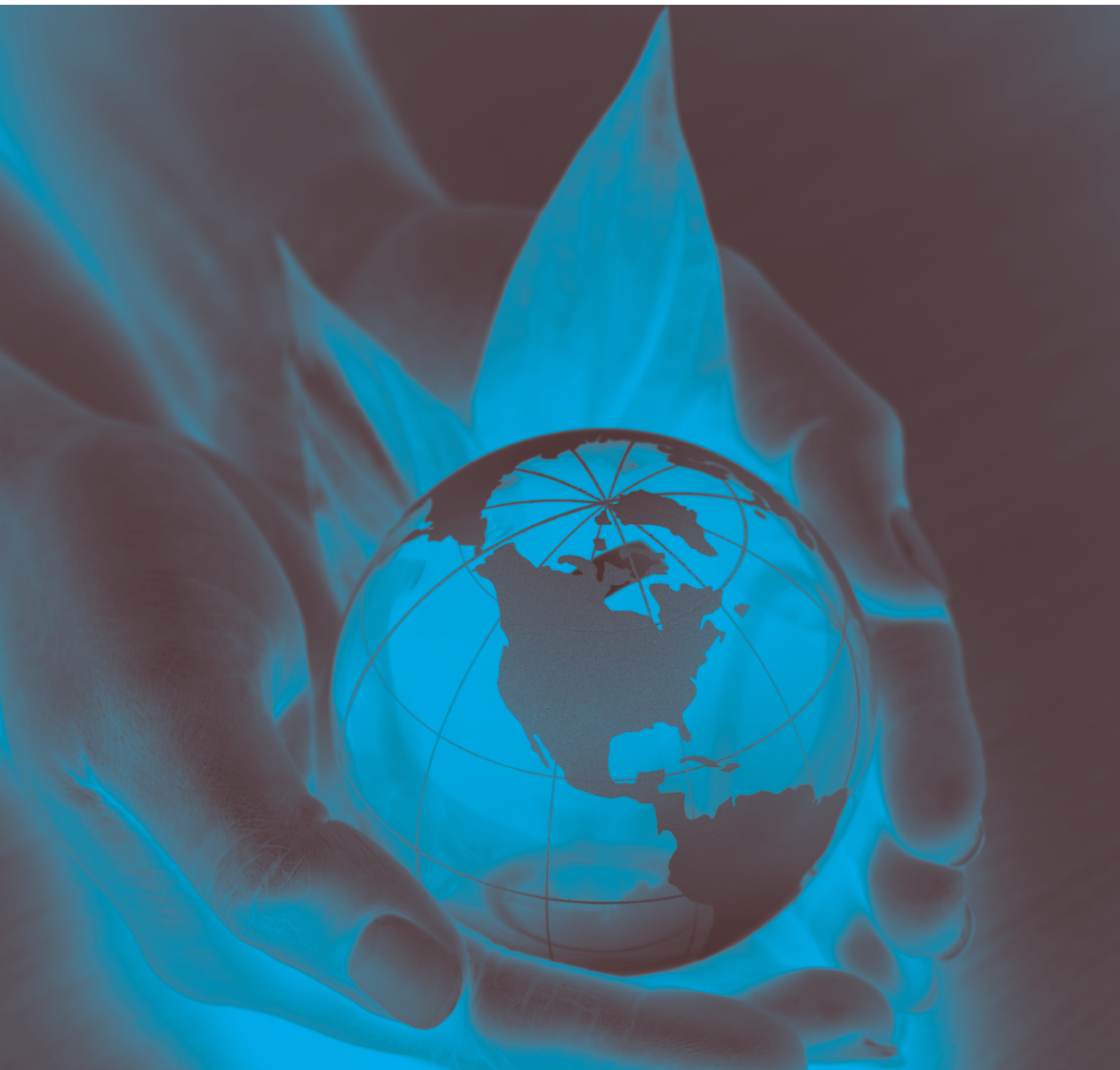


# The Local Board of Health Environmental Health Primer

*Second Edition*



**N A L B O H**

National Association of Local Boards of Health

**The Local Board of Health  
Environmental Health Primer  
Second Edition**

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## Foreword

The National Association of Local Boards of Health (NALBOH) is pleased to provide *The Local Board of Health Environmental Health Primer, Second Edition*. For the first edition, NALBOH collaborated with faculty of environmental health programs to develop the *Primer* for local board of health members. For the second edition, NALBOH staff and NALBOH's Environmental Health Subcommittee identified key passages that needed updating and revision. The Environmental Health Services Branch of the Centers for Disease Control and Prevention (CDC), National Center for Environmental Health (NCEH), has encouraged the project and provided technical oversight and support. The publication was supported by Cooperative Agreement Number 5U38HM000512. Its contents are solely the responsibility of the authors and do not represent the official views of the Centers for Disease Control and Prevention.

Local boards of health are responsible for assuring the provision of adequate public health services in their communities, including protecting a community from environmental health risks. A board of health's role is to:

- **Assess** a community's environmental health needs.
- **Develop or recommend** policies and programs to meet a community's environmental health needs.
- **Assure** that the personnel, training, and resources are available to support necessary environmental health programs.

This responsibility is a dynamic one. Needs change, the scientific knowledge base grows, and regulatory requirements are modified. Periodic evaluation and implementation of responsive program modifications are vital to ensure that community environmental health needs are met.

### Reference Materials

At the end of each chapter, reference materials are provided for a variety of technical and regulatory documents. Of particular importance are the following resource guides and tools.

First, the *Healthy People 2020* national health objectives, published by the U.S. Department of Health and Human Services, include a range of environmental health goals for both local and national communities. The chapters on environmental health, food safety, and injury and violence prevention, among others, may help local boards of health set appropriate objectives for environmental health promotion and disease prevention. *Healthy People 2020* and related publications, including comparative health data, may be downloaded or ordered from the U.S. Department of Health and Human Services' Healthy People website at [www.healthypeople.gov/](http://www.healthypeople.gov/).

Second, boards of health may wish to explore the environmental health assessment tool developed by the National Association of County and City Health Officials (NACCHO). The Protocol for Assessing Community Excellence in Environmental Health (PACE-EH) is designed to help local boards of health and local public health agencies measure a community's environmental health status and needs. PACE-EH may be ordered from the NACCHO website at [www.naccho.org](http://www.naccho.org).

Finally, the Division of Emergency and Environmental Health Services at CDC's National Center for Environmental Health developed the Environmental Public Health Performance Standards (EnvPHPS) as a compliment to the National Public Health Performance Standards. The EnvPHPS describe the level of performance and capacity to which all environmental health systems (EH systems) and programs should aspire. The EnvPHPS include the

Environmental Public Health Self-Assessment Instrument. The results of the self-assessment can be used to determine what action is needed to successfully fulfill the 10 Essential Environmental Public Health Services, which serve as the framework for the EnvPHPS. Boards of health can use the EnvPHPS to improve collaboration, identify strengths and gaps of environmental health programs that can be addressed through quality improvement efforts, as a benchmark for environmental public health practice improvements, or to collect data that can be used for policy development or advocacy. More information can be found at <http://www.cdc.gov/nceh/ehs/envphps/>.

### **How to Use This Primer**

Your health department employs or contracts with professional staff to carry out board of health policies and regulations. In some cases, board members themselves may be called upon to implement policies. It is our belief that the *Primer* will provide useful assistance as you address your community's environmental health issues.

