease.
2. Understand the key disciplines that inform nurses' work in environmental health.
3. Apply the nursing process to the practice of environmental health.
4. Describe legislative and regulatory policies that have influenced the impact of the environment on health and disease patterns in communities.
5. Explain and compare the environmental health roles and skills for nurses practicing in public health, as well as those practicing in practice settings.
6. Incorporate environmental principles into practice.

KEY TERMS

agent, p. 222
 bioaccumulated, p. 236
 biomonitoring, p. 221
 climate change, p. 223
 compliance, p. 236
 consumer confidence reports, p. 228
 environment, p. 222
 environmental justice, p. 236
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 risk assessment, p. 228
 risk communication, p. 233
 risk management, p. 232
 route of exposure, p. 233
 toxicants, p. 229
 toxicology, p. 221
 —See Glossary for definitions

CHAPTER OUTLINE

Healthy People 2020 Objectives for Environmental Health

Historical Context

Environmental Health Sciences

- Toxicology
- Epidemiology
- Geographic Information Systems
- Multidisciplinary Approaches

Climate Change

Environmental Health Assessments

- Information Sources

Applying the Nursing Process to Environmental Health

- Individual Environmental Exposure History
- Community-wide Environmental Health Assessment Tools

Environmental Exposure by Media

- Air
- Water
- Land and Soil
- Food

Right to Know

Risk Assessment

Vulnerable Populations

- Children's Environmental Health

Precautionary Principle

Environmental Health Risk Reduction

- Industrial Hygiene Hierarchy of Controls
- Risk Communication

Governmental Environmental Protection

Policy and Advocacy

- Environmental Justice and Environmental Health
- Disparities
- Environmental Health Threats from the Health Care Industry: New Opportunities for Advocacy

Referral Resources

Roles for Nurses in Environmental Health

“Environmental health comprises those aspects of human health, including quality of life, that are determined by physical, chemical, biological, social, and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations.”

United Nations University, 1993 (UNU)

An estimated 24% of the global burden of disease and 23% of all deaths can be attributed to environmental factors (WHO, 2015). As nurses there are a number of ways in which we can define our environment. Our homes, schools, workplaces, and communities are the environments in which most of us can be found at any given time. Each location holds potential health risks. As nurses, who are among the most trusted conveyors of information to the public, it is our responsibility to understand as much as possible about these risks—how to assess them, how to eliminate or reduce them, how to communicate and educate about them, and how to advocate for policies that support healthy environments.

We can also divide and examine the environment from the perspective of the media in which environmental degradation takes place: air, water, soil, and food. And a third approach would be to divide environmental exposures into categories: biological, chemical, and radiological. In this chapter we will look at the environment as comprehensively as possible and consider the roles that nurses can have in assessing and addressing environmental health.

Environmental exposures are rarely limited to one location or to one source. For example, the broad category of pesticides includes the insecticides we may use in our homes, the herbicides we may use in our gardens, the pesticide residues on fruits and vegetables, and our antimicrobial soaps. Each of these

forms of pesticides comes with a potential health risk. If you have children and regularly use pesticides in your home, you increase their risk of contracting leukemia. The more you use insecticides, the greater the risk of leukemia (Metayer et al, 2013; Wigle et al, 2009; Turner et al, 2010; Brown, 2004). The childhood risk for leukemia increases if the mother was exposed to pesticides, including occupational exposures (Bailey et al, 2014). Many playing fields where children compete in sports are regularly sprayed with pesticides (Gilden et al, 2012).

In May 2010, the President's Cancer Panel proclaimed that the contribution environmental carcinogens have made to the burden of cancer in the United States has been grossly underestimated. In addition to the main focus on chemical carcinogens, the panel noted the importance of radiation sources—ionizing and nonionizing. In a letter to President Obama, they wrote: “The Panel urges you most strongly to use the power of your office to remove the carcinogens and other toxins from our food, water, and air that needlessly increase our health care costs, cripple our Nation's productivity and devastate American lives” (President's Cancer Panel, 2010). With this call came a range of recommendations for reducing the risk of cancer, both through individual choices and through national policy. The recommendations for individuals are found in Resource 10.A on the Evolve resources website.

Cancer is not the only health endpoint of environmental exposures. An estimated 52 million homes in the United States contain some lead-based paint that is associated with risks for premature births, learning disabilities in children, hypertension in adults, and many other health problems. Lead poisoning is a completely preventable disease (Figure 10-1). Of the top 20 environmental pollutants that were reported to the Environmental Protection Agency (EPA), nearly three fourths were known or suspected neurotoxins. Thirty million Americans drink water that exceeds one or more of the EPA's safe drinking



FIG 10-1 Although lead is no longer allowed in house paint, over 34 million homes in the United States have lead-based paint. U.S. Department of Housing and Urban Development (US DHUD, 2011). Pregnant women and parents who live in homes built before 1978 should be encouraged to have their homes tested for lead-based paint dust. (From State of Hawaii Department of Public Health. Available at <http://hawaii.gov/health/environmental/noise/asbestoslead/images2/child.jpg>. Accessed December 15, 2010.)

water standards, and 50% of Americans live in an area that exceeds current national ambient air quality standards. When these standards are exceeded, there is an increased risk to the public for a wide range of health effects.

Although food labeling includes nutrition information, there is no requirement to label whether pesticides are used in the food production; whether nontherapeutic antibiotics were given to the livestock, poultry, or farmed fish; the presence of genetically modified organisms (GMOs) in a product; or whether recombinant bovine growth hormone (rBGH) was given to the dairy cows. Nurses have declared that the “right to know” about potentially hazardous exposures is one of the basic principles of environmental health (see Box 10-1). Nurses have a range of potential public health responsibilities in protecting the public from exposures and environmental health risks (ANA 2007).

A range of influences including genetics, socioeconomic status, and environmental exposures impact environmental health. In evaluating environmental exposures in a home, nurses’ assessments can begin with a set of questions: What exposures can you identify in your own home? Do you use pesticides? Does your home have lead-based paint? (The age of a home is a good proxy for identifying the presence of

BOX 10-1 American Nurses Association’s Principles of Environmental Health for Nursing Practice

The ANA calls for all nurses to understand basic environmental health concepts, invokes the Precautionary Principle, recognizes the multidisciplinary nature of environmental health, and promotes and supports nurses’ roles in developing and maintaining environmentally healthy workplaces for themselves and their patients. Principles include knowledge about environmental health and its effect on nursing practice, the Precautionary Principle, nurses’ rights to work in a safe workplace and use materials, products, technology, and practices that reflect an evidence-based approach. Other principles relate to quality assessment of the environment, interdisciplinary work in environmental health, involvement in research, and support of nurses who advocate for a safe environment (ANA, 2007).

From American Nurses Association. Principles of environmental health for nursing practice, Silver Spring, MD, 2007.

lead-based paint because it is most likely found in homes built before 1978, when the use of lead was banned in household paint.) Is the paint chipping or peeling? Are any of your appliances or heat sources producing unhealthy levels of carbon monoxide? Have you checked your home for radon, the second largest cause of lung cancer in the United States? How about your workplace? Do you eat fish on a regular basis? (Some fish can have unhealthy levels of mercury.) A more comprehensive home assessment tool can be found in the Resources.

LINKING CONTENT TO PRACTICE

The Council on Linkages Between Academic and Public Health Practice, 2010 a key document that guides practice in both nursing and public health. Specifically, the core competencies of the Council on Linkages includes, within the domain of public health science skills, a competency that says practitioners will apply “the basic public health sciences (including, but not limited to, environmental health sciences, health services administration, and social and behavioral health sciences) to public health policies and programs.” The Quad Council of Public Health Nursing Organizations (2011) further applies this competency specifically to public health nursing practice by adding that these skills are applied to public health nursing practice, policies, and programs. In 2007, the ANA adopted 10 principles of environmental health. Although all 10 are essential, three are highlighted here. Nurses should know about environmental health concepts, participate in assessing the quality of the environment in which they practice, and live and use the Precautionary Principle (which is discussed later in the chapter) to guide their work. A third principle points out that healthy environments are sustained through multidisciplinary collaboration, which is a key concept discussed throughout the chapter.

In 2010, the American Nurses Association (ANA) established an environmental health standard within the Scope and Standards of Professional Practice that define the profession of nursing. This means that all nurses are now expected to have knowledge of and skills associated with environmental health.

Underpinning many of these organizational decisions to include environmental health in nursing were the recommendations made in the report *Nursing, Health and Environment* (Pope, Snyder, and Mood, 1995) from the Institute of Medicine (IOM) of the National Academy of Science, which recommended that all nurses have a basic understanding of environmental health principles and integrate these principles into our practice, education, advocacy, policies, and research. In this chapter, we will explore the basic competencies recommended by the IOM. Box 10-2 presents the competencies.

BOX 10-2 General Environmental Health Competencies for Nurses Recommended by the Institute of Medicine in *Nursing, Health and the Environment*

Basic Knowledge and Concepts

All nurses should understand the scientific principles and underpinnings of the relationship between individuals or populations and the environment (including the work environment). This understanding includes the basic mechanism and pathways of exposure to environmental health hazards, basic prevention and control strategies, the interprofessional nature of effective interventions, and the role of research.

Assessment and Referral

All nurses should be able to successfully complete an environmental health history, recognize potential environmental hazards and sentinel illnesses, and make appropriate referrals for conditions with probable environmental causes. An essential component is the ability to access and provide information to clients and communities and to locate referral sources.

Advocacy, Ethics, and Risk Communication

All nurses should be able to demonstrate knowledge of the role of advocacy (case and class), ethics, and risk communication in client care and community intervention with respect to the potential adverse effects of the environment on health.

Legislation and Regulation

All nurses should understand the policy framework and major pieces of legislation and regulations related to environmental health.

From Pope AM, Snyder MA, Mood LH, editors: *Nursing, health, and environment*, Washington, DC, 1995, Institute of Medicine, National Academy Press.

HEALTHY PEOPLE 2020 OBJECTIVES FOR ENVIRONMENTAL HEALTH

Environmental health is one of the priority areas of the *Healthy People 2020* objectives. The federal government has long recognized the importance of the relationship between environmental risks and the underlying factors contributing to diseases. Selected examples of the *Healthy People 2020* environmental health objectives are outlined in the following Healthy People 2020 box (U.S. Department of Health and Human Services, *Healthy People 2020*, 2010).



HEALTHY PEOPLE 2020

Examples of Objectives Related to Environmental Health

- EH-8.1: Eliminate elevated blood lead levels in children.
- EH-9: Minimize the risks to human health and the environment posed by hazardous sites.
- EH-10: Reduce pesticide exposures that result in visits to the health care facility.
- EH-11: Reduce the amount of toxic pollutants released into the environment.
- EH-13: Reduce indoor allergen levels.
- EH-18: Decrease the number of U.S. homes that are found to have lead-based paint or related hazards.

From U.S. Department of Health and Human Services: *Healthy People 2020*. Available at <http://www.healthypeople.gov/2020/topicsobjectives2020/default.aspx>. Accessed January 1, 2011.

HISTORICAL CONTEXT

Historically, nurses and physicians have been taught little about the environment and environmental threats to health. In the IOM report mentioned previously, quotes from Florence Nightingale are used extensively, not only because she is a recognized symbol of nursing (i.e., the lady with the lamp), but also because of the central focus of environment in her practice and writings. She promoted the use of clean water and safe sanitary conditions and connected these elements to disease prevention. Early in the twentieth century, Lillian Wald, who coined the name “public health nurses,” spent her life improving the environment of the Henry Street neighborhood and encouraging her broad network of influential contacts to make changes in the physical environment, as well as social conditions that had direct health impacts. As modern day nurses are rediscovering environmental health, they are reintegrating many of the observations and skills that were practiced by early nurse pioneers.

There are still many communities like the ones that Lillian Wald served. Poverty is highly associated with health disparities and is also associated with disproportionately higher environmental exposure, which compounds the health disparities. Poverty is linked to living in substandard housing, living closer to hazardous waste sites, working in more hazardous jobs, having poorer nutrition, and having less access to quality health care (particularly preventative services). The term *environmental justice* refers to the disproportionate environmental exposures that poor people and people of color experience in the United States and elsewhere, including lead paint dust exposure, the presence of pests (resulting in increased use of pesticides), and the use of supplemental heating sources that may cause dangerous carbon monoxide exposure. These combined circumstances multiply the risk for health disparities.

It is important to note how we began to understand the relationship between environmental chemical exposures and their potential for harm. There are several ways in which we have historically made such discoveries:

- When humans present with signs and symptoms that can be connected to a specific chemical exposure. This may occur with acute pesticide poisoning or carbon monoxide poisoning. It often occurs when workers are occupationally exposed. In such instances, the temporal and geographic relationships to the exposures and health effects help to identify health hazards in the environment (e.g., the diagnosis of mesothelioma from asbestos exposure).
- When large accidental releases of chemicals occur in a community that contaminate air, water, soil, or food, resulting in health effects. Such events show us how toxic chemicals are to humans and animals. For example, in the Love Canal incident outside of Buffalo, NY, an entire community was affected by hazardous chemicals that were dumped on the land where a housing development was built.
- In rare instances, when human environmental (and occupational) epidemiologic studies have been performed. Through such studies, we have learned about the toxic effects of chemicals.

However, the most common way in which the relationships between chemical exposures and health risks are identified is when toxicologists study the effects of chemicals on animals and then use models to estimate what the effects might be on humans. This estimation process is called *extrapolation*. More than 84,000 man-made (synthetic) chemical compounds have been developed and introduced to our environment since World War II, and we are most often reliant on the data that are created in animal studies to warn us about their potential toxicity to humans. For many of these chemicals, no toxicity data are available. Surprisingly, there is no current requirement for original toxicological research to be completed when a product or process is being brought to market.

We live in a radically different environment compared to a century ago. In addition to man-made pollutants contaminating our air, water, and food, many of the same pollutants are now also found in our bodies (including breast milk). In 2001, the Centers for Disease Control and Prevention began **biomonitoring**—the testing of human fluids and tissues for the presence of potentially toxic chemicals, as part of its National Health and Nutrition Exam Study. For instance, most Americans carry pesticides, solvents, heavy metals and other potentially toxic chemicals in their bodies. In 2005, an Environmental Working Group tested the umbilical cord blood of newborn babies and found that they also contained a similar range of potentially harmful chemicals (EWG, 2005). Each of these potentially hazardous substances creates a health risk. Nurses need to understand the environmental exposures and the health effects that may be associated with chemicals in order to develop assessment tools, implement hazard reduction programs, and advocate for safe and healthy chemical policies. For example, when a woman is pregnant for the first time, this is an ideal time for a nurse to help her assess and reduce or eliminate preventable environmental health risks in her home and workplace. A good environmental health history can help uncover a number of exposures from the products she may use, the ways in which she addresses pests in her home and garden, to the way in which she may set up a new nursery room.

In the Resource Section under chemical policies, there are a number of links to organizations that track federal and state legislation on chemical issues.

ENVIRONMENTAL HEALTH SCIENCES

Toxicology

Toxicology is the basic science that contributes to our understanding of health effects associated with chemical exposures. Historically, it was referred to as the “study of poisons.” Its corollary in health care is pharmacology, which studies the human health effects, both desirable and undesirable, associated with drugs. In toxicology, only the negative effects of chemical exposures are studied. However, the key principles of pharmacology and toxicology are the same. Just as the dose of a drug makes the difference in its efficacy and its toxicity, the quantity of an air or water pollutant to which we may be exposed can determine whether or not (and the extent to which) we experience a risk of a health effect. In addition, the timing

of the exposure—over the human life span—can make a difference. For example, during embryonic and fetal development, exposure to toxic chemicals can create immediate harm or create a critical pathway for future disease. Very young children, whose systems are still immature, are also more vulnerable to exposures. *In Harm's Way*, an online report by Physicians for Social Responsibility (with associated training materials) describes the neurological damage that several common chemicals can cause to developing children (Schettler et al, 2000). Just as is true of medications, the same dose that one would give an adult will have a much greater effect on a child and certainly on a fetus. As we age our liver and renal functions slow, thereby creating opportunities for toxic chemicals to accumulate, and thus creating higher risks for harm.

Both drugs and pollutants can enter the body from a variety of routes. Most drugs are given orally and absorbed by the gastrointestinal (GI) tract. Water- and food-associated pollutants, including pesticides and heavy metals, enter the body via the digestive tract. Some drugs are administered as inhalants, and some pollutants in the air (including indoor air) enter the body via the lungs. Some drugs are applied topically. In work settings, employees can receive dermal exposures from toxic chemicals when they immerse their unprotected hands in chemical solutions, especially solvents. Pollution can enter our bodies via the lungs (inhalation), GI tract (ingestion), skin, and even the mucous membranes (dermal absorption). Most chemicals cross the placental barrier and can affect the fetus, just as most chemicals cross the blood–brain barrier. In addition to direct damage to cells, tissues, organs and organ systems, there can be changes to the DNA from chemical exposures that can change gene expression, which in turn can predict disease. This latter effect is the focus of a relatively new field of biological study: **epigenetics**. Scientists now understand that there are many variables that predict disease outcomes, including environmental exposures.

In the same way that we consider age, weight, other drugs taken, and underlying health status of a client when we administer drugs, we must consider that these same factors can affect an individual's response to environmental exposures. For example, children are much more vulnerable to virtually all pollutants. People who are immunosuppressed (people with HIV/AIDS or those on immunosuppressant drugs like steroids or anti-cancer medications) are especially at risk for foodborne and waterborne pathogens. Because our communities are comprised of people of different ages and different health statuses, their vulnerabilities to the effects of pollution will also vary. When assessing a community's environmental health status, be sure to review the general health status of the community and to identify members who may have higher risk factors.

Chemicals that are similar are often grouped into categories or “families” so that it is possible to understand the actions and risks associated with those groupings. Examples are metals and metallic compounds (e.g., arsenic, cadmium, chromium, lead, mercury), hydrocarbons (e.g., benzene, toluene, ketones, formaldehyde, trichloroethylene), irritant gases (e.g., ammonia, hydrochloric acid, sulfur dioxide, chlorine), chemical asphyxiants (e.g., carbon monoxide, hydrogen sulfide, cyanides), and

pesticides (e.g., organophosphates, carbamates, chlorinated hydrocarbons). Although some common health risks exist within these families of chemicals, the possible health risks for each chemical should be evaluated individually when a potential human exposure exists. The best source of peer-reviewed information for this is the National Library of Medicine (NLM). The NLM has a set of databases that are focused on toxicology and environmental health called TOXNET. You will find the link to several of these helpful informational programs and databases in the Referral Resources.

Epidemiology

Whereas toxicology is the science that studies the poisonous effects of chemicals, **epidemiology** is the science that helps us understand the strength of the association between exposures and health effects. Epidemiology is often used for occupationally related illnesses but has been used less often to study environmentally related diseases. It is difficult to characterize and/or distinguish among the many exposures that we all experience, and it can be challenging to find control groups when the environmental exposure of concern is in the air, water, or food.

Epidemiologic studies have helped us to understand the association between learning disabilities and exposure to lead-based paint dust, asthma exacerbation and air pollution (Smargiassi et al, 2014; Habre et al, 2014), and GI disease and waterborne *Cryptosporidia* (Yoder et al, 2012). Environmental surveillance, such as childhood lead registries, provides data with which to track and analyze incidence and prevalence of health outcomes. The results of such analyses can help to target scarce public health resources. Scientists are now approaching epidemiology at the molecular level, looking at gene/environment interactions.

As described in Chapter 12, three major concepts—agent, host, and environment—form the classic **epidemiologic triangle**. (See Figure 12-2, A in Chapter 12.) This simple model belies the often-complex relationships between **agent**, which may include chemical mixtures (i.e., more than one agent); **host**, which may refer to a community with people of multiple ages, genders, ethnicities, cultures, and disease states; and **environment**, which may include dynamic factors such as air, water, soil, and food, as well as temperature, humidity, and wind. Limitations of environmental epidemiologic data include reliance on occupational health studies to characterize certain toxic exposures. The occupational health studies were performed on healthy adult workers whose biological systems were different from those of neonates, pregnant women, children, people who are immunosuppressed, and the elderly. Nevertheless, nurses can review epidemiologic studies regarding exposures of concern to their communities and use epidemiologic techniques to assess environmental risks in communities.

Geographic Information Systems

Another research tool for environmental health studies is **geographic information systems** (GIS), a methodology that requires the coding of data so that it is related spatially to a place on Earth. By layering geographically related data, maps can be created to note where the data may be related. For instance, by

taking a data set that geographically notes where children under 10 years of age live and overlaying another data set that notes geographical areas designated by the age of housing stock, a public health nurse could see where there are the largest number of children who live in areas with older housing stock. With this information, the nurse could target a lead surveillance and educational program. Nurse researcher Mona Choi used GIS to study the relationship between air pollution and emergency visits for cardiovascular and pulmonary diagnosis. Community-based maps that are created using GIS technologies are helpful in educating community members and local policy makers. The maps can provide useful graphic depictions of public health problems.

Environmental health requires a combination of tried and tested nursing tools mixed with new tools, such as GIS, and the recognition that many disciplines may be involved in the identification and the resolution of environmental health issues.

Nurse scientists Wade Hill and Patricia Butterfield (2006) developed a model for environmental risk interventions, which can be provided by public health nurses, that improves children's health by addressing home-related sources such as lead paint, contaminated drinking water, and environmental tobacco smoke, among others. These risks can cause health effects ranging from minor learning deficiencies to serious and life-threatening diseases such as cancer. Many of the environmental risks children encountered were prevented or reduced by taking practical and affordable steps. Butterfield developed an environmental justice framework by which to consider environmental exposures in rural areas (Butterfield & Postma, 2009).

Multidisciplinary Approaches

In addition to toxicology and epidemiology, there are a number of earth sciences to help us understand how pollutants travel in air, water, and soil. Geologists, meteorologists, physicists, and chemists all contribute information to help explain how and when humans may be exposed to hazardous chemicals, radiation (e.g., radon), and biological contaminants. Key public health professionals include food safety specialists, sanitarians, radiation specialists, and industrial hygienists.

The nature of environmental health demands a multidisciplinary approach to assess and reduce/eliminate environmental health risks. For instance, to assess and address a lead-based paint poisoning case we might include a housing inspector with expertise in lead-based paint or a sanitarian to assess the lead-associated health risks in the home; clinical specialists to manage the client's health needs; laboratories to assess the blood lead levels, as well as lead levels in the paint and house dust and drinking water; and then lead-based paint remediation specialists to reduce the lead-based paint risk in the home.

We might also add a health educator and outreach worker to educate the family and encourage compliance with environmental health behaviors and clinical treatments. And finally, we may need to work with public health lawyers to address non-compliant landlords. Such combined approaches could potentially involve the local health department, the state department of environmental protection, the housing department, a primary and tertiary care setting, public or private sector labs, and the

legal system. The nurse's responsibility is to understand the roles of each respective agency and organization, know the public health laws (particularly as they pertain to lead-based paint poisoning in their communities), and work with the community to coordinate services to meet their needs. The nurse also might set up a blood lead screening program through the local health department, educate local health providers to encourage them to systematically test children for lead poisoning, and/or work with advocacy organizations to improve the condition of local housing stock. Note that although lead-based paint is no longer in use in the United States, it is still widely used in developing countries.

QSEN FOCUS ON QUALITY AND SAFETY EDUCATION FOR NURSES

Targeted Competency: Function effectively within nursing and interprofessional teams, fostering open communication, mutual respect, and shared decision making to achieve quality client care.

Knowledge: Describe scopes of practice and roles of health care team members.

Skills: Assume the role of team member or leader based on the situation.

Attitudes: Value the perspectives and expertise of all health team members.

Safety Question: One of the objectives of *Healthy People 2020* related to environmental health is "Reduce pesticide exposures that result in visits to a health care facility" (ED 8-10). The public health nurse, who is working on a project to help mothers learn parenting skills, visits a new mother who lives and works on a large farm. When the nurse drives into the farm on her way to the housing where workers live, she sees that the fields are being sprayed with pesticides from a truck and that two young children are riding in the back of the truck. What action should she take?

Answer: At the individual level, she should talk with the owner or manager of the farm and remind him or her of the toxicity of pesticides and the danger to those who are in the vicinity of the spraying. She should recommend that he or she not allow anyone to ride in the open portion of the vehicle and that the driver should leave the window closed and wear a mask to protect his or her nose and mouth.

Systems level: She should identify areas where the workers on the farms congregate, such as churches, social halls, and so forth. Then she should ask if she could provide an educational program on the dangers of coming into contact with pesticides. She could distribute pamphlets about this hazard in local venues where both farm managers and workers will be able to access them. What else might the nurse do?

CLIMATE CHANGE

According to the World Health Organization, "climate change is a significant and emerging threat to public health, and changes the way we must look at protecting vulnerable populations" (WHO, 2014b). The 2014 report of the Intergovernmental Program on Climate Change, a WHO-related group of scientists, concludes that "climate change will act mainly, at least until the middle of this century, by exacerbating health problems that already exist, and the largest risks will apply in populations that are currently most affected by climate-related diseases" (IPCC, 2014). In the United States we are already seeing some of the earlier climate change predictions materialize: long-term warming trends, extreme weather conditions, as well as

disruption in water supplies, agriculture, ecosystems, and coastal communities.

There are two concurrent categories of roles for nurses: mitigation and response. There is still much we can do to mitigate the steep upward slope that we are now observing for temperatures, CO₂ levels, desertification, and sea water levels. Working at the individual, community, institutional (school, hospital, etc.), and governmental levels, there is much work to be done to ensure energy-conserving policies and practices, rational transportation practices, and changes in our consumption patterns.