As issues emerge, the *Primer* should serve as a resource to identify key responsibilities and concerns related to boards of health. For more comprehensive coverage of these issues, technical resources should be consulted. The second edition of the *Primer* includes factsheets and PowerPoint presentations that can be used at board of health meetings for educational purposes.

We hope you find it helpful reading.



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## Executive Summaries

Based on extensive consultations with board of health members and environmental health experts, 11 topic areas were identified to include in this *Primer*. Each chapter serves as a stand-alone resource. The chapters are not in-depth or technical, as their intended audience is policy makers rather than technical staff. A brief summary of each chapter follows.

### **Air Quality**

Ambient (outdoor) air quality standard setting and regulatory enforcement are primarily federal and state level responsibilities. National standards have been established for six ambient air contaminants. All local areas must ultimately be in compliance with those standards. Local health departments may be actively involved in helping to implement and maintain community programs to meet specific air quality objectives. Additionally, local health departments can proactively identify and address specific concerns within their jurisdictions, including issues that fall outside of any formal regulatory programs.

Much less comprehensive regulatory programs govern indoor air quality, making local board of health involvement an important factor in protecting public health. Asthma rates in children, radon gas, mold growth, carbon monoxide, sick building syndrome, and air quality at specific places such as schools or indoor pools are all examples of problems that boards of health should monitor and address in their communities. Boards of health can also focus on indoor air quality by promoting and implementing healthy homes programs, which take a holistic approach to address the myriad of problems or risks associated with unsafe housing. The decisions of local boards of health determine the level of involvement by their health departments, directly affecting the quality of air in their communities.

### **Food Safety**

Local health departments play a central role in protecting the public from food-borne illnesses. A local health department is usually responsible for licensing and inspecting food service facilities. Effective food safety programs at local health departments include a solid regulatory framework with an effective enforcement strategy; comprehensive licensing and permitting criteria; a monitoring and inspection program; a surveillance and investigation program; ongoing education and training for food service workers, consumers, and health agency staff; a communication and public relations strategy; regular program assessment; and an effective, knowledgeable, and proactive local board of health.

The components of an effective food safety program are strengthened by having an effective and proactive local board of health. Boards of health are responsible for assessing the current food safety program, creating policy, allocating sufficient resources, providing effective oversight of the program, identifying measurable objectives, conducting regular program assessments, maintaining enforceable regulations, providing a policy and procedures manual, establishing a strong relationship with the health officer, and securing adequate and qualified staffing levels.

### **Drinking Water**

Preventing waterborne disease is a key public health concern. Separating drinking water supplies from wastewater containing microbiological contaminants is crucial to protecting public health. Chemical and radiological contamination also can adversely affect water supplies and present unique problems for detection and mitigation efforts.

Local health departments are often called upon to respond to perceptions of inadequate water quality, independent of regulatory responsibilities. Rural areas supplied by wells and other local water supplies typically lack routine quality monitoring programs. Local health departments are often responsible for regulating wells and other local sources prior to new construction, but have no regular system for maintaining adequate quality after an initial inspection. People are often surprised to learn that there is no formal protection governing contaminants possibly present in the water used in their homes. Local boards of health have an opportunity to make an enormous contribution by developing policies that provide individuals without access to a municipal system with the education and tools needed to protect their individual water systems.

Local boards of health also have an important role to play in areas with municipal water supplies. For example, boards of health and health departments must be prepared to respond to emergency situations, to investigate disease outbreaks that may be water linked, and to provide leadership about drinking water issues, such as fluoridation. Active involvement of local boards of health is essential to providing the high quality water supply necessary to maintain excellent public health.

### **Wastewater**

Local boards of health are often responsible for providing oversight, assessment, and evaluation of private home sanitary wastewater treatment programs. In rural areas, local health departments are often the only direct regulatory authority. However, this direct control is typically limited to initial on-site wastewater disposal (septic) system permitting and installation. Following installation, operations usually are not systematically monitored and maintenance is voluntary. Unsurprisingly, performance tends to vary widely. Health departments are often the lead agency responding to nuisances created by malfunctioning local systems.

In urban areas, sanitary wastewater is usually managed through a centralized system that incorporates the use of a wastewater treatment plant. Regulatory responsibilities are primarily those of the municipality following state and federal rules. Local health departments typically do not have a formal role in municipal wastewater management. However, should a real or perceived problem occur, a local health department often will be called first. Thus, it is important for local health departments to be familiar with the wastewater treatment systems in their communities. Moreover, if a health problem occurs, it is vital for local health departments to identify potential illness sources, including exposure to wastewater.

Economic development carries with it a burden to plan for wastewater disposal. Local boards of health have much to offer the planning process. Many communities now face problems related to wastewater control where a lack of planning has resulted in adverse situations with no simple remedies. Local boards of health have the opportunity to lead their departments in proactively addressing wastewater generation, treatment, and disposal issues.

### **Solid Waste**

Local boards of health often have a primary role in assuring the proper management of solid wastes. These responsibilities can include regulation and licensure of waste management facilities. In addition, health departments may partner with other agencies, companies, and the public in providing services affecting solid waste. These may include programs to increase recycling, to encourage the reduction of waste being generated, and to help obtain support (or at least minimize opposition) to new waste management facilities being located in a community. Frequently, boards of health play a key role in the development of new solid waste facilities, landfills, and transfer stations. Providing appropriate information to the public and a proper hearing process to allow for comment and review of the permit process is essential.

An important policy decision for a board of health is the appropriateness of moving beyond mandated regulatory roles and working as a community leader in promoting comprehensive waste management systems.

### **Hazardous Waste**

Hazardous waste can be found almost anywhere in a community. A complex regulatory structure formally governs hazardous waste management and largely excludes local health departments from having primary responsibility. Yet, numerous incidents of exposure resulting in substantial adverse health effects demonstrate the need for local health department involvement.

Local boards of health help provide leadership in protecting their communities from hazardous waste. This may include such activities as:

- Contributing to pollution prevention and waste minimization programs.
- Implementing or supporting household hazardous waste collection programs.
- Being a partner during emergency response incidents.
- Investigating disease outbreaks that may be linked to hazardous waste exposure.
- Helping with zoning and other methods for encouraging compatible land uses.
- Working with the community to ensure proportionate distribution of chemical pollution and waste treatment facilities within a community (e.g., not disproportionately affecting minority or low-income neighborhoods).

### **Vector Control**

Vectors transmit disease-causing agents by mechanical or biological mechanisms. For example, mosquitoes act as vectors to transmit West Nile Virus and ticks transmit Lyme Disease. Local health department vector control programs involve surveillance of outbreaks (or potential outbreaks), public education about disease vectors, prevention of vector growth and development, reduction of adult vector populations, and, occasionally, immunization of susceptible hosts. It is critical that local boards of health provide resources for their health departments to fully accomplish the objectives of these programs.

Boards of health should ensure that their communities employ Integrated Pest Management (IPM) practices. IPM is an environmentally-aware approach to pest management, combining an array of common-sense practices that ultimately have the potential to reduce the need for pesticides and avoid unnecessary economic and environmental damage.