Regarding response preparation, public health nurses must lead the development of contingencies for long-term, high-heat weather conditions, as well as increased storm activities (that include more severe storm patterns), more extensive fires in areas prone to fires, and the associated disaster preparedness. For more on disaster preparedness, see Chapter 23 on nurses' roles in disaster management. Nurses should also be prepared for threats to food security from shifting weather patterns that may deter/eliminate food production and for acute shifts of populations as they migrate away from low-lying, coastal regions or other areas acutely affected by storm or fire damage. These shifts are likely to create climate change-related refugee migrations.

The oil spill in the Gulf of Mexico was the largest in history and caused devastating damage. It is expected that its effects on birds, fish, and other sea animals, as well as the environment, will continue for many more years. Since fish populations were affected, many fishermen lost their jobs and the livelihood that they knew (Gulf Oil Spill, n.d.). This type of ecosystem destruction and economic disruption will be typical if we do not address climate change and our associated need to reduce/eliminate our reliance on fossil fuels (gas, oil, coal). It is important to explore the science underpinning climate change, consider the human and ecological health threats, and reflect on nurses emerging roles as climate change unfold.

ENVIRONMENTAL HEALTH ASSESSMENTS

There are a number of ways to assess environmental health risks in a community. For example, risks can be assessed by medium: air, water, soil, or food. Or exposures could be listed according to urban, rural, or suburban settings, with many exposures being common to all three settings. Nurses may also divide the environment into functional locations such as home, school, workplace, and community. Each of these locations will have unique environmental exposures, as well as overlapping exposures. For instance, ethylene oxide, the toxic gas that is used in the sterilizing equipment in hospitals, is typically found only in a workplace. However, pesticides might be found in any of the four areas. When assessing environments, be sure to determine if an exposure is in the air, water, soil, and/or food and whether it is a chemical, biological, or radiological exposure.

Information Sources

The NLM has developed some of the most useful, comprehensive, and reliable sources of environmental health information.

The NLM's website for ToxTown (<http://toxtown.nlm.nih.gov/>) is one of the best places to start when developing environmental assessment skills. Within ToxTown, there is a Household Products page where nurses can research common products such as those for personal care, cleaning, pet care, lawn care, and others to see the potential health risks that may be associated with them. Also, chemicals can be researched by brand or chemical name or by Chemical Abstract System number. (The NLM website can be accessed at www.nlm.nih.gov; at the website, search for the environmental assessment section.)

Also within ToxTown, you can search for general environmental health risks in the "city," "town," and "farm," or even go to a "US-Mexico Border Community." While in the virtual "city" you can visit a hair salon, hospital, or funeral home to see what kinds of environmental health risks are posed in such places. ToxTown brings together governmental and well-vetted nongovernmental sources for a rich web resource in which to learn about environmental health.

Another database that is specific to personal care products, which includes over 68,000 products that can be searched by brand name and specific product descriptors, is the Skin Deep database (<http://www.ewg.org/skindeep/>). The Safe Cosmetics website, which links to the Skin Deep database, additionally provides information on better protecting your health by selecting products that have simpler ingredients and fewer synthetic chemicals. For example, the site points out that even top-selling brands of natural and organic products may have some toxic components. Specifically, they say that some top-selling herbal shampoos contain 1,4-dioxane, a synthetic chemical carcinogen. They also comment on the number of lipsticks that they found to contain lead. Note that in both the NLM and the Safe Cosmetics databases, the information is predicated on what the manufacturers place on the label as ingredients (Figure 10-2). If the manufacturer claims that a component is a "trade secret," it will not appear on the label. Rarely are the chemicals that make up a "fragrance" listed on the label; instead, it is likely to only read "fragrance" on the label. And finally (and this is especially true with pesticides), the label may merely say "inerts"



FIG 10-2 Some of the chemicals in our personal care products can be hazardous to our health. You can look up the chemicals in your products and learn about the potential health risks by going to the SkinDeep database: <http://www.ewg.org/skindeep/>. (Photo from the U.S. Food and Drug Administration. Available at <http://www.fda.gov/Cosmetics/default.htm?vvsessionid=1724ec6bbda343c6b7d0e092db6c2f30>.)

without any further information about their chemical identity. Thus, it is sometimes impossible to make a true assessment about the health risks based on the information provided by the manufacturer.

One of the ANA Environmental Health Principles is the tenet of the "Right to Know," which recommends the need for access to all information necessary to make informed decisions and protect our health. There are still a number of ways in which full disclosure of chemical exposure is lacking in terms of air and water pollution, food contents, and product ingredients. Nurses, both individually and through their professional organizations, can advocate for increasing access to information through "right to know," labeling, and other legislative and regulatory efforts.

APPLYING THE NURSING PROCESS TO ENVIRONMENTAL HEALTH

If you suspect that a client's health problem is being influenced by environmental factors, follow the nursing process and note the environmental aspects of the problem in every step of the process:

1. **Assessment.** Use your observational skills (e.g., windshield surveys); interview community members; ask your individual clients; and ask the families of your clients. Review web-based data on existing exposures, such as air and water pollution monitoring data, drinking water testing, and contaminated soil. Relate the disease and the environmental factors in the diagnosis.
2. **Planning.** Look at community policy and laws as methods to facilitate the care needs for the client; include environmental health personnel in planning.
3. **Intervention.** Coordinate medical, nursing, and public health actions to meet the client's needs. Ensure that the affected person or family is referred for appropriate clinical care.
4. **Evaluation.** Examine criteria that include the immediate and long-term responses of the client as well as the recidivism of the problem for the client.

Individual Environmental Exposure History

When working with individuals, it is important to include environmental health risks as part of a client's history. Ask certain questions to assess exposures that may occur in all of the settings in which they spend time. A helpful mnemonic was developed to assist health professionals in remembering the areas of concern when taking an environmental history: "I PREPARE." The mnemonic (see Box 10-3) can be used when interviewing an individual client or when assessing a family or it can be adapted for use with a group of community members.

Community-wide Environmental Health Assessment Tools

Nurses have developed several exposure assessment tools, including forms for pregnant women, home and school assessments, community-wide assessments, and assessment tools for hospital-related exposures. The web links on the Evolve site for this book include several examples of environmental assessment tools.

BOX 10-3 The “I PREPARE” Mnemonic from the Agency for Toxic Substances and Disease Registry

Investigate Potential Exposures

Present Work

Residence

Environmental Concerns

Past Work

Activities

Referrals and Resources

Educate

- Do an Exposure History to:
- Identify current or past exposures.
- Reduce or eliminate current exposures.
- Reduce adverse health effects.

Taking an Exposure History: Questions to Consider

I—Investigate Potential Exposures

Investigate potential exposures by asking:

- Have you ever felt sick after coming in contact with a chemical, such as a pesticide or other substances?
- Do you have any symptoms that improve when you are away from your home or work?

P—Present Work

At your present work:

- Are you exposed to solvents, dusts, fumes, radiation, pesticides, or other chemicals?
- Are you exposed to loud noise?
- Do you know where to find material safety data sheets for chemicals with which you work?
- Do you wear personal protective equipment?
- Are work clothes worn home?
- Do coworkers have similar health problems?

R—Residence

- When was your residence built?
- What type of heating do you have?
- Have you recently remodeled your home?

- What chemicals are stored on your property?
- Where is the source of your drinking water?

E—Environmental Concerns

- Are there environmental concerns in your neighborhood (i.e., air, water, soil)?
- What types of industries or farms are near your home?
- Do you live near a hazardous waste site or landfill?

P—Past Work

- What are your past work experiences?
- What job did you have for the longest period of time? Have you ever been in the military, worked on a farm, or done volunteer or seasonal work?

A—Activities

- What activities and hobbies do you and your family pursue?
- Do you burn, solder, or melt any products?
- Do you garden, fish, or hunt?
- Do you eat what you catch or grow?
- Do you use pesticides?
- Do you engage in any alternative healing or cultural practices?

R—Referrals and Resources

Use these key referrals and resources:

- Environmental Protection Agency (www.epa.gov)
- National Library of Medicine—TOXNET Programs (www.nlm.nih.gov)
- Agency for Toxic Substances and Disease Registry (www.atsdr.cdc.gov)
- Association of Occupational and Environmental Clinics (www.aoec.org)
- Occupational Safety and Health Administration (www.osha.gov)
- EnviRN website (www.enviRN.umaryland.edu)
- Local Health Department, Environmental Agency, Poison Control Center

E—Educate (A Checklist)

- Are materials available to educate the client?
- Are alternatives available to minimize the risk of exposure?
- Have prevention strategies been discussed?
- What is the plan for follow-up?

Prepared by Grace Paranzino, RN, MPH, for the Agency for Toxic Substances and Disease Registry. For more information, contact ATSDR at 1-888-42-ATSDR or visit ATSDR's website at <http://www.atsdr.cdc.gov>.

A windshield survey is a helpful first step in understanding the potential environmental health risks in a community. If the community is urban, the age and condition of the housing stock and potential trash problems (and the associated pest problems) can be determined easily by driving around the neighborhood. Note proximity to factories, dump sites, major transportation routes, and other sources of pollution. In rural communities, note if and when there are aerial and other types of pesticide and herbicide spraying, if people rely on wood-burning stoves, if there are industrial-type agricultural practices, and/or if there are contaminated waterways. Using ToxTown can really help with identifying health risks associated with the observations from a windshield survey.

You may not be able to “see” the pollution that is in your community, but the U.S. Environmental Protection Agency's website, EnviroFACTS, can help identify air, water, and soil pollution in your area by entering your ZIP code. Nurses are often surprised to find out what is being released into their neighborhood's water and air.

The Right to Know section of this chapter contains a description of the types of information that are available to the public about air and water pollutants, drinking water quality, and other environmental sources or exposures. Armed with this information, a nurse can create a significant environmental health map of a community. In addition, Appendix F.3 presents an example of an occupational and environmental assessment.

While we observe environmental health risks in our communities, it is equally important for us to identify the positive environmental contributors to our communities. Settings that connect people to nature—parks, green spaces, and beaches—are incredible assets to communities. The term *nature-deficit disorder* was coined by author Richard Louv in his book *Last Child in the Woods* to describe what happens to young people who become disconnected from the natural world. Louv links this lack of nature to some of the most disturbing childhood trends, such as the rises in obesity, attention disorders, and depression (Louv, 2005). Policy makers, educators, and children's health advocates are considering their roles in addressing

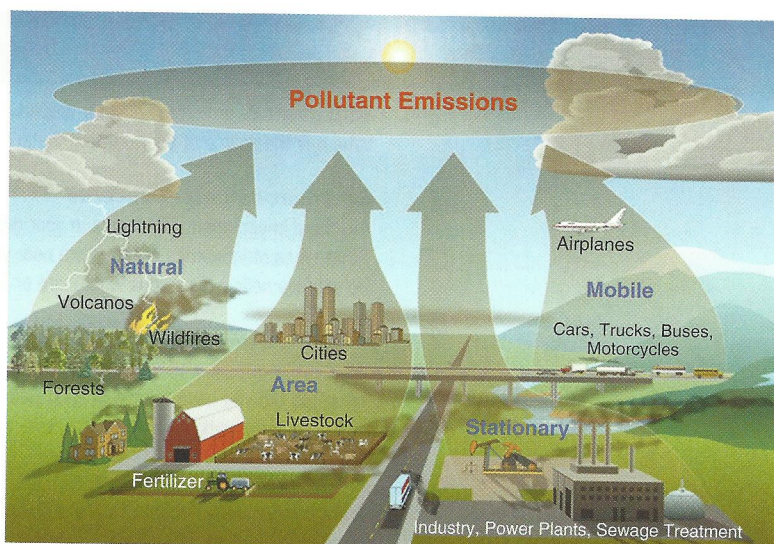


FIG 10-3 Air pollution comes from a wide range of sources. EPA's EnviroFACTS site allows you to check the air and other pollutants in your ZIP code. <http://www.epa.gov/enviro/>. (Figure from the National Park Service, Sources of Air Pollution. Retrieved March 16, 2014 from <http://www2.nature.nps.gov/air/aqbasics/sources.cfm>.)

this issue. The National Park Service works to bring more people to parks—local, state, and national.

Man-made “green” spaces such as community gardens, streetscapes, bike paths, and water features can positively contribute to a community’s health and sense of well-being. Recent attention has been paid to the importance of “walkable communities,” access to nature, and other concerns included in discussions about “Smart Growth” or “Sustainable Communities.”

Some new suburban developments are designing space for agriculture in the form of Community Sustainable Agriculture (CSA), a model of local agriculture in which community members purchase shares in the spring and receive fruits and vegetables as they are harvested. Also in this model, community members have the option to volunteer on the farm. This creative new community design addresses a number of public health issues—obesity, depression/social isolation, poor nutrition—by getting people outside and moving, creating opportunities for building supportive relationships, and providing fresh produce.

ENVIRONMENTAL EXPOSURE BY MEDIA

Many of the environmental protection regulations are based on the “medium” in which pollutants are carried—air, water, and soil. Additionally, chemical, biological, and radiological hazards can be found in food and consumer products. For air, water, and soil, the U.S. EPA and its state-level equivalents are the primary regulatory agencies. However, the EPA also regulates pesticides used in agriculture. The U.S. Department of Agriculture focuses substantially on pathogens in our food supply.

Air

Air pollution is a significant contributor to human health problems, and a sign that regulatory efforts are not completely

BOX 10-4 U.S. EPA Criteria Air Pollutants—National Ambient Air Quality Standards (NAAQS)

Ozone (ground level)	Particulate matter
Sulfur dioxide	Carbon monoxide
Nitrogen dioxide	Lead

effective. Nurses can have a role in addressing both the health problems and the policies affecting the exposures. Air pollution is divided into two major categories: point source and non-point source (see Figure 10-3). **Point sources** are individual, identifiable sources such as smokestacks. They are sometimes referred to as fixed sites. **Non-point sources** come from more diffuse exposures. For instance, the largest non-point source of air pollution is from mobile sources such as cars and trucks, which are the greatest single source of air pollution in the United States. The Clean Air Act regulates air pollution from point and non-point sources. Box 10-4 presents a list of the air pollutants that comprise the “criteria pollutants”—a set of pollutants that the EPA uses to gauge the overall air quality. The burning of fossil fuel (e.g., diesel fuel, industrial boilers, and coal-fired power plants) and waste incineration are two other major contributors. Health effects associated with air pollution include asthma and other respiratory diseases, cardiovascular diseases (including cardiac disorders and hypertension), cancer, immunological effects, and reproductive health problems including birth defects, infant death, and neurological problems. For children with asthma the additional insult of living near a fixed source of pollution can create additional health risks (Smargiassi et al, 2014).

The single greatest source of mercury in our air is coal-fired power plants. Many people do not know that a pea-sized amount of mercury is sufficient to contaminate a 25-acre lake

and make its fish unfit to eat. Mercury, like lead, is an element and it persists in our fresh waterways and oceans from which we continue to get our fish. We cannot readily take these elements out once they have been released into the environment; our job is to focus on policies that prevent them from being released.

Indoor air quality (IAQ) is a growing public health concern in office buildings, schools, and homes and is reflected in the alarming rise in asthma incidence in the United States, particularly among children. The EPA and the American Lung Association both provide excellent materials on IAQ. The EPA has a free kit called *IAQ: Tools for Schools*, which includes a video and a number of helpful materials for people interested in improving the air quality in a school building.

Radon, a naturally occurring radioactive element that is found in the earth's crust and can seep into basements and into groundwater, is the second leading cause of lung cancer in the United States, second only to smoking. To learn more about this important environmental exposure, read more in the Resource Section. Other major culprits contributing to poor indoor air are carbon monoxide, formaldehyde, dusts, molds, pests and pets, pesticides, cleaning and personal care products (particularly aerosols), lead, and of course environmental tobacco smoke.

Because environmental health implies a relationship between the environment and our health, we must assess both the environmental exposures and the human health status within a community. Health status is assessed by using local, state, and national health data or by collecting our own data, or a combination of the two. As we learn more about the exposures in our communities and their known or suspected health effects, we can target the health statistics we wish to review or collect.

Water

Water is necessary for all life forms. Human bodies consist of 70% water. Only 2.5% of the water on this planet is fresh water; the rest is salt water. Much of the fresh water is in the polar icecaps, whereas groundwater makes up most of what remains, leaving only 0.01% in lakes, creeks, streams, rivers, and rainfalls. People's lives are inextricably tied to safe and adequate water. Water is necessary for the production of food. In the United States, all public water suppliers must test their water in accordance with the EPA's safe drinking water standards and they must summarize the results of their testing annually and make them available to their customers—those who pay water bills. The technical term for these reports is Consumer Confidence Reports (CCR). Nurses can request these summaries from the water suppliers that serve their communities. Private wells are not regulated and need not be tested except when they are first drilled. Nurses should encourage people with private wells to have them tested annually, especially in agricultural areas where pesticides are applied.

Pollution discharges into water bodies from industries and from wastewater treatment systems can contribute to the *degradation* of water quality. An additional source of pollution in our waters is pharmaceuticals used for humans and animals. The U.S. Geological Service has found antibiotics, codeine,

17 β -estradiol (an estrogen replacement hormone), and acetaminophen (Tylenol), as well as a variety of endocrine disrupting chemicals, in measurable quantities in U.S. streams and rivers.

Water quality is also affected by non-point sources of pollution, such as storm water runoff from paved roads and parking lots, erosion from clear-cut tracts of land for timbering and mining, and runoff from chemicals added to soils such as pesticides and fertilizers. Soil erosion is another huge public health threat in the making as it is decreasing the amount of soil that can sustain agriculture and the global food supply. Eighty percent (80%) of the world's forests are gone, which is contributing to massive erosion of farmable soil and deterring the flow of and healthy biotic life in creeks and rivers.

Land and Soil

Current and past land use can affect a community's health. Local governments dictate land use through zoning laws. For instance, zoning decisions can determine if a community will have a hazardous waste site built in its neighborhood or whether the land can be used only for residential purposes (housing). Historically, communities in which poor people and people of color live have been more likely to have undesirable and unhealthy industries, railway lines, and hazardous waste sites. In many communities, prior use of the land has left a legacy of unhealthy contaminants. There are two designations for lands that may be contaminated: Superfund sites (highly contaminated sites, with associated health threats that are designated by the EPA) and Brownfield sites (land that has been used previously *and* which is now slated for redevelopment). Public health nurses can play an important role with both Superfund and Brownfield sites related to the health assessment. Funds are available through both the Superfund and Brownfield laws to engage the community and to do health assessments.

Food

Many health risks are associated with food and food production. In recent years, we have seen foodborne illnesses associated with *Salmonella* and *Escherichia coli* H:0157:H7 in chicken, eggs, and meats. Good food preparation practices, such as proper washing and using adequate cooking temperatures and time, can prevent foodborne illnesses associated with most pathogens. Local health departments are responsible for monitoring food establishments (restaurants, food trucks, etc.) in the community, and the U.S. Department of Agriculture is responsible for oversight of meat, poultry, fish, and produce production.

However, there are also environmental health risks posed by the presence of pesticide residues in our food; the use of recombinant bovine growth hormone (rBGH), which is given to many dairy cows; the administration of antibiotics to beef cattle, pigs, and chickens at nontherapeutic doses that are given to promote growth; and the use of genetically modified organisms (GMOs) for genetically engineered crops. In the Resources Section, there are a number of websites through which you can find out more information about food-related public health issues.

When assessing a community's environmental health risks, a nurse must consider air, water, soil, and food. It is important

that nurses understand the term “organic” regarding food labeling. If a food is labeled “Certified Organic” this is a meaningful term that has a legal USDA definition. The legal definition stands for foods that have been produced without the use of pesticides, genetically modified organisms (GMOs), or unnecessary (nontherapeutic) use of antibiotics. If a food is merely labeled “organic,” the consumer does not have the same guarantee for what chemicals or farming practices have been used. When purchasing foods directly from farmers through farm stands or farmers’ markets, consumers can directly ask about the chemicals and farm practices.

RIGHT TO KNOW

Several environmental statutes give the public the **right to know** about the hazardous chemicals in the environment. Under one of the “right to know” laws, health professionals and community members can easily access key information by ZIP code regarding major sources of pollution that are being emitted into the air or water in their community. The EPA has an Envirofacts section on its website that provides several sources of exposure data by ZIP code (<http://www.epa.gov/enviro/>).

Nurses can access drinking water **consumer confidence reports**, sometimes referred to as “right to know” reports, to determine what pollutants have been found in the drinking water. If the drinking water poses an immediate health threat, the water provider must send emergency warnings out to the community via the local newspapers, radios, and television. If there is a biological hazard (microbial) in the water, the health notice may suggest boiling the water or not drinking it at all. If the hazard is chemical, boiling the water may not be helpful because that may simply concentrate the chemical. A federal law, the Freedom of Information Act, allows citizens to request many kinds of public documents, including information about environmental permits and inspections of facilities in your communities.

Employees have the right to know about the hazardous chemicals with which they work through the federal Hazard Communication Standard, which is under the purview of the Occupational Safety and Health Administration (OSHA). This standard requires employers (including hospitals) to maintain a list of all of the potentially hazardous chemicals that are used on site. Each of these chemicals should have an associated chemical information sheet known as a material safety data sheet (MSDS), which is written by the chemical manufacturer. These MSDSs are to be made available to any employee or his or her representative (e.g., a union) and should provide information about the chemicals that constitute the product, the health risks, and any special guidance on safe use or handling (e.g., requirements for protective gloves or respiratory protection). For more extensive information on workplace health and safety, see <http://www.osha.gov>.

RISK ASSESSMENT

Currently, the EPA uses a process referred to as “risk assessment” when they develop health-based standards. The term **risk**

assessment refers to a process to determine the probability of a health threat associated with an exposure. The following illustration of a chemical exposure demonstrates the four phases to a risk assessment:

1. Determining if a chemical is known to be associated with negative health effects (in animals or humans). For this, we rely on toxicological and/or epidemiologic data. (Remember, the available toxicological data will probably be based on animal studies and these studies estimate the potential effects on humans, whereas the results of human epidemiologic studies will be for human health effects.)
2. Determining whether the chemical has been released into the environment—into the air, water, soil, or food. This is accomplished by testing for the presence of the suspected chemical in the various media (air, water, soil, food). Environmental professionals such as air and water pollution scientists, environmental engineers, meteorologists, and others might be involved in this activity. When doing a risk assessment, it is important to note if there are multiple sources of the chemical in question. For example, is lead found in the drinking water, the ambient air, *and* in the paint within the houses of a given community?
3. Estimating how much and by which route of entry the chemical might enter the human body—inhalation, ingestion, dermally, or in utero exposure. This estimate can be based on a one-time exposure, a short-term exposure, or a projected lifetime exposure. (When federal standards are created for air, water, and other pollutants, they are based on an estimation of a lifetime exposure. However, in workplace settings the chemical exposure standards are based on an average exposure during a typical 8-hour work shift or set for a maximum exposure level that should not be exceeded.)
4. Characterizing the risk assessment process and taking into account all three of the previous steps. Is the chemical toxic? What is the source and amount of the exposure? What is the route and duration of the exposure for humans? The final synthesis attempts to predict the potential for harm based on the estimated exposure.

All science is subject to interpretation, and so is risk assessment. The reason that environmental laws are so often contentious is because there are economic interests at stake and not just public or ecological health concerns. In translating the risk assessment results for the purposes of policy development and recommendation for risk reduction activities, there are often several interpretations of each of the risk assessment steps that then result in differing recommendations for health-based standards. There are also areas of scientific uncertainty that contribute to variations in assessment of risk. It is critical to have public health voices in the debates. The American Public Health Association is actively engaged on major policy debates through the Environment Section.

VULNERABLE POPULATIONS

Many of the social determinants of health contribute to the risk levels associated with environmental exposures. Poor people who live in low-income communities are more often housed in

substandard housing (with attendant risks of chipping and peeling paint, pests, and unsafe neighborhoods), live closer to pollution sources, are employed in more dangerous occupations, and have less access to healthy food options. In addition, vulnerability is variable through the human life cycle. The embryo and fetus are the most vulnerable to chemical exposures because of the rapid growth of cells and the development of tissues, organs, and organ systems. Following is a section on children's special vulnerabilities. The very young and the very old also are vulnerable because their body systems are either still developing or are less efficient, respectively. For more information about the special vulnerabilities of the elderly, see the EPA's dedicated information site on older Americans (www.epa.gov/aging/) and look at their report "Growing Smarter/Living Healthier: A Guide to Smart Growth and Active Aging" (<http://www.epa.gov/aging/docs/growing-smarter-living-healthier.pdf>). For more information on the effects of perinatal exposures, the University of California San Francisco has a Program on Reproduction and Environment that provides informational webinars, factsheets, the latest research and policy/advocacy information available at <http://www.prhe.ucsf.edu>.

Children's Environmental Health

Consider some of the current childhood health statistics with which environmental factors are associated: approximately 9% of American children suffer from asthma, with higher rates in black children (CDC, 2012). About 20% of the world's children and adolescents suffer from a mental health problem (WHO, n.d.), and this statistic is mirrored in the United States (DHHS, 2005). The CDC monitoring system for autism spectrum disorders reports that the prevalence of autism among 8-year-olds in the United States is 1 in every 68 children (CDC, 2014a). The global prevalence of autism has increased twentyfold to thirtyfold since the earliest epidemiologic studies were conducted in the late 1960s and early 1970s. And millions of homes in the United States continue to have chipping and peeling lead-based paint.