### **Injury Prevention**

Boards of health have regular involvement with a diverse number of programs, both through regulatory responsibilities and because of the need to provide protection for unregulated activities or conditions. In this chapter, discussion focuses on programs that also are important to the role of the health department. Specifically, attention is turned to programs for injury prevention, occupational health and safety, recreational waters, and radiation.

In addition, recognition is given to the need for local boards' vigilance in ensuring that their departments respond to new threats to public health. For example, the popularity of tattoos and body piercing has led to an increased

role in providing for protection from needles that potentially harbor disease-causing organisms. Threats to public health can be very localized, and boards of health face challenges in ensuring that they provide the leadership necessary to meet the particular needs of their communities.

### **Risk Assessment, Management, and Communication**

People often turn to health departments to learn if something is “safe.” While apparently a simple question, it really involves the process of integrating the likelihood of an event with the consequences of that event. But knowing the probability that something will happen is only a first step (albeit an important one) toward understanding risk. Risk assessment must be followed by risk management, or the process of identifying, evaluating, and implementing intervention strategies.

Local boards of health have a responsibility to assure their health departments are correctly addressing their communities’ most critical problems. Risk assessment is a vital tool in determining priorities. Moreover, the public often wants to be an integral part of that prioritization process and the board of health plays a key role in providing the opportunity for meaningful input.

### **Epidemiology**

Epidemiology is the study of the distribution and determinants of health-related states or events in specified populations and the application of this study to control health problems.

Local health departments need to investigate disease outbreaks, prevent environmental conditions conducive to adverse health outcomes, and thoroughly understand the relationship between environmental conditions and public health outcomes. To accomplish these missions, environmental health staff needs to have a thorough understanding of the use of epidemiology as a research tool.

Epidemiology is particularly useful in determining statistically valid relationships between disease and environmental conditions. Local boards of health should ensure that it is used appropriately in decision making and policy development.

### **Management Tools: Environmental Policy, Law, and Administration**

Local health departments help their communities through programs and policies that prevent disease and promote good health. Boards of health can use community health assessments, health impact assessments, strategic planning, and evidence-based programs as important decision-making tools for program and policy development.

Board of health members are actively involved in the process of creating new or revising existing public health policies. It is important that boards of health have an understanding of the law, including the Constitution, state statutes, and local codes and regulations. Boards of health should know where their power is derived from and whether they have advisory, policy-making, or governing authority, or some combination of the three.

### **Conclusion**

Through their roles in developing, recommending, and implementing policy, local boards of health have a primary responsibility to protect the health of the public. These policies may involve providing regulatory services, including direct permitting and inspection of facilities. Many environmental health problems fall under the control of other agencies at state and national levels. However, lacking formal responsibility for an environmental health program does not eliminate the need for active local health department involvement.



Boards of health provide leadership in enabling their departments to meet specific regulatory obligations and in fulfilling a more holistic mission of comprehensive protection of their communities' health. Focusing only on the first of these roles would leave no agency with the comprehensive responsibility for the health of the public within a community. Assuming a broader role not limited to regulatory mandates gives the public confidence that their local health department is working in their best interest and is a good community partner.

Boards of health influence how ambitious local health departments are in protecting their communities. Some boards may choose to do the minimum—responding to regulatory requirements and reacting only as requirements change. However, health departments are well suited to understand emerging problems and to respond proactively. In addition, most state and federal environmental agencies have regulatory programs that are limited in scope to particular issues (e.g., air quality or water quality) or have limited objectives. Local boards of health can act across a variety of issues, work within a network of interests, and keep health, rather than the attainment of regulatory standards, as their primary objective.

With support from the Centers for Disease Control and Prevention, NALBOH prepared this *Primer* to provide boards of health with essential information useful in guiding and developing the capacity of their health departments to protect the public's health. The success of local health departments is enhanced greatly by the informed leadership of their boards. Local health departments historically have played key roles in protecting their communities—new challenges have only increased the need for their active local involvement. This *Primer* will help local board members make a difference within their own communities and make a difference in people's lives by providing an environment promoting good health.





# Air Quality

## Introduction

We breathe air every minute of every day. Breathing is a continuous route of exposure to potential health stressors. Compared with other environmental media, such as water and food, individuals have far less control over the quality of the air they breathe. The continuous exposure, lack of control, and possible negative health outcomes from exposure to poor quality air makes air quality an important environmental health concern.

Air quality issues can be regulated, monitored, and enforced at the local, state, and/or federal levels. Local boards of health and health departments may be involved in overseeing efforts to achieve federal air quality standards or in the implementation of state plans for meeting federal requirements, which could include the monitoring, enforcement, and administration of air quality management plans. This level of involvement is often the case for health departments in and around metropolitan areas, where federally targeted air pollution issues are a problem. In addition, boards of health and health departments can proactively identify and address specific concerns within their jurisdictions. Some local boards are aggressively involved in issues such as radon in the home, odor management, and indoor air quality problems subsequent to flooding.

In the past, citizens in rural areas rarely needed to address the air quality issues emphasized by federal or state programs. Today, however, they may have to address a specific source of pollution in their area or address air quality nuisance complaints, such as odor or visibility issues. In addition, the long-range transport of some pollutants and the proliferation of automobiles have brought air pollution from these sources to remote areas. Local agencies everywhere have to face a range of air quality issues, including emissions from factories, vehicles, and agriculture, and air quality in homes. Air quality is characterized by identifying the pollutants that are present in the air, the levels or concentrations of those pollutants, and the period of time that the concentrations last. Boards of health need to have a general understanding of how air pollution sources, weather, and mechanisms of dispersion work together to affect air quality. They also need to understand the different approaches to controlling air pollution, technology, and policy efforts. Understanding how these factors interact will enable boards of health to appropriately address air quality issues, whether they are linked to state and federal regulations or arise from unique situations within the jurisdiction of the board.