Developmental disorders and attention deficit hyperactivity disorder (ADHD) collectively are estimated to affect 17% of school-age children (AHRQ, 2002; Anney et al, 2006). Child obesity has doubled and adolescent obesity has more than quadrupled in the last 30 years (CDC, 2014b). From 1975 to 2010 the incidence rates for 4 cancer types, acute lymphocytic leukemia, non-Hodgkin lymphoma, acute myeloid leukemia, and testicular germ cell tumors, increased in children (ACS, 2014). The most common cancers among children ages 0 through 14 are acute lymphocytic leukemia, brain and CNS, neuroblastoma, and non-Hodgkin lymphoma (ACS, 2014, p. 25). "All cancers involve the malfunction of genes that control cell growth and division. Only a small proportion of cancers are strongly hereditary..." (ACS, 2014, p. 1). According to the American Cancer Society (ACS), about 5% of all cancers are strongly associated with heredity (ACS, 2010). The rest occur from environmental exposures, lifestyle choices (diet, smoking, etc.), and other factors during our lifetimes.

Over the past 25 years there has been great improvement in the 5-year survival rate of major childhood cancers. The 5-year

survival rate for children for all cancer sites improved from 58% for those diagnosed between 1975 and 1977 to 81% for children diagnosed between 1999 and 2007 (Jemal et al, 2010). The list of possible causes of children's cancers includes the following: genetic abnormalities, ultraviolet and ionizing radiation, electromagnetic fields, viral infections, certain medications, food additives, tobacco, alcohol, and industrial and agricultural chemicals (Ross and Olshan, 2004; Bassil et al, 2007). Clearly, the environment is playing an important role.

EVIDENCE-BASED PRACTICE

Gilden et al examined the use of pesticides on athletic fields where children play sports. This cross-sectional descriptive study used a survey to assess playing field maintenance practices related to the use of pesticides on the field. The authors gave the survey to 33 field managers in order to assess maintenance practices. Their data were analyzed using descriptive statistics and generalized estimating equations.

They found that 65.3% of the managers said they applied pesticides, primarily herbicides, to the fields. They also found that managers of urban and suburban fields were less likely to apply pesticides than were managers of rural fields. The use of pesticides presents many health hazards, and the results of this study demonstrated that children who engage in sports activities on athletic fields are exposed to health hazards.

- **Nurse Use:** Nurses can inform people such as school officials, coaches, and field managers of the dangers of using pesticides on athletic fields.

Gilden R, Friedmann E, Sattler B, et al: Potential health effects related to pesticide use on athletic fields. *Public Health Nursing* 29(3):198-207, May/June 2012.

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 breathe more rapidly than adults, and this increase in respiratory rate translates to a proportionately greater exposure to air pollutants. While infants' lungs are developing they are particularly susceptible to environmental **toxics**. Although full function of the lungs is attained at approximately age 6, changes continue to occur in the lungs through adolescence (Dietert et al, 2000). Children are short and, as such, their breathing zones are lower than adults, causing them to have closer contact to the chemical and biological agents that accumulate on floors and carpeting. Children of color and poor children in America are disproportionately affected by a range of environmental health threats, including lead, air pollution, pesticides, incinerator emissions, and exposures from hazardous waste sites (Suk and Davis, 2008; Landrigan et al, 2010).

In clinical settings, there is little that can be done to address a child's body burden of toxic chemicals; however, the nursing community as a profession has a weighty obligation to understand the science and risks associated with environmental pollutants and to engage in the political and economic decisions regulating the environment that have a profound effect on human health, especially the health of our children. This engagement occurs in policy-making arenas including legislative, regulatory, and international treaties. Nurses have increasingly become involved in the policy arena. The Alliance of Nurses for Healthy Environments is actively engaging nurses in

state and federal chemical policies and energy policies (including fracking) as they relate to health, and policies related to sustainable foods.

Children's bodies also operate differently. Some of the protective mechanisms that are well developed in adults, like the blood-brain barrier, are immature in young children, thereby increasing their vulnerability to the effects of toxic chemicals. And finally, the kidneys of young children are less effective at filtering out undesirable toxic chemicals, and these chemicals then continue to circulate and accumulate.

Infants and young children drink more fluids per body weight than adults, thus increasing the dose of contaminants found in their drinking water, milk (hormones and antibiotics), and juices (particularly pesticides). If an adult were to drink a proportionate amount of water to an infant, the adult would have to drink about 50 glasses of water a day. Children also eat more per body weight, eat different proportions of food, and absorb food differently than adults (EPA, 2013). How many adults could eat the same amount of raisins pound-for-pound as the average 2-year-old? Children consume much greater quantities of fruits and fruit juices than adults, once again adding exposure to doses of pesticide residues. The average 1-year-old drinks 21 times more apple juice, 11 times more grape juice, and nearly 5 times more orange juice per unit of body weight than the average adult (Rawn et al, 2004). The Food Quality Protection Act (FQPA) was passed to specifically address the consumption patterns and special vulnerabilities of children (Box 10-5).

BOX 10-5 Provisions Under the Food Quality Protection Act Regarding Pesticide Exposure to Children from Multiple Sources

New provisions under the Food Quality Protection Act of 1996 related to protection of infants and children:

Health-based standard: A new standard of a reasonable certainty of "no harm" that prohibits taking into account economic considerations when children are at risk.

Additional margin of safety: Requires that the EPA use an additional 10-fold margin of safety when there are adequate data to assess prenatal and postnatal development risks.

Account for children's diet: Requires the use of age-appropriate estimates of dietary consumption in establishing allowable levels of pesticides on food to account for children's unique dietary patterns.

Account for all exposures: In establishing acceptable levels of a pesticide on food, the EPA must account for exposures that may occur through other routes, such as drinking water and residential application of the pesticide.

Cumulative impact: The EPA must consider the cumulative impact of all pesticides that may share a common mechanism of action.

Tolerance reassessments: All existing pesticide food standards must be reassessed over a 10-year period to ensure that they meet the new standards to protect children.

Endocrine disruption testing: The EPA must screen and test all pesticides and pesticide ingredients for estrogen effects and other endocrine disruptor activity.

Registration renewal: Establishes a 15-year renewal process for all pesticides to ensure that they have up-to-date science evaluations over time.

From Environmental Protection Agency: Food Quality Protection Act of 1996. Available at <http://www.epa.gov/pesticides/regulation/laws/fqpa/>. Accessed December 15, 2010.

Toxic chemicals can have different effects depending on the timing of exposure. During fetal development, there are periods of exquisite sensitivity to the effects of toxic chemicals. During such times, even extraordinarily small exposures can prevent or change a process that may permanently affect normal development. The brain undergoes rapid structural and functional changes during late pregnancy and in the neonatal period. Therefore, it is extremely important to safeguard women's environments when they are pregnant (Table 10-1).

Alarming, 27 states have issued mercury contamination advisories for fish in every lake and river within their state's borders (EPA, 2009). According to the EPA, more than 1 million women in the United States of childbearing age eat sufficient amounts of mercury-contaminated fish to risk damaging brain development of their children. Nurses in all settings need to understand the implications that the fish advisories have for their clients and communities, and the contribution that the health sector has in creating this health risk, while at the same time counseling on the positive contribution of fish to a nutritionally balanced diet.

About 84,000 chemicals are used in commerce in the United States (EPA, 2014). Almost all are man-made; 15,000 of them are produced annually in quantities greater than 10,000 lb and 2800 of them are produced in quantities greater than 1 million pounds per year (Goldman and Koduru, 2000). Of the 2,800, only 7% have been tested for developmental effects and only 43% have been tested for any human health effects.

Companies are not required to divulge the results of their private testing. A full battery of neurotoxicity tests is not required even for pesticides that may be sprayed in nurseries and labor and delivery areas, not to mention in homes. To make things even more complicated, risks from multiple chemical exposures are rarely considered when regulations are drafted. Such an omission ignores the reality that both children and adults are exposed to many toxic chemicals, often concurrently. The only exception to this rule is in the case of regulations regarding pesticides that are used on food (Figure 10-4). This exception was created by the 1996 FQPA, in which Congress acknowledged that children eat foods that may be contaminated by more than one pesticide residue. See Box 10-5 for the provisions under the FQPA.

PRECAUTIONARY PRINCIPLE

With thousands of chemical compounds now creating a chemical soup in our air and water (and in our bodies, in our breast milk), it is increasingly difficult to prove specific hypotheses regarding the relationship of exposure to a singular chemical and disease outcome in humans. It has been suggested that we adopt a precautionary approach when research and other indicators demonstrate a possible toxic relationship between a chemical and health. Box 10-6 presents the *Wingspread Statement on the Precautionary Principle*. This precautionary approach calls for action to reduce potentially toxic exposure to humans in light of data or other indicators, rather than delaying until more "conclusive" studies are performed. We will never have the perfect studies. Nurses, who are trained in disease

TABLE 10-1 Workplace Hazards to Women of Reproductive Age*

Agent	Observed Effects	Potentially Exposed Workers
Cancer treatment drugs (e.g., methotrexate)	Infertility, miscarriage, birth defects, low birth weight	Health care workers, pharmacists
Organic solvents (e.g., toluene, xylene, formaldehyde)	Miscarriage	Health care workers, laboratory workers, print shop and manufacturing employees
Lead	Infertility, miscarriage, low birth weight, developmental disorders	Battery makers, solderers, welders, bridge repainters, firing range workers, home remodelers
Strenuous physical labor (e.g., prolonged standing, shift/night work)	Miscarriage, preterm delivery	Many types of workers
Cytomegalovirus	Birth defects, low birth weight, developmental disorders	Health care workers, workers who have contact with infants and children
Parvovirus B19	Miscarriage	Health care workers, workers who have contact with infants and children
Rubella	Birth defects, low birth weight	Health care workers, workers in who have contact with infants and children
Toxoplasmosis	Miscarriage, birth defects, developmental disorders	Animal care workers, veterinarians
Varicella zoster	Birth defects, low birth weight	Health care workers, workers who have contact with infants and children

*This list is not complete. Information about these hazards is constantly being revised. Readers should not assume that a substance is safe if it is missing from this list.

Source: National Institute for Occupational Safety and Health (www.cdc.gov/niosh/99-104.html)



FIG 10-4 Aerial application of agricultural pesticides makes it very difficult to control exposures. The chemicals get tracked into homes in farming communities. (Copyright © 2011 Photos.com, a division of Getty Images. All rights reserved. Photo #87531230.)

prevention, appreciate and should advocate for a precautionary approach when it may prevent injuries or illnesses. The ANA has adopted the **precautionary principle** as the basic tenet on which to guide its environmental advocacy work.

The bottom line is that life depends on the environment, and what humans do collectively can affect this vital resource for present and future generations. A central concept in Native American cultures is that humans are stewards, not proprietors, of the environment. Native Americans make the “Rule of Seven” central to all environmental decisions: What will be the effect

on the seventh generation? A quote (Myths-Dreams-Symbols, 2006) attributed to Chief Seattle, a nineteenth-century Native American, illustrates the need to think more holistically when we consider environmental impacts: “Whatever befalls the earth befalls the sons of the earth. Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself.” McDonough suggests that, as we make policies, plans, and designs, we ask ourselves how these decision are evidence that “we love all the children of all the species for all times” (Huff interview with McDonough, 2013).

Mary O’Brien, in her book *Making Better Environmental Decisions: An Alternative to Risk Assessments*, notes that we are repeatedly given a very short list of risk reduction choices, and that the public is not effectively engaged in the decision-making process. She suggests that a broader range of options would allow us to see the possibilities for further reducing (or even eliminating) risks and that the process should be much more democratic in nature. O’Brien suggests the best approach to making effective environmental decisions is to use information, emotion, and a sense of relationship to others concurrently. By “others” she means other species, cultures, and generations (O’Brien, 2000). Her method is consistent with a nursing approach. Using her approach will require that nurses more actively engage in environmental health—assessing environmental health risks, developing risk reduction strategies, and supporting policies that embrace the precautionary principle and care for all of the children of all of the species for all times.

ENVIRONMENTAL HEALTH RISK REDUCTION

Prevention is a core goal in every public health intervention. Preventing problems is less costly whether the cost is measured in resources consumed or in human health effects. Policies, as well as practices, can promote primary prevention. After we have assessed the environmental risks in our communities, we

BOX 10-6 Wingspread Statement on the Precautionary Principle

In 1998 an international group of health and public health professionals, scientists, government officials, lawyers, grassroots activists, and labor activists met at a conference center called "Wingspread" in Wisconsin to define the "precautionary principle." The group issued the following consensus statement:

The release and use of toxic substances, the exploitation of resources, and physical alterations of the environment have had substantial unintended consequences affecting human health and the environment. Some of these concerns are high rates of learning deficiencies, asthma, cancer, birth defects and species extinctions, along with global climate change, stratospheric ozone depletion and worldwide contamination with toxic substances and nuclear materials.

We believe existing environmental regulations and other decisions, particularly those based on risk assessment, have failed to protect adequately human health and the environment the larger system of which humans are but a part.

We believe there is compelling evidence that damage to humans and the worldwide environment is of such magnitude and seriousness that new principles for conducting human activities are necessary.

While we realize that human activities may involve hazards, people must proceed more carefully than has been the case in recent history. Corporations, government entities, organizations, communities, scientists and other individuals must adopt a precautionary approach to all human endeavors.

Therefore, it is necessary to implement the Precautionary Principle: When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof.

The process of applying the Precautionary Principle must be open, informed and democratic and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including no action.

Wingspread Statement on the Precautionary Principle, Racine WI, 1998. Available at <http://www.gdrc.org/u-gov/precaution-3.html>. Retrieved March 12, 2015.

can apply the basic principles of disease prevention when planning intervention strategies. For lead exposure, remediating a home with lead-based paint to make it lead safe applies the primary prevention strategy of removing the exposure (at least from that specific source of lead) (Figure 10-5). Even good lead poisoning surveillance will not prevent lead exposure, but may help with early detection of rising blood lead levels. Such surveillance is a secondary prevention strategy. Finally, when a symptomatic child is seen, it is important to have a health care system readily available in which specialists familiar with lead poisoning will provide swift medical interventions to reduce blood lead levels, thus reducing the risk of further harm. This is a tertiary prevention response. Box 10-7 presents examples of risk reduction strategies for nurses in the health care setting.

Industrial Hygiene Hierarchy of Controls

For workplace exposures, industrial hygienists have developed a "hierarchy of control" for avoiding or minimizing employee

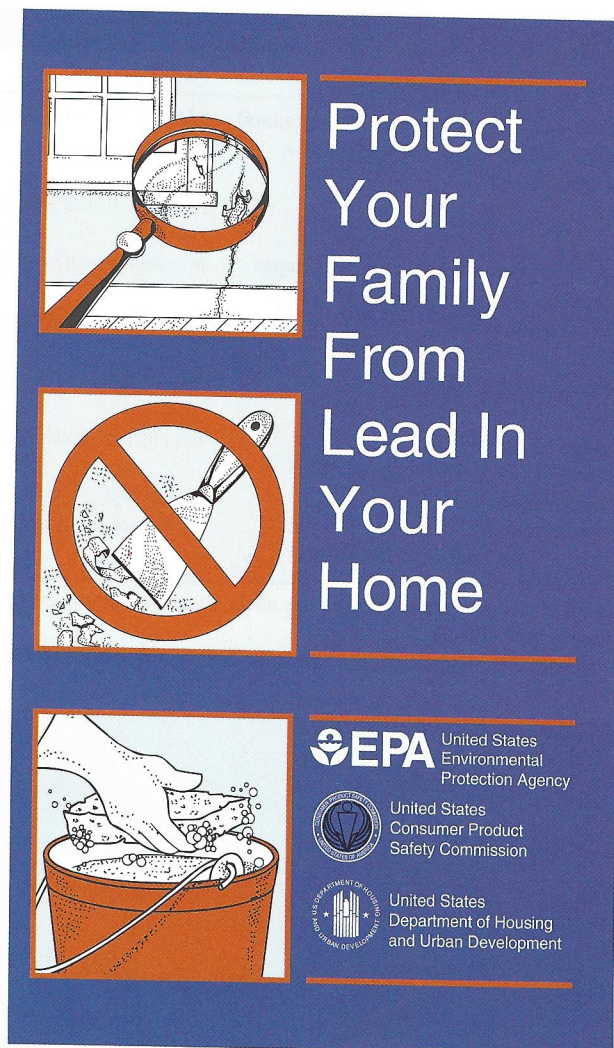


FIG 10-5 Lead can be found in many places in a home. Nurses should help families learn about these sources and take actions to remove any lead-based paint using certified professionals. Good hygiene is key to reducing lead dust exposure, especially given that urban soot will often have lead from the legacy of lead used in gasoline for many decades. (From U.S. Environmental Protection Agency. Available at <http://www.epa.gov/lead/pubs/leadpdf.pdf>. Accessed December 29, 2010.)

exposures to potentially hazardous chemicals. Industrial hygienists are public health professionals who specialize in workplace exposures to hazards—physical, chemical, and biological—that create the conditions for health risks (Box 10-8 presents the **industrial hygiene hierarchy of controls**). Once it is established that a human health threat exists, develop a plan of action—a way of eliminating or managing (reducing) the risk. **Risk management** should be informed by the risk assessment process and involves the selection and implementation of a strategy to eliminate or reduce risks.

Box 10-9 lists the 3 Rs for reducing environmental pollution.

Nursing interventions to reduce environmental health risks can take many forms. Education is one example of a nursing intervention. By working with a wide array of community

BOX 10-7 Risk Reduction: Every Nurse's Role

In the health care setting (hospital, clinic, home health), we have many opportunities to make environmentally friendly and healthy choices:

- Shift to electronic records, thus avoiding the use of paper. When paper is a must, use products that are made from recycled ingredients
- Recycle: paper, glass, cans, plastic, small batteries, blue wrap, electronic equipment
- Work with suppliers to get products with minimum packaging and the safest ingredients possible: "environmentally preferable purchasing"
- Promote the use of green cleaners
- Go fragrance free by using fragrance-free products in the hospital and creating a policy that requires employees to use fragrance-free personal care products (shampoos, creams, etc.)
- Turn off lights AND computers AND patient monitoring equipment when rooms are not being used
- Report leaky sinks, toilets, and other plumbing sources
- Promote the purchase of local, sustainably grown foods (with a preference for organic, no use of GMOs, no use of unnecessary antibiotics, and no pesticides)
- Start a hospital/clinic/health department garden
- Start a Green Team, or join the existing one in your institution
- Create community while doing these activities and build relationships—it makes the whole process more meaningful and fun!

BOX 10-8 Industrial Hygiene Hierarchy of Controls*

Eliminate unnecessary toxic chemicals.

Substitute less hazardous or nonhazardous substances (e.g., using water-based vs. solvent-based products).

Isolate the hazardous chemicals from human exposure (e.g., use closed systems).

Apply engineering controls (e.g., ventilation systems, including exhaust hoods).

Reduce the exposures through **administrative controls** (e.g., rotating employees in areas with high exposures).

Use **personal protective equipment** (e.g., gloves, respirators, protective clothing).

*In addition, education is a critical tool in the hierarchy of controls. Modified from Levy B, Wegman D: Occupational health: recognizing and preventing work-related disease and injury, ed 4, Philadelphia, 2000, Lippincott Williams & Wilkins.

BOX 10-9 The 3 Rs for Reducing Environmental Pollution

The "3 Rs" adage of the environmentalist community—*reduce, reuse, and recycle*—helps us consider ways to decrease our personal impact on the environment, and thereby decrease environmental health risks. These concepts can apply to our health care settings, as well as our homes. By recycling, we prevent the need to extract more resources from the earth to manufacture products. By recycling, we also prevent products from unnecessary landfilling or incineration. Choosing reusable products, versus single-use devices and products, similarly prevents the need for manufacturing more products and decreases the waste stream. Reducing our waste stream can also be accomplished generally by a reduction in consumption (buying less "stuff," as well as by reducing unnecessary packaging and other nonessential goods). The "Story of Stuff" (www.thestoryofstuff.org) provides an excellent overview of the "cradle to grave" travels of products and the full range of their human and ecological impacts.

members, nurses can help a community understand the relationship between harmful environmental exposures and human health and guide the community toward risk reduction on the basis of both individual behavior changes, as well as community-wide approaches. In communities in which radon is likely to be a naturally occurring exposure, nurses can educate the community about the health risks, methods to measure radon levels in a home, and how to address unhealthy radon levels.

Nurses work with individuals, families, and communities in all three levels of prevention. For example, in Planned Parenthood Clinics in the United States, as a form of primary prevention, clinicians ask clients about possible environmental health risks in their everyday lives and then direct them to safer products and healthier behaviors to decrease potentially toxic exposures. Secondary prevention takes place when pediatric clinics include lead screening as part of their protocols. By doing so they are apt to find children with elevated blood lead levels, which then allow them to act to decrease the child's environmental lead exposures. This form of secondary prevention does not actually prevent the exposure but calls for action based on evidence of exposure. If a child has a seriously high blood lead level, the child would be admitted to the hospital for chelation therapy which is a process used to decrease the body's burden of lead.

LEVELS OF PREVENTION

Example Applied to Lead-Based Paint Exposure

Primary Prevention

Eliminate lead-based paint and lead-based paint dust from the home.

Secondary Prevention

Provide blood lead testing of children in communities with older housing stock.

Tertiary Prevention

When a child presents with extremely elevated blood lead levels, make sure the child is being cared for by a health professional who is familiar with clinical interventions to reduce blood lead levels using clinical (chelating medications) interventions, **while concurrently assuring that the child returns to a lead-safe place.**

The clinical intervention is tertiary prevention. It neither prevents the exposure, nor focuses on decreasing the exposure, but rather focuses on decreasing the potential health sequela associated with elevated lead levels.

Risk Communication

Risk communication is both an area of practice and a skill that is a composite of two separate words: "risk" and "communication." *Risk* is a familiar term in nursing practice. It is understood in the health context when we counsel patients about the risks of pregnancy, communicable disease (especially sexually transmitted disease), unintentional injury, and risk associated with personal choices (e.g., smoking, alcohol consumption, and diet). Risk assessment in environmental health focuses on characterizing the hazard (the "source"), its physical and chemical properties, its toxicity, and the potential exposure pathways—mode of transmission, **route of exposure**, receptor population, and dose. In their seminal work on risk communication,

BOX 10-10 Definitions of Risk

Risk has traditionally been defined by the following equation:

$$\text{Risk} = \text{magnitude} \times \text{probability}$$

There is a growing body of literature from practitioners and researchers who have studied the human reaction to risk—real and perceived. Sandman et al (1991) were the first to examine the “outrage” factor that can influence the way in which we perceive risk, particularly to environmental risks.

$$\text{Risk} = \text{hazard} + \text{outrage}$$

Addressing only the hazard is doing only half of the necessary work; addressing the response (outrage) is equally important.

From Sandman PM, Chess C, Hane BJ: Improving dialogue with communities, New Brunswick, NJ, 1991, Rutgers University.

BOX 10-11 Outrage Factors: Characteristics of Risk That Contribute to the Public's Feeling of Outrage

Safer = Less Outrage	Less Safe = More Outrage
12 Principal Outrage Components	
Voluntary	Involuntary (coerced)
Natural	Industrial (artificial)
Familiar	Exotic
Not memorable	Memorable
Not dreaded	Dreaded
Chronic	Catastrophic
Knowable (detectable)	Unknowable (undetected)
Individually controlled	Controlled by others
Fair	Unfair
Morally irrelevant	Morally relevant
Trustworthy sources	Untrustworthy sources
Responsive process	Unresponsive process

Sandman, Chess, and Hane (1991) noted that risk has traditionally been formulated as magnitude (the size, severity, extent of area, or population affected) multiplied by the probability (how likely exposure or damage is to occur) (Box 10-10). For example, an environmental risk assessment of a contaminated site would involve a calculation of the dose that might be received through all routes of exposure, the toxicity of the chemical, the size and vulnerability (age, health) of the population potentially exposed (resident, future resident, transient), and the likelihood of exposure. Sandman et al (1991) also noted that the reaction to things that scare people and the things that kill people are often not related to the actual hazard. They have gone further to probe what is behind those differences and identified a list of “outrage factors” to explain people’s responses to risk (Box 10-11). They maintain that the outrage is just as predictable and open to intervention as the science of addressing the hazard.

“Communication” of risk involves understanding the outrage factors relevant to the risk being addressed so they can be incorporated in the message—the information—either to create action to ensure safety or prevent harm or to reduce unnecessary fear. An example of raising outrage to produce action can be seen in the shift from emphasis on smokers (voluntary) to

victims of passive smoking (involuntary) to stimulate public policy that limits or bans smoking in public places. When the emphasis on risk went from a voluntary choice of smokers to an involuntary exposure of nonsmokers, the outrage level of the nonsmoking public became high enough to result in legislation guaranteeing smoke-free public spaces (e.g., public buildings, airplanes, and restaurants).

On the other hand, outrage decreases when people receive information on the situation from a trusted source, and physicians and nurses are often cited in surveys as trusted sources of information on environmental risks (Kaiser Foundation, 2013). The public trust is a compelling incentive to match professional knowledge and skills to a community’s expectations. The outrage factor can also be a driving force in building credibility and trustworthiness in every person whose work involves interacting with the public.

Risk communication includes all the principles of good communication in general. It is a combination of the following:

- *The right information:* Accurate, relevant, in a language that audiences can understand. A good risk assessment is essential information for shaping the message.
- *To the right people:* Those affected and those who are worried but may not be affected. Information on the community is essential: geographic boundaries, who lives there (i.e., demographics), how they obtain information (e.g., flyers or newspapers, radio, television, word of mouth), where they congregate (e.g., school, church, community center), and who within the community can help plan the communication.
- *At the right time:* For timely action or to allay fear.