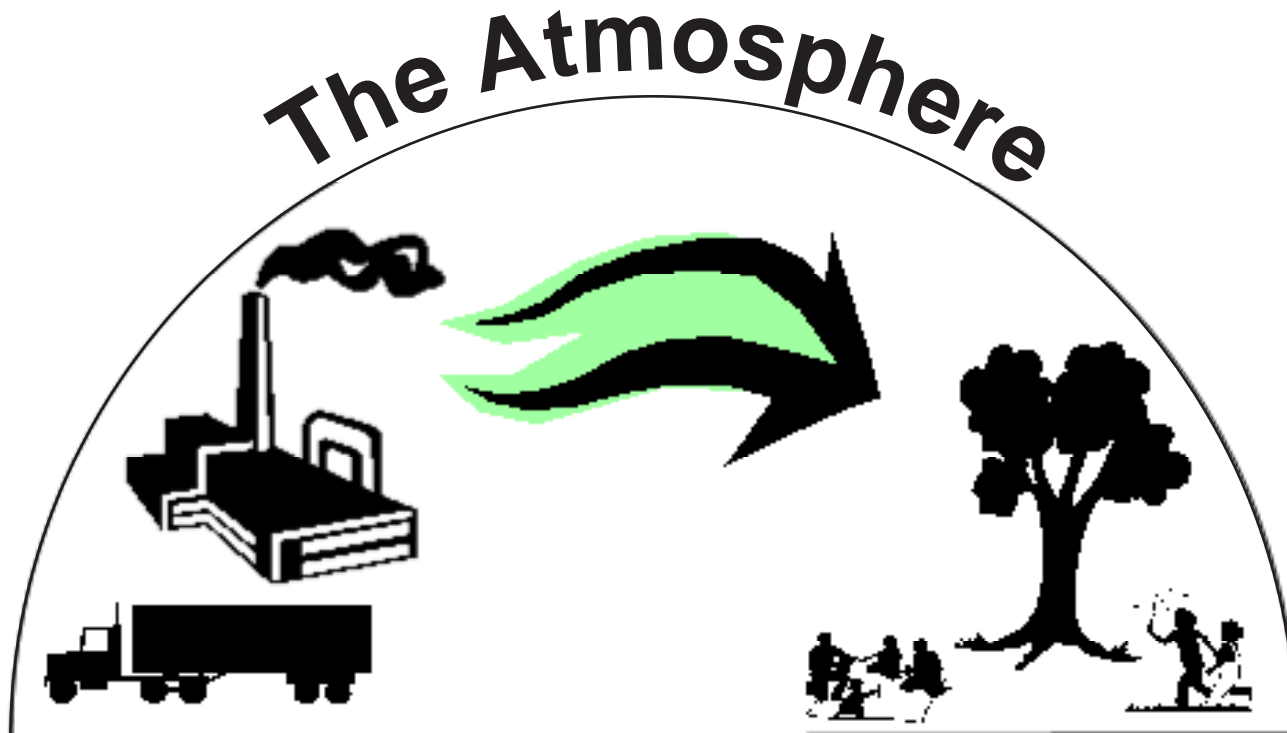
This chapter looks at two general realms of air quality: outdoor air, sometimes called ambient air quality, and indoor air quality (IAQ).

## Outdoor Air Quality

Figure 1 on page 8 illustrates the components that interact in determining air quality. Sources emit pollutants into the air. These sources can be stationary (e.g., a factory) or mobile (e.g., vehicles). Combustion processes, such as steam production, coal fire, electricity generation, and process boilers, are major contributors to stationary sources of air pollution emissions. Mobile sources of air pollution, such as internal combustion engines and fuels used by automobiles and trucks, contribute up to 50% of the pollution that results in smog and 90% of the carbon monoxide in urban areas. Although automobiles built today are 60-80% less polluting than those made in the 1960s, the increase in the total number of vehicles diminishes the benefit of improved technology.

In addition to being classified as stationary or mobile, sources of pollution can be described as point sources or area sources. Pollution from a specific location, such as a smoke stack, is called point source because the pollution can be traced to a specific site. Area sources have a less distinct point of release. A refinery is an example of an area source because the combination of many points of pollutant release, some quite small, contributes to the overall

**Figure 1** The atmospheric pollution system: Sources, pollution transport, and receptors.



emissions from a refinery. Identifying each individual release point would be extremely difficult, so the entire complex is often considered an area source. Waste lagoons at animal production facilities are another example of area sources. The entire surface of a lagoon emits pollution. The amount of pollutants that are emitted over time is the basis for the permits and the characterization of sources. Local agencies may be involved in issuing permits for sources, allowing a certain level of emissions, and making sure that those permitted levels are not exceeded.

The concentration of pollution is very high close to the point of release. Once emitted into the atmosphere, weather and other factors dilute the pollution and transport it to other regions. The transported air pollution can affect humans, animals, plants, and ecosystems, usually at a lower concentration than the concentration at the source. The reduced level of concentration results from many factors, including how far the person, animal, plant, or ecosystem is from the source; the wind speed and wind direction; the atmospheric stability; and other weather factors. Computer models, which can be used to make policy, help predict exposures based on these varying factors.

Boards of health and health departments need to be concerned about the local level of air pollution, often called the ambient concentration. The United States Environmental Protection Agency (USEPA) has identified concentrations of key pollutants that should not be exceeded. Local agencies may be involved in monitoring outdoor concentrations to determine public health risks and to demonstrate compliance with the federal regulations.

### *Health Effects*

Exposure to air pollution has a number of health effects for humans, animals, plants, and ecosystems. As with any environmental exposure, the effects depend on the concentration, duration, and frequency of the exposure. Boards of health and health departments are primarily concerned with the effect of air pollution on people; however, they may also be concerned with its impact on vegetation, crops, animals, and bodies of water. This section will focus on human health effects.



Because people breathe in air pollutants through the lungs, many of the resulting health effects are seen in the pulmonary system. Short-term, high-level exposures decrease lung function. Although generally reversible, during a period of increased air pollution decreased lung capacity contributes to increases in hospital admissions and emergency room visits for a variety of diseases (e.g., lung- and heart-related diseases) and can aggravate existing diseases such as asthma. In extreme cases, premature death may result. For example, in December 1952, London, England, experienced a very severe air pollution episode. Hundreds of deaths were attributed to the pollution, many the result of exacerbation of existing conditions. The worst air quality event in the United States happened between October 26 and 31, 1948 in Donora, PA. Twenty people were asphyxiated and 7,000 became ill as a result of severe air pollution over Donora. The pollution was a result of thick smog created by a temperature inversion and high amounts of factory smoke. More recent events demonstrate health problems that can arise from air quality as well. It is estimated that as many as 25,000 people have developed asthma after being exposed to dust in the air from the World Trade Center falling during the terrorist attacks on September 11, 2003.

To help alert the public to short-term air pollution effects, the USEPA published the Air Quality Index (AQI) Reporting Final Rule in August 1999. The AQI is used to report daily air quality conditions to the public. Based on the concentrations of pollutants that produce short-term effects, a value is generated (100 is equivalent to the allowable level) and is accompanied by an air quality descriptor (see Table 1). Reporting of the AQI is required for metropolitan areas with populations greater than 350,000. A useful tool for the AQI is the “Interactive AQI Calculator” program, which is available on the USEPA AIRNOW website at [www.epa.gov/airnow](http://www.epa.gov/airnow). This program not only calculates the AQI and identifies susceptible groups and health effects but also suggests cautionary language to use in reporting. For example, if the allowable level for ozone is 109, i.e., “Unhealthy for Sensitive Groups” (identified as “children and people with asthma”), the recommended cautionary language is: “Active children and adults and people with respiratory disease, such as asthma, should limit heavy outdoor exertion.” Local or regional agencies are often responsible for monitoring and issuing the daily AQI.

AQI reports can be distributed to the local media (newspaper, TV, radio), issued on an accessible website, or be given via a recorded telephone message. An AQI report must include the reporting area, the reporting period, the critical pollutant, the AQI, the category descriptor and associated color, and appropriate warnings for sensitive populations when the index value exceeds 100.

**Table 1** Air quality index, category index values, and descriptor.

Index	Values	Descriptor Color
0 – 50	Good	Green
51 – 100	Moderate	Yellow
101 – 150	Unhealthy for Sensitive Groups	Orange
151 – 200	Unhealthy	Red
201 – 300	Very Unhealthy	Purple
301 – 500	Hazardous	Maroon

When the AQI reaches a value of 100 or higher, people with lung disease, children and older adults, and people who are active outdoors should limit or avoid all outdoor exertion. Ozone can make it more difficult to breathe deeply and rapidly, cause shortness of breath and coughing, inflame the lung lining, increase frequency of asthma attacks, and continue to harm lungs even after symptoms desist. Recommendations to help improve air quality include conserving energy, carpooling or using public transportation, limiting engine idling, keeping car engines tuned up, and using environmentally safe paints and cleaning products. When it is a high ozone day, recommend that individuals refuel cars after dusk, when emissions are less likely to produce ozone, and delay using gas powered lawn and garden equipment as well as household or garden chemicals until air quality has improved. Boards of health should oversee that public messaging about air quality is occurring in their communities, especially messages that target vulnerable or at-risk populations.