GOVERNMENTAL ENVIRONMENTAL PROTECTION

The government has a variety of tools to address environmental exposures. In addition to passing legislation, creating and enforcing standards and regulations, deciding how land should be used, providing permits, and supporting research, the government is actively engaged in educating the public. Many federal agencies are involved in environmental health regulation, such as the EPA, the FDA, and the Department of Agriculture. The Department of Health and Human Services (DHHS) has two major research institutes, the National Institute of Environmental Health Science (NIEHS) and the National Institute of Occupational Safety and Health (NIOSH). Within DHHS is the CDC (which includes the National Center for Environmental Health [NCEH] that is responsible for tracking environmental health trends, recommending clinical and public health practices, and also engaging in research). Every state has an agency responsible for environmental quality. At the city or county level, the local health department most often manages environmental health issues. However, environmental protection issues are typically directed by the state using both federal and state laws. Box 10-12 lists key environmental protection laws.

Potentially harmful pollution that cannot be prevented must be controlled. An important step in the process of controlling pollution is **permitting**, a process by which the government

BOX 10-12 Environmental Laws**National Environmental Policy Act (NEPA)**

The NEPA established the Environmental Protection Agency (EPA) and a national policy for the environment and provides for the establishment of a Council on Environmental Policy. All policies, regulations, and public laws shall be interpreted and administered in accordance with the policies set forth in this act.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA provides federal control of pesticide distribution, sale, and use. The EPA was given the authority to study the consequences of pesticide usage and requires users such as farmers and utility companies to register when using pesticides. Later amendments to the law required applicators to take certification examinations, registration of all pesticides used in the United States, and proper labeling of pesticides that, if in accordance with specifications, will cause no harm to the environment (summary from FIFRA, 1972).

Clean Water Act (CWA)

The CWA sets basic structure for regulating pollutants to U.S. waters. The law gave the EPA the authority to set effluent standards on an industry basis and continued the requirements to set water quality standards for all contaminants in surface water. The 1977 amendments focused on toxic pollutants. In 1987 the CWA was reauthorized, and again focused on toxic pollutants, authorized citizen suit provisions, and funded sewage treatment plants.

Clean Air Act (CAA)

The Clean Air Act regulates air emissions from aerial, stationary, and mobile sources. The EPA was authorized to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment. The goal was to set and achieve the NAAQS by 1975. The law was amended in 1977 when many areas of the country failed to meet the standards. The 1990 amendments to the Clean Air Act intended to meet unaddressed or insufficiently addressed problems such as acid rain, ground level ozone, stratospheric ozone depletion, and air toxics. Also in the 1990 reauthorization was a mandate for Chemical Risk Management Plans. This mandate requires industry to identify "worst case scenarios" regarding the hazardous chemicals that they transport, use, or discard (summary from Clean Air Act, 1970).

Occupational Safety and Health Act (OSHA)

The OSHA was passed to ensure worker and workplace safety. The goal was to make sure employers provide an employment place free of hazards to health and safety such as chemicals, excessive noise, mechanical dangers, heat or cold extremes, or unsanitary conditions. To establish standards for the workplace, the Act also created NIOSH (National Institute for Occupational Safety and Health) as the research institution for OSHA.

Safe Drinking Water Act (SDWA)

The SDWA was established to protect the quality of drinking water in the United States. The Act authorized the EPA to establish safe standards of purity and required all owners or operators of public water systems to comply with primary (health-related) standards.

Resource Conservation and Recovery Act (RCRA)

The RCRA gave the EPA the authority to control the generation, transportation, treatment, storage, and disposal of hazardous waste. The RCRA also proposed a framework to manage nonhazardous waste. The 1984 Federal Hazardous and Solid Waste Amendments to this Act required phasing out land disposal of hazardous waste. The 1986 amendments enabled the EPA to address problems from underground tanks storing petroleum and other hazardous substances.

Toxic Substances Control Act (TSCA)

The TSCA gives the EPA the ability to track the 75,000 industrial chemicals currently produced in or imported into the United States. The EPA can require

reporting or testing of chemicals that may pose environmental health risks and can ban the manufacture and import of those chemicals that pose an unreasonable risk. TSCA supplements the Clean Air Act and the Toxic Release Inventory.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund)

This law created a tax on the chemical and petroleum industries and provided broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment.

Superfund Amendments and Reauthorization Act (SARA)

SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act with several changes and additions. These changes included increased size of the trust fund; encouragement of greater citizen participation in decision making on how sites should be cleaned up; increased state involvement in every phase of the Superfund program; increased focus on human health problems related to hazardous waste sites; new enforcement authorities and settlement tools; emphasis on the importance of permanent remedies and innovative treatment technologies in clean-up of hazardous waste sites; and Superfund actions to consider standards in other federal and state regulations. (Under Superfund legislation, the Federal Agency for Toxic Substances and Disease Registry was established.)

Emergency Planning and Community Right to Know Act (EPCRA)

The EPCRA, also known as Title III of SARA, was enacted to help local communities protect public health safety and the environment from chemical hazards. Each state was required to appoint a State Emergency Response Commission that was required to divide their state into Emergency Planning Districts and establish a Local Emergency Planning Committee (LEPC) for each district.

National Environmental Education Act

The National Environmental Education Act created a new and better coordinated environmental education emphasis at the EPA. It created the National Environmental Education and Training Foundation.

Pollution Prevention Act (PPA)

The PPA focused industry, government, and public attention on reduction of the amount of pollution through cost-effective changes in production, operation, and use of raw materials. Pollution prevention also includes other practices that increase efficient use of energy, water, and other water resources, such as recycling, source reduction, and sustainable agriculture.

Food Quality Protection Act (FQPA)

The FQPA amended the Federal Insecticide, Fungicide, and Rodenticide Act and the Federal Food, Drug, and Cosmetic Act. The Act changed the way the EPA regulates pesticides. The requirements included a new safety standard of reasonable certainty of no harm to be applied to all pesticides used on foods.

Chemical Safety Information, Site Security, and Fuels Regulatory Act (Amendment to Section 112 of Clean Air Act)

This act removed from coverage by the Risk Management Plan (RMP) any flammable fuel when used as fuel or held for sale as fuel by a retail facility (flammable fuels used as a feedstock or held for sale as a fuel at a wholesale facility are still covered). This Act required certain facilities to have in place a risk management program and submit a summary of that program, called a Risk Management Plan (RMP) to the EPA. The law has two distinct parts that pertain to: flammable fuels and public access to Off-Site Consequence Analysis (OCA) data. OCA is "worst-case scenario" data.

places limits on the amount of pollution emitted into the air or water. A **permit** is a legally binding document.

Environmental standards may describe a permitted level of emissions, a maximum contaminant level (MCL), an action level for environmental clean-up, or a risk-based calculation; environmental standards are required to address health risks. It is the responsibility of potential polluters to operate within the regulations and standards. Compliance and enforcement are the next building blocks in controlling pollution. **Compliance** refers to the processes for ensuring that permit/standard/regulatory requirements are met. Clean-up or remediation of environmental damage is another control step. Public information and involvement processes, such as citizen advisory panels or community forums, are integral to the development of standards, on-going **monitoring**, and remediation.

POLICY AND ADVOCACY

There are almost 3 million nurses in the United States today—approximately 1 in every 100 Americans is a registered nurse! Nurses can and should be a strong voice for a healthy environment. As informed citizens, nurses can take a variety of actions to protect the environmental health of families, clients, and communities. Nurses are perceived as trusted messengers and as reliable sources of environmental health information and as such, have a responsibility to be informed and take action in the best interest of public health. Often, legislators are called to vote on environmental legislation without a sound understanding of how the legislation may affect public health. Nurses can serve as a resource for state and federal legislators and their staff. Although every nurse may not be an expert in all aspects of environmental health, every nurse does have a basic education in human health and has a sufficient understanding of who may be most vulnerable to environmental insult. Nurses' thoughts about the potential impacts of new laws on the health of individuals and communities are valuable to legislators and other policy makers, as well as the public.

Grounded in science and using sound risk communication skills, nurses become the most credible sources of information at community gatherings, formal governmental hearings, and professional nursing forums. Nurses work as advocates for environmental justice so that all members of the community have a right to live and work in an environment that is healthy and safe (Mood, 2002). Public health nurses also volunteer to serve on state, local, or federal commissions, and they know about zoning and permit laws that regulate the impact of industry and land use on the community. Many nurse legislators began their careers by advocating for the rights of others. Nurses must read, listen, and ask questions. Then, as informed citizens, they will be leaders, fostering community action to address environmental health threats.

In 2008 the Alliance of Nurses for Healthy Environments was created to coalesce individual nurses and nursing organizations around issues associated with the environmental exposures and human health. This organization addresses the integration of environmental health into nursing education, practice (including greening the health care sector), research, and advocacy.

Environmental Justice and Environmental Health Disparities

Some diseases differentially affect different populations. Certain environmental health risks disproportionately affect poor people and people of color in the United States. If you are a poor person of color, you are more likely to live near a hazardous waste site or an incinerator, and more likely to have children who are lead poisoned. You are also more likely to have children with asthma, which has a strong association with environmental exposures. Campaigns to improve the unequal burden of environmental risks in communities of color and in poor communities are striving to achieve **environmental justice** or environmental equity.

In 1993 the Environmental Justice Act was passed, and in 1994 Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations," was signed. This Act and the subsequent actions created policies to more comprehensively reduce the incidence of environmental *injustice* by mandating that every federal agency act in a manner to address and prevent illnesses and injuries. Nursing interventions and involvement in environmental health policies can have a significant effect on the health disparities experienced by our most challenged communities.

Environmental Health Threats from the Health Care Industry: New Opportunities for Advocacy

Many choices in the health care setting affect environmental health. Nurses often lead in reducing the use of mercury-containing products in hospitals. The use of mercury-containing thermometers and sphygmomanometers leads to a risk of breakage, which releases a highly toxic substance into the workplace. Further, when a hospital uses incineration to dispose of their waste, the mercury-containing products will create significant releases of mercury into the air, thus contaminating communities. This airborne mercury will be present in raindrops; when the airborne mercury lands on water bodies (e.g., lakes, rivers, or oceans), it is converted by the microorganisms in the water to methylmercury, which is highly toxic to humans. The **methylmercury** is then **bioaccumulated** in the fish: as larger fish eat smaller fish, the body burden of methylmercury increases significantly.

Many synthetic chemicals that contaminate the environment are referred to as **persistent bioaccumulative toxins** (PBTs) or **persistent organic pollutants** (POPs). These are chemicals that do not break down in air, water, or soil, or in the plant, animal, and human bodies to which they may be passed. Ultimately, since humans are at the top of the food chain, these chemicals may come to reside in our bodies. For instance, lead, which should not be found in the human body, can be found in the long bones of almost any human in the world because of its ubiquitous use and presence in our environment.

Dioxin, another pollutant that contaminates our communities, is created, in part, by the health care industry. Dioxins are created when we manufacture or burn (incinerate) products that contain chlorine, such as bleached white paper or polyvinyl chloride (PVC) plastics. When dioxins are released into the

environment, they are consumed by agricultural animals (e.g., beef and dairy cows, hogs, and poultry) and fish, where they are stored in fat cells as they work their way up the food chain. This phenomenon has resulted in dioxin deposition in breast tissue and been found in both cow and human milk. Virtually all women now have dioxin in their breast tissue. Dioxin, an endocrine-disrupting chemical and a strong carcinogen, is associated with several neurodevelopmental problems including learning disabilities and is now in every human's body. The solution to this problem is to stop releasing dioxins into the environment. In the health care setting, one way to eliminate the creation and release of dioxins is to stop using products like PVC plastics and selecting safer alternatives by employing environmentally preferable purchasing policies and practices.

An international campaign called Health Care Without Harm is working to reduce and eliminate mercury and PVC plastic in the health care industry, as well as the elimination of incineration of medical waste. The ANA was a founding member of the Health Care Without Harm campaign, and nurses have taken many leadership roles in the activities in the United States and around the world. The Health Care Without Harm website (<http://www.noharm.org>) provides outstanding information on greening hospitals and resources about pollution prevention in the health care sector.

REFERRAL RESOURCES

There is no one source of information about environmental health nor is there a single resource to which a public health nurse can refer an individual or community should an environmentally related problem be suspected. As mentioned earlier, the NLM's ToxTown is a great starting place, and it allows the interested browser to dig deeply into environmental health content. TOXNET has an amalgamation of important databases and environmental health literature and additional peer-reviewed environmental health literature. The EPA is another rich source of information (www.epa.gov). Use of the Internet

makes information widely accessible, but finding an actual person to assist you or the communities you serve may not be as easy. One starting point may be the environmental epidemiology unit or toxicology unit of the state health department or department of environmental quality. The Association of Occupational and Environmental Clinics (AOEC) (<http://www.aoec.org>) is a national network of specialty clinics and individual practitioners available for consultation and sometimes for provision of educational programs for health professionals. Through AOEC, you can also find the Pediatric Environmental Health Specialty Units; there are 10 throughout the country. These specialty units were specifically established to provide consultation on environmental health issues. Another local or state resource may be environmental health experts in nursing or medical schools or schools of public health.

Local resources include local health and environmental protection agencies; poison control centers; agricultural extension offices; and occupational and environmental departments in schools of medicine, nursing, and public health. Some local and state agencies have developed topical directories to assist in accessing the appropriate staff for specific questions. Many of the resources have websites that allow ready access through the Internet and can be located by using any of the popular search methods. Box 10-13 presents an extensive list of environmental health agency resources.

The most active advocates for environmental health policies are grassroots organizations, the big environmentalist organizations, and environmental justice organizations. To learn more about who these organizations are, see the Resource Section under nongovernmental organizations.

ROLES FOR NURSES IN ENVIRONMENTAL HEALTH

Nurses can be involved in many environmental health roles, in full-time work, as an adjunct to existing roles, and as informed citizens. Nurses who are passionate about this issue can develop

BOX 10-13 Information and Guidance Sources for Referrals

The websites for each of these agencies can be accessed directly through the WebLinks feature on the book's website at <http://evolve.elsevier.com/Stanhope>.

Federal Agencies

Agency for Toxic Substances and Disease Registry
Centers for Disease Control and Prevention
Consumer Product Safety Commission
Environmental Protection Agency
Office of Children's Environmental Health
Food and Drug Administration
National Institute for Occupational Safety and Health
National Institute of Environmental Health Sciences
National Institutes of Health
National Cancer Institute
National Institute of Nursing Research
Occupational Safety and Health Administration
National Library of Medicine—TOXNET

State Agencies

State Health Departments
State Environmental Protection Agencies

Associations and Organizations

American Association of Poison Control Centers
American Association of Occupational Health Nurses
Association of Occupational and Environmental Clinics
Beyond Pesticides
Center for Health and Environmental Justice
Children's Environmental Health Network
Environmental Defense
Environmental Working Group
Health Care Without Harm
National Environmental Education Foundation
Natural Resources Defense Council
Pediatric Environmental Health Specialty Units
Society for Occupational and Environmental Health

research expertise, sit on commissions, write articles, and take national leadership roles. All nurses can include environmental exposures in their history taking; consider the environmental impacts of the products they select for their clinics, hospitals, schools, and other settings; promote recycling and reuse of products; and promote environmentally preferable purchasing. Each type and level of engagement is important. The following are some ways in which nurses can get involved both professionally and as informed citizens:

- *Community involvement/public participation.* Organizing, facilitating, and moderating; making public notices effective and public forums accessible; welcoming input. Making information exchange understandable and problem solving acceptable to culturally diverse communities are valuable assets a nurse contributes. Skills in community organizing and mobilizing can be essential for a community to have a meaningful voice in decisions that affect them.
- *Individual and population risk assessment.* Using nursing assessment skills to detect potential and actual exposure pathways and outcomes for clients cared for in the acute, chronic, and healthy communities of practice.
- *Risk communication.* Interpreting, applying principles to practice. Nurses may serve as skilled risk communicators

within agencies, working for industries or working as independent practitioners. Amendments to the Clean Air Act require major industrial sources of air emissions to have risk management plans and to inform their neighbors of specifics of the risks and plans (Clean Air Act, 1996).

- *Epidemiologic investigations.* Nurses need to have the skills to respond in scientifically sound and humanely sensitive ways to community concerns about cancer, birth defects, and stillbirths when citizens fear environmental causation.
- *Policy development.* Proposing, informing, and monitoring action from agencies, communities, and organization perspectives.

The assimilation of the concepts of environmental health into a nurse's daily practice gives new life to traditional public health values of prevention, community building, and social justice. Box 10-14 presents the work of three nurses currently working in environmental health.

As nurses learn more about the environment, opportunities for integration into their practice, education programs, research, advocacy, and policy work will become evident and will evolve. Opportunities abound for those pioneering spirits within the nursing profession who are dedicated to creating healthier environments for their clients and communities.

BOX 10-14 Examples of Three Modern-Day Environmental Health Nursing Pioneers

In Baltimore, MD, **Dr. Claudia Smith** (a nurse who is on the faculty at the University of Maryland) directed a project in which nurses worked with community members to address a variety of health problems associated with poor housing conditions. For this project, which was funded by the U.S. Department of Housing and Urban Development, Dr. Smith hired and trained community members to assess and reduce unhealthy conditions caused by lead-based paint, high levels of carbon monoxide, and asthma triggers (e.g., dust mites, pet dander, and pests); she taught community members about safer choices for pest control using the least toxic approach to pest management by using an integrated pest management approach.

After **Denise Choiniere**, a graduate student in community health who was working in the cardiac care unit (CCU) at the University of Maryland Medical Center, learned about the health effects associated with heavy metals, she was very uncomfortable with simply throwing away the batteries that were used in the many small devices, such as Holter monitors. Instead, she developed a battery recycling program for the CCU and the telemetry unit. She then discovered that her hospital purchased 97,000 small batteries every year. Each of these small batteries contains a heavy metal—mercury, lithium, cadmium, or lead. She was the driving force in developing a hospital-wide, small battery recycling program. This activity created a whole new career trajectory for Ms. Choiniere, who was recently appointed to the executive position of Sustainability Coordinator for the whole hospital. She has since addressed green cleaning products, promoted the recycling of “blue wrap” used in the operating rooms, and organized a farmers’ market that meets weekly in front of the hospital, thus bringing locally grown and sustainably farmed products to hospital employees and the surrounding community. She then was given oversight for all of the 650-bed hospital’s purchases.

Dr. Robyn Gilden is a nursing faculty member who worked for 5 years with communities that knew or suspected that they were living near a hazardous waste site. She learned about the many laws and agencies involved in hazardous waste site assessments and clean-ups. Hazardous wastes can affect soil, water,

and air. Sources of contamination may come from old, unlined landfills; uncontrolled dump sites; spills or discharges from industry; leaking underground storage tanks (like gasoline tanks); or runoff from fields. The Agency for Toxic Substances and Disease Registry (ATSDR), a federal agency responsible for documenting the health hazards associated with environmental exposures, maintains a listing of the most problematic contaminants found at polluted sites. They include a wide range of highly toxic chemicals including arsenic, lead, mercury, vinyl chloride, benzene, polychlorinated biphenyls (PCBs), and cadmium. These toxic chemicals top the list because they are the most commonly found contaminants and pose a significant threat to human health based on routes of exposure and level of toxicity. Dr. Gilden learned about the resources that are available for the best and most current toxicological information. The National Library of Medicine’s TOXNET and ATSDR’s websites, including their ToxFaq’s, are some of the best sources of navigable information.

In working with communities, Dr. Gilden met with government officials, including mayors of small towns, as well as concerned parents, people from local governments, health departments, educational institutions, businesses, developers, bankers, realtors, and other community members. She has also learned about the many statutes that cover hazardous waste sites, such as the Superfund legislation (which covers the most polluted waste sites) and Brownfields legislation (which covers contaminated sites where economic development is involved). Both these pieces of legislation mandate community involvement, which is where Dr. Gilden’s community health and risk communication skills are used. Regardless of who is responsible for or in charge of a contaminated site, the nurse understands that the community must be an active and equal participant. It is the community members who will be impacted by decisions and have to live with the results of clean-up and redevelopment. As is true of most nurses, Dr. Gilden quickly became a trusted person to the community members.

When she discovered the “Pesticide Warning” signs on the playing fields where her children played sports, this launched Dr. Gilden into a new area of research and advocacy regarding children’s exposures.

PRACTICE APPLICATION

Following are two case scenarios related to exposure pathways. The first involves lead poisoning and the second, fracking-related concerns.

At the county health department, a 3-year-old boy named Billy presents with gastric upset and behavioral changes. These symptoms have persisted for several weeks. During your history taking, you discover that Billy's parents have been renovating their old home. A parent in Billy's daycare center suggested that Billy's symptoms might be associated with lead, so Billy's parents have brought him in to the clinic.

You relay this information to the primary care practitioner who, in turn, orders a blood lead level, which comes back at 45 mcg/dL. This is a very high value.

You research lead poisoning and discover that there are many potential health effects of lead exposure and that children are at greatest risk because their bodies, especially their nervous systems, are still developing. You also find that chronic lead poisoning may lead to long-term effects, such as developmental delays and impaired learning ability.

You let the health professional know about the lead poisoning specialists in the nearby children's hospital. On further investigation, you find that Billy's home was built before 1950 and is still under renovation. Billy should not return to the home. At this point, the sanitarian from the local health department tests the dust in the home and finds high lead levels. Because of Billy's age and associated behaviors, such as

hand-to-mouth activities, you determine that the lead dust in the home is the probable exposure. However, you must also consider multiple sources of exposure.

1. What other sources of exposure might exist?
2. What would you include in an assessment of this situation?
3. What prevention strategies would you use to resolve this issue? At the individual level? At the population level?

Mrs. Bell calls the local health department to report that her drinking water, from their private well, is discolored and that her son has been experiencing headaches and nose bleeds. You talk with Dan, the health department's environmental health professional (sanitarian) who tells you that there is new "fracking" activity on the east side of your rural county, where Mrs. Bell and her family live, and that this may be the reason for the water discoloration and the child's symptoms. You look up "fracking" and discover that the word is shorthand for hydraulic fracturing, a new technique for extracting natural gas that is fraught with community and health concerns. (For more information on fracking, see the Resource Section.) Dan and you agree to make a site visit to the Bell's farm.

1. What will you be looking for on your visit?
2. How can you help the Bells, if any of their issues seem to be associated with the nearby fracking site?
3. What other experts are available to you and the Bells?

Answers can be found on the Evolve site.

KEY POINTS

- Nurses need to be informed professionals and advocates for citizens in their community regarding environmental health issues.
- Models describing the determinants of health acknowledge the role of the environment in health and disease.
- Climate change is creating profound risks to human health globally and in the United States.
- For most chemicals in our homes, work, schools, and communities, no research has been completed to determine whether or not they will cause health effects.
- Prevention activities include education, reduction/elimination of exposures, waste minimization, energy policies, and land use planning.
- Pollution control activities include use of technologies; environmental permitting; environmental standards, monitoring, compliance, and enforcement; and clean-up and remediation.
- Each nursing assessment should include questions and observations concerning potential and existing environmental exposures.
- Useful environmental exposure data are difficult to acquire. Those data that exist can be used to aid in the assessment, diagnosis, intervention, and evaluation of environmentally related health problems.
- Both case advocacy and class advocacy are important skills for nurses in environmental health practice.
- Risk communication is a critical skill and must acknowledge the outrage factor experienced by communities with environmental hazards.
- Federal, state, and local laws and regulations, as well as international treaties, exist to protect the health of people from environmental hazards.
- Environmental health practice engages multiple disciplines, and nurses are important members of the environmental health team.
- Environmental health practice includes principles of health promotion, disease prevention, and health protection.
- *Healthy People 2020* objectives address both targets for the reduction of risk factors and diseases related to environmental causes.

CLINICAL DECISION-MAKING ACTIVITIES

1. Explain why the source of drinking water is important to investigate in the assessment of an unusually high number of infertility cases in a community; in increased lead levels in children from a certain school; and in an outbreak of a gastrointestinal epidemic in an agricultural community.
2. Discuss the use of the epidemiologic triangle in explaining the determinants of health.
3. Discover if your jurisdiction has a law or regulation for the disclosure of lead-based paint or radon levels for personal property as part of the act of sale for real estate. If your community does not, investigate with the government officials of the community the reasons for the lack of a disclosure requirement.

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Genomics in Public Health Nursing*



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ADDITIONAL RESOURCES

 **Evolve Website** <http://evolve.elsevier.com/Stanhope>

- Healthy People 2020
- WebLinks
- Quiz

- Case Studies
- Glossary
- Answers to Practice Application

OBJECTIVES

After reading this chapter, the student should be able to do the following:

1. Define key terms related to genetics and genomics.
2. Discuss the history of genomics and its integration into public health nursing.
3. Describe the relationship between genomics, genetics, and nursing.
4. Explain the core competencies related to genomics that nurses and selected other public health professionals should integrate into their practice.
5. Describe at least three potential implications of persons knowing their genetic information on clients, families, and communities.

KEY TERMS

DNA, p. 245

epigenetics, p. 253

family health history, p. 251

genes, p. 245

genome, p. 243

genomics, p. 243

genetics, p. 243

genetic susceptibility, p. 254

Human Genome Project, p. 244

multifactorial diseases, p. 253

mutations, p. 245

pedigree, p. 251

—See Glossary for definitions

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