Long-term exposure to moderately increased concentrations of pollutants can produce effects such as increased rates of pulmonary infections and chronic bronchitis. Certain air pollutants have specific systemic toxic effects. For example, exposure to lead has been linked to low IQ in children, nervous system effects, and kidney and liver damage. Lead, however, is a success story for air quality improvement efforts. Lead used to be a significant outdoor air pollutant, but the phase-out of lead from gasoline and the subsequent reduction in levels of airborne lead have been major contributors to the drop in the number of children with elevated blood lead levels.

Other pollutants can cause organ disease, cancer, and reproductive problems. The health effects of specific pollutants can be found in *The Health Effects Notebook for Hazardous Air Pollutants* on the USEPA Unified Air Toxics website at <http://www.epa.gov/ttn/atw/hlthef/hapindex.html>.

### *Regulatory Classes of Air Pollutants*

National Ambient Air Quality Standards (NAAQS), set by the USEPA, are health-based standards for air pollutants considered harmful to public health and the environment. These standards are divided into two categories: primary and secondary. Primary standards protect public health, including the health of “susceptible” groups, such as the young, old, and ill. Secondary standards preserve public welfare issues, such as maintaining visibility and decreasing plant, animal, and structural damage.

Six common pollutants make up the NAAQS (see Table 2). Also known as criteria pollutants, these six air pollutants are used to characterize the air quality of an area. They are measured in parts per million (ppm) by volume, milligrams per cubic meter of air ( $\text{mg}/\text{m}^3$ ), and micrograms per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ).

For areas not in compliance with the NAAQS, the USEPA requires a state implementation plan (SIP) detailing how the state will return to compliance. While the NAAQS characterize regional patterns of air quality, local patterns from specific sources may be independent of broader geographical air quality issues. For local air quality, the USEPA developed the Hazardous Air Pollutants (HAP) list of air pollutants that are associated with serious health effects, such as cancer, organ disease, and reproductive effects, and that are regulated at the emission level.

### *Regional Air Pollution Issues*

Some air pollutants are not emitted directly from a source. Rather, they are formed in the atmosphere as a result of chemical reactions. Many of these reactions take time, and as a result, these pollutants, sometimes called secondary pollutants, have impacts far downwind of the initial precursor release. Two examples of this are ozone, a main component of smog, and acid particles that contribute to acid rain. For example, high ozone levels in the Appalachian Mountains are the result of emissions many miles away. These situations present unique problems to local boards of health since the poor air quality is caused by sources far outside their jurisdiction. Managing air pollution resulting from long-range transport requires regional cooperation.

**Table 2** The National Ambient Air Quality Standards.

Pollutant (abbreviation)	Allowed Concentration	Over (averaging time)
Ozone (O <sub>3</sub> )	0.12 ppm <sup>b</sup> 0.075 ppm <sup>b</sup>	1 hour <sup>b</sup> 8 hour <sup>b</sup>
Carbon Monoxide (CO)	9 ppm (10 mg/m <sup>3</sup> ) <sup>a</sup> 35 ppm (40 mg/m <sup>3</sup> ) <sup>a</sup>	8 hour <sup>b</sup> 8 hour <sup>a</sup>
Nitrogen Dioxide (NO <sub>2</sub> )	53 ppb <sup>b</sup> 100 ppb <sup>a</sup>	Annual <sup>b</sup> 1 hour <sup>a</sup>
Sulfur Dioxide (SO <sub>2</sub> )	0.03 ppm (80 µg/m <sup>3</sup> ) <sup>a</sup> 0.14 ppm (365 µg/m <sup>3</sup> ) <sup>a</sup> 75 ppb <sup>a</sup> 0.50 ppm (1300 µg/m <sup>3</sup> ) <sup>c</sup>	Annual <sup>a</sup> 24 hour <sup>a</sup> 1 hour <sup>a</sup> 3 hour <sup>c</sup>
Particulate matter (PM <sub>10</sub> )	15 µg/m <sup>3</sup> <sup>b</sup> 35 µg/m <sup>3</sup> <sup>b</sup>	Annual <sup>b</sup> 24 hour <sup>b</sup>
Lead (Pb)	0.15 µg/m <sup>3</sup>	Rolling 3 month avg. <sup>b</sup>

<sup>a</sup> Primary standard, <sup>b</sup> primary and secondary standard, <sup>c</sup> secondary standard

Another emerging issue in rural areas is the environmental health effects of large-scale animal production, particularly the issue of animal waste. Although often cited as a water quality concern, there are air quality impacts to consider. Animal manure may be a valuable fertilizer, but its management at large animal production facilities is difficult and leads to a variety of environmental health problems, such as exposure to the gases from the decaying waste either at the jobsite or in surrounding areas and the strong odors from the facility. Operators are increasingly taking efforts to minimize the environmental impacts of their facilities. The United States Department of Agriculture (USDA), state programs, and other agencies are sponsoring research on management practices and technological controls.

### *Regulating Air Pollution*

One of the ways to control air quality is through the use of laws to regulate the allowable levels of emission. The regulations for air pollution are found in the Clean Air Act (CAA) of 1990. The CAA targeted the key issues of urban air pollution problems, hazardous air pollutants, and acid rain. In addition, the CAA created an Air Pollution Operating Permit Program that significantly changed the way states issue permits for air pollution. The program established minimal federal regulations for air emissions, which means that as long as state and local governments meet these requirements, they have the flexibility to create a permit program that works best for their location. As part of the program, the USEPA continues to improve the program by simplifying the permit application, streamlining permit revisions, and involving citizens in the permit review process.

The CAA lists the regulations for the entire country, but states and local or regional agencies are often responsible for implementing the law.

## Indoor Air Quality

The majority of the population of the United States spends 90% or more of its time indoors. Therefore, IAQ has a large potential to affect peoples' health. Boards of health need to develop education and inspection programs addressing indoor air quality. Just as with outdoor air, the pollution sources and the methods of its transport via indoor air affect humans, plants, and animals. Table 3 lists some of the common contaminants and the sources of their introduction to indoor air.

**Table 3** Some typical sources of indoor air pollutants.

Type	Sources	Example Pollutants
Combustion products	Heating Cooking Tobacco smoke	Carbon monoxide (CO) Nitrous dioxide (NO <sub>2</sub> ) Particles
Biologic contaminants	Pets Wet materials Pests	Dander/allergans Mold/fungus spores
Consumer chemicals	Insecticides Cleaning products Adhesives	Numerous pesticides Ammonia Solvents
Furniture and building material	Pressed wood board Furniture Carpet	Formaldehyde Volatile organic compounds (found in paints, varnishes, cleaners, solvents, etc.) Asbestos
Soil gas	Cracked foundation or basement	Radon

Mold growth is one specific contaminant that can acutely decrease indoor air quality. There are hundreds of types of mold that can grow indoors, but they all thrive in damp environments. Mold spores float in the air and can create or exacerbate health problems. Some forms of mold are toxic, while others can trigger asthma attacks or cause stuffy noses, watery eyes, or headaches for those who are allergic. People with chronic lung illness can develop mold infections in their lungs. Certain molds can cause infectious disease, such as histoplasmosis, or toxic effects, such as aflatoxin-induced liver cancer from exposure to this mold-produced toxin in food.

The key to preventing mold growth in a building is to control moisture. Several methods can be taken to reduce moisture and prevent mold growth in a home. Fixing leaks and seepage is a crucial step to reducing moisture. Mold growth can also be reduced by reducing the humidity in a home. Venting bathrooms to the outside, using air conditioners and de-humidifiers, and increasing ventilation in a home are all effective ways of reducing humidity. If there are areas where there are persistent moisture problems, such as by drinking fountains or sinks, do not install carpeting on concrete floors. You can prevent condensation by raising the temperature of areas where moisture condenses. Mold growth or the potential for mold growth can be detected by visual evidence of mold growth, the



discovery of musty odors, and inspection for water staining or damage. Hand-held moisture meters can also be useful to pinpoint areas of potential mold growth.

Because mold grows in wet environments, mold threats can be especially problematic after flooding. Water damaged areas should be dried within 24 to 48 hours to prevent mold growth. Professionals may need to assist in flood clean-up; otherwise, respirators should be worn while cleaning, all surfaces should be cleaned and dried, and any items that became wet and possibly have mold growth but cannot be cleaned should be thrown out. Absorbent materials, such as ceiling tiles, should probably be replaced after mold growth has started. Communities who have experienced flooding should be on alert regarding mold threats. Boards of health can assist in implementing mold education programs after flooding in a community.

Radon is another potential indoor air contaminant with serious consequences. Radon is a radioactive gas that can be naturally found in the ground, and is created by the normal deterioration of uranium in soil. It is odorless and tasteless and can enter homes through crawlspaces, cracks in the foundation, building joints, gaps around pipes, or cavities within walls. Radon can also enter the home through water or building materials, although that risk of contamination is much less than exposure through soil. Breathing high concentrations of radon can increase a person's risk for lung cancer—radon is the second leading cause of lung cancer in the United States. Although radon levels can vary area by area, high radon levels are found in all states.

It is estimated that 1 in 15 homes have elevated levels of radon; however, the only way to determine radon concentration in a home is to get it tested. "Do-it-yourself" home test kits are available or a professional can be hired to perform a test. There are both short-term tests, which tests radon levels for periods between 2 and 90 days, and long-term tests, which measure radon levels for over 90 days. Long-term tests provide a more accurate picture of the year-round radon levels in a home. Radon is measured in Pico curies per liter of air, or pCi/L, and a result of 4 pCi/L or more indicates an unsafe level of radon. The USEPA recommends that a short-term test is taken in homes, and if the results are 4 pCi/L or more, a second short-term or a long-term test should be taken as a follow-up. If the initial short-term test results in high scores, as much as double the 4 pCi/L action level, then the follow-up test should be a short-term test to get results quickly. Radon levels should be tested before and after there are any renovations done to a home, as renovations can alter the radon levels in building.

If radon tests indicate high levels of radon in a home, there are different strategies to mitigate elevated radon levels in a home, and most homes should be able to maintain a level of 2 pCi/L or less. The average home has a radon level of 1.3 pCi/L, and outdoor air levels remain around 0.4 pCi/L. Soil suction strategies, which involve drawing radon from the soil and venting it through a pipe out to the air above your home, are the most popular radon reduction method. Sealing foundation cracks and other openings make soil suction methods work more efficiently. There are also several strategies that can be incorporated into new construction to reduce radon risks. These include building a gas-permeable layer under homes that have slab foundations, placing plastic sheeting over gas-permeable layers or crawlspace floors, sealing and caulking all below-grade openings in the foundation floor, and installing a vent pipe to vent gas through the house to the roof. Many boards of health are providing home radon test kits to the public.

Carbon monoxide is another serious indoor air contaminant. It is a clear, odorless, and tasteless gas that can cause serious health effects or even death without someone knowing it is in their home. Carbon monoxide is created through the incomplete burning of fuels such as gasoline, kerosene, natural gas, wood, or charcoal. Carbon monoxide can enter the air through burning wood in poorly ventilated areas, tobacco smoke, space heaters that use fossil fuel, malfunctioning gas furnaces and water heaters, and car exhaust. Exposure to low levels of carbon monoxide can cause headaches, dizziness, fatigue, mental confusion, and shortness of breath. Higher levels of



exposure can cause severe headaches, dizziness, nausea, weakness, impaired vision or coordination, and symptoms that can be mistaken for the flu. Carbon monoxide causes the formation of carboxyhemoglobin in the blood, which inhibits the body's ability to absorb oxygen. In the direst cases, reduced brain function or death can occur. Certain populations are more at risk for carbon monoxide poisoning, including older adults, children, infants, unborn babies, and those with heart or lung disease.

Many steps can be taken to reduce the levels of carbon monoxide in indoor air, which boards of health and health departments can include in educational programs. Carbon monoxide reduction measures include installing a carbon monoxide alarm near all sleeping areas; never using generators inside homes, garages, or enclosed areas; keeping gas appliances adjusted; installing or using an exhaust fan over gas stoves; having a professional tune up gas furnaces and heating systems annually; and not idling cars in garages. It is also important to educate people about the symptoms of carbon monoxide poisoning and the differences between poisoning and the flu, including that symptoms clear up when individuals are not home.

Formaldehyde can also affect air quality and cause health problems. It is a chemical that is widely used in the manufacture of building materials and household products, such as carpet. Formaldehyde can also be introduced to air through fuel-burning appliances, such as gas stoves, and through environmental tobacco smoke. It is most often found in pressed-wood products that have urea-formaldehyde resins. It is a colorless, pungent-smelling gas which can cause nausea, watery eyes, difficulty breathing, asthma attacks, severe allergic reactions, and can possibly cause cancer. Certain people can develop a sensitivity to formaldehyde. Increased ventilation, especially after introducing pressed wood products to the home or indoor space, can help counter the effects of formaldehyde, as well as reducing temperatures and humidity levels in a home.

Boards of health should be aware of potential air quality problems in very specific places, like indoor public swimming pools. Irritants known as chloramines can build up in the air around swimming pools. Chloramines are a by-product of chlorine disinfection of pools, and are caused when chlorine binds with the sweat or urine from swimmers. Chloramines can cause difficulty breathing, wheezing, lung disease, or asthma. Chloramines can also cause people to develop sensitivities to other irritants, such as fungi or bacteria. Irritants build up when there is poor air turnover in areas around pools. Without adequate fresh air around swimming pools, irritants can accumulate and reach unhealthy levels. Problems with chloramines can be reduced by ensuring that air recycling systems around indoor pools bring in plenty of fresh air and using fans to increase air circulation when pools are in use. Super chlorination can remove by-products from the pool water. Requiring that swimmers take showers before using the pool reduces the amount of body waste entering a pool. Boards of health should also ensure that air quality is monitored at public indoor swimming pools, which are usually licensed by health departments. The indoor air contaminants discussed in this chapter are only a sampling of pollutants that can affect indoor air. For a complete listing of potential contaminants, visit the Agency for Toxic Substances and Disease Registry at <http://www.atsdr.cdc.gov/>.

The ventilation system of a building may bring pollution inside. Poor air exchange systems and insufficient amounts of fresh air to a building (or to certain areas in a building) may adversely affect health. If a specific health effect can be related to a specific source, it is called a building-related illness (BRI). Some examples of BRI are Legionnaires' disease, a form of pneumonia possibly caused by contaminated water in central air conditioning units, and hypersensitivity pneumonitis, a condition with a range of influenza- or pneumonia-like symptoms caused by contaminated home humidifiers and building heating, ventilation, and air conditioning units.

If a building's occupants experience a variety of health effects that are difficult to link to a specific source, it is called sick building syndrome (SBS). Typical symptoms of SBS are irritated breathing passages, headaches, fatigue, nasal discomfort, nausea, and general discomfort.

When addressing indoor air quality problems, removing the source of the contamination should be the first choice of action. In addition to the above mentioned strategies, changing the ventilation system and introducing air cleaners are additional steps that could be taken to improve indoor air quality.

Two controversial approaches to improving air quality are duct cleaning and using ozone generators in the home. Although cases of extreme biological growth may warrant duct cleaning, studies on the benefits of routine duct cleaning are inconclusive. In addition, there is little evidence that proves that ozone generators improve air quality. In fact, the ozone levels created by the generators can be a harmful pollutant. More information on both of these issues can be found online at the Indoor Air Quality section of the USEPA Office of Air and Radiation website at [www.epa.gov/iaq/](http://www.epa.gov/iaq/).

There is an emerging holistic approach to home air quality incorporated in the "healthy homes" approach, which is a comprehensive way to reduce injury and risk from housing. It provides public health workers with training to address a myriad of problems or risks associated with unsafe housing. This integrated approach considers the people living in the home, the structure, and the potential hazards. The basic physiologic needs for a healthy home include: protection from the elements, a thermal environment that will avoid undue heat loss, a thermal environment that will provide adequate heat-loss from the body, an atmosphere of reasonable chemical purity, adequate daylight illumination and avoidance of undue daylight glare, direct sunlight, adequate artificial illumination and avoidance of glare, protection from excessive noise, and adequate space for exercise and children to play. According to "healthy homes" principles, a home should be kept dry, clean, ventilated, pest-free, safe, contaminant-free, and maintained. There is a variety of training offered by the Centers for Disease Control and Prevention and the Department of Housing and Urban Development for public health workers who are interested in learning more about healthy homes.

One aspect of the healthy homes approach is to discontinue using chemical-laden or toxic household cleaners and products, which can contribute to indoor air pollution. These products release contaminants into the air, some of which can be harmful immediately, while others build over time and cause health problems. Health effects can include dizziness, nausea, allergic reactions, respiratory tract irritation, and even cancer. Whenever possible, avoid using toxic cleaners altogether and use nontoxic alternatives. If using toxic cleaners cannot be avoided, do not buy cleaning products in bulk, store them and dispose of them properly, follow instructions carefully, increase indoor ventilation while using, and minimize exposure to them. Boards of health can take a role in improving indoor air quality by examining what types of cleaners or air fresheners are used in schools, the health department, and other county or municipal buildings, and recommending nontoxic alternatives.

Boards of health can also monitor and assess indoor air quality at schools. Poor indoor air quality at schools can affect the health and comfort of students and staff, which can affect concentration and performance, as well as lead to long-term health problems like asthma. Sources of indoor air pollutants in schools include outdoor air sources, such as spores, pollen, industrial emissions, or vehicle emissions; underground sources, such as radon; heating or air conditioning units; emissions from office equipment or labs; cleaning items; pesticides; and furnishings. The USEPA has created *The Indoor Air Quality Tools for Schools* program, which provides resources to help schools identify and solve indoor air problems. More information about *The Indoor Air Quality Tools for Schools* is available at <http://www.epa.gov/iaq/schools/>.

Local boards of health and health departments can be instrumental in addressing some key IAQ issues, from planning and managing resources during a crisis to working with agencies to improve conditions where poor air quality exists. An example of crisis management would be air quality issues in homes and businesses following flooding or other disasters. Standing water and wet materials (carpets, curtains, etc.) can promote the growth of disease-causing microorganisms, thereby threatening public health. While local boards of health work with local agencies to respond to these public health threats, prior planning before the damage occurs is an important part to maintaining public health. Local board of health members should work with other agencies to establish disaster and emergency plans well before a disaster occurs.

Local boards of health can also improve the health department's capacity to provide IAQ resources for homeowners and renters. Boards can take a leadership role in ensuring that local health agencies create and provide access to information and advice on how to address IAQ concerns. The USEPA Office of Air and Radiation has a variety of publications available on their Indoor Air Quality website ([www.epa.gov/iaq/pubs/](http://www.epa.gov/iaq/pubs/)) including *The Inside Story: A Guide for Indoor Air Quality* ([www.epa.gov/iaq/pubs/insidest.html](http://www.epa.gov/iaq/pubs/insidest.html)).

Air quality can seriously influence our health, and new correlations between air quality and certain diseases are being discovered. Indoor and outdoor air quality clearly affects asthma, however the cause of asthma is not fully known. Low income children and adults are more likely to be affected by asthma, and some states have higher asthma prevalence than others. Asthma can significantly affect an individual's quality of life, and therefore boards of health and other public health professionals should develop an inclusive plan for preventing and controlling asthma. There is a wide variety of actions boards recommend or develop to address asthma problems, including developing pollution control strategies, eliminating tobacco smoke in public places, eliminating idling buses and cars at schools, developing mold remediation policies, educating community members about asthma, encouraging public transportation, enforcing indoor and outdoor air quality standards, and developing media campaigns that inform people about environmental triggers.

Local boards of health can be instrumental in protecting indoor and outdoor air quality. They should partner with other local, state, and possibly federal agencies to assist in monitoring air quality. In addition, local boards can work with their local health agency to plan responses to events that threaten air quality, such as forest fires, or to provide the necessary warnings or advisory against pollution or high levels of ozone. Finally, local boards can help provide information to homeowners, schools, businesses, and others on indoor air quality.



## Questions and Considerations for Local Boards of Health

1. What is the health status of your community? What are the local asthma rates?
2. Does the community know what to do when air quality is poor? If not, why?
3. Do certain areas of the community have higher asthma rates? If they do, is this being investigated by the health department?
4. Is your jurisdiction prone to flooding and mold growth?
5. Does your community meet compliance with the federal air quality standards?
6. What industries are located in your jurisdiction? What pollutants do these industries emit?
7. Does your health agency conduct any air quality testing of schools? If not, who performs this service in your jurisdiction? Are there agreements in place?
8. Is the community aware of potential threats to air quality that exist in their community?
9. Are other agencies responsible for monitoring air quality? Do they report the results to the health department or board of health?
10. Do environmental health specialists make routine inspections of heating, cooling, or air ventilation units in schools, daycare centers, hospitals, food service areas, and other public places?
11. Has the board passed any policies or regulations that relate to indoor or outdoor air quality?
12. Does your community have any history of poor air quality events?

## Resources for Additional Information

AIRNOW. Available at [www.airnow.gov](http://www.airnow.gov)

American Lung Association. Healthy Air. Available at <http://www.lungusa.org/healthy-air/>

American Lung Association. *State of the air: 2010 report*. Retrieved from <http://www.stateoftheair.org/2010/assets/SOTA2010.pdf>

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Calhoun, Y. (Ed.). (2005). *Air quality*. New York, NY: Infobase.

Centers for Disease Control and Prevention. Agency for Toxic Substances and Disease Registry. National Toxic Substance Incidents Program. Available at <http://www.atsdr.cdc.gov/ntsip/>

Department of Housing and Urban Development. Healthy Homes Initiative. Available at [www.hud.gov/offices/lead/hhi/index.cfm](http://www.hud.gov/offices/lead/hhi/index.cfm)

Enviroflash. Available at [www.enviroflash.info/](http://www.enviroflash.info/)

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National Association of Local Boards of Health. Available at [www.nalboh.org](http://www.nalboh.org)

Scorecard: The Pollution Information Site. Available at <http://scorecard.org/>

United States Environmental Protection Agency. EPA Operating Permits Program. Available at [www.epa.gov/oar/oaqps/permits/index.html](http://www.epa.gov/oar/oaqps/permits/index.html)

United States Environmental Protection Agency. Indoor Air Quality Division. Available at [www.epa.gov/iaq](http://www.epa.gov/iaq)

United States Environmental Protection Agency. National Ambient Air Quality Standards. Available at [www.epa.gov/air/criteria.html](http://www.epa.gov/air/criteria.html)

United States Environmental Protection Agency. Office of Air and Radiation. Available at [www.epa.gov/oar](http://www.epa.gov/oar)

United States Environmental Protection Agency. Office of Air Quality Planning and Standards. Available at [www.epa.gov/oar/oaqps](http://www.epa.gov/oar/oaqps)

United States Environmental Protection Agency. Technology Transfer Network Air Toxics Web Site. Available at <http://www.epa.gov/ttn/atw/>

# Food Safety

## Introduction

The protection of the United States' food supply from the farm to the table is one of the most fundamental responsibilities and activities of public health and environmental health surveillance and monitoring systems. It is a complex network of federal, state, and local agencies, as well as the food industry itself, which oversees food production and delivery. Combating foodborne disease requires the vigilance of government entities and active participation by the food industry, academia, and the consumer. The three primary federal agencies that are responsible for the overall safety and surveillance of the food supply are the Food and Drug Administration (FDA), the United States Department of Agriculture (USDA), and the Centers for Disease Control and Prevention (CDC). In addition, each of the states and their localities play a vital role in food safety surveillance, monitoring, and control in similar corresponding agencies, organizations, and industries (i.e., state and local health departments).

It is a primary responsibility of both state and local public health agencies to protect the public through education, licenses or permits, routine inspection of all food service and retail establishments within their jurisdictions, and the investigation of potential foodborne illnesses. At the state level, the health and agriculture departments, along with the FDA and USDA, may share the responsibility for surveillance of the food supply. The scope of inspection and monitoring differs among states and localities. It is vital that all agencies communicate and work together to regulate all segments within the food industry to prevent foodborne illnesses.

Local public health agencies assume the responsibility for food safety assessment at the community level and are often the last line of defense to ensure that safe and wholesome food reaches the consumer. Most local health agencies in the United States are responsible for regulating the retail segment of the food service industry. Local public health agency staff accomplish this by licensing and inspecting food service establishments with the primary goal of preventing foodborne illness through the education of food service operators. These actions are conducted with the intent that routine inspections, investigations of complaints and foodborne illnesses, education of food service workers, and licensing requirements will assure that food and beverages are safe. In addition to providing the final defensive actions prior to reaching consumers, local public health agencies are often the first entities to be contacted to investigate a foodborne outbreak. According to the FDA Food Code, the goal of local and state food protection programs should be to work with the food industry to safeguard the public's health and ensure that food is safe, wholesome, unadulterated, honestly presented, and meets customer expectations.

## What Is the Public Health Issue?

The food service industry is big business. It represents over 4% of the gross domestic product in the United States. According to the National Restaurant Association, food service has grown well over tenfold in the past four decades, from a \$42.8 billion industry in 1970 to a \$566 billion industry in 2009. Over 13 million people, or 9% of the workforce in the United States, are employed in the food service industry. In addition, supermarkets and grocery stores generate another \$527 billion dollars annually, with nontraditional food stores and convenience stores adding another \$330 billion and \$150 billion in sales, respectively.

The average American spends roughly 25% of his or her income on food. Of this, 44% of the food budget is spent on meals, snacks, and beverages eaten outside of the home. Approximately 70 billion meals and snacks are eaten annually in food service establishments in the United States. Almost half of all adults are food service customers every day.



Although the food safety system in the United States has been one of the best in the world, foodborne illnesses continue to be a major, even increasing, problem. Foodborne diseases cause enormous numbers of illnesses and deaths each year, and are a significant drain on financial resources. Foodborne illness outbreaks in the past 5 years, such as *E. coli* found in spinach, ground beef, and prepackaged cookie dough or *salmonella* in peanut butter and tomatoes, demonstrates that there are still serious threats found in the food supply. The Department of Health and Human Services' Public Health Service has listed food safety as a priority with established objectives in Healthy People 2000, Healthy People 2010, and Healthy People 2020. Food safety issues continue to be a top priority in the federal government. In March of 2009, President Obama announced the creation of the Food Safety Working Group, chaired by the Secretaries of the Department of Agriculture and the Department of Health and Human Services. The working group is charged with modernizing the food safety system, updating food safety laws, and fostering coordination among government departments.

### *The Extent of the Foodborne Illness Problem*

CDC estimates that foodborne diseases cause an estimated 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths each year from sources known and unknown. They also report that three pathogens, *Salmonella*, *Listeria*, and *Toxoplasma*, are responsible for 75% of reported illnesses and 1,500 deaths. Many foodborne illnesses, however, are never reported to local or state health departments or to the CDC.

Several recent foodborne illness epidemics reported in the news help to further demonstrate the extent of the food safety problem in the United States. The following are examples of recent foodborne disease outbreaks that have appeared in the media within the last few years:

- The Hepatitis A virus caused several foodborne outbreaks in the late 1980s through the 1990s, sickening thousands of people. These outbreaks were linked to ill food service workers failing to wash their hands frequently while working. Outbreaks are also linked to a lack of washing of fruits and vegetables before service.
- In 2006, *E. coli* found in bagged fresh spinach caused 199 people in 26 states to fall ill. Of the 199 people who reported becoming ill, 102 required hospitalization and 33 developed a type of kidney failure called hemolytic-uremic syndrome. Three people died as a result of the *E. coli* outbreak. It was concluded that the probable source of the outbreak was a cattle ranch in California that leased land to organic spinach growers, though the exact cause for contamination is not certain.
- In 2007, another outbreak of *E. coli* was linked to ground beef, and caused 14 people in six Western states to become ill. It led to a recall of 5.7 million pounds of beef—the second largest beef recall in the United States.

The USDA's Economic Research Service (ERS) has estimated the economic costs of foodborne illnesses. It suggests that the direct medical costs and productivity loss range from \$6.6 billion to \$37.1 billion for seven foodborne pathogens. There are other indirect costs that are not included, such as the cost to the food industry.

Despite surveillance techniques and loss estimates, there is a large gap between the actual number of confirmed cases of foodborne disease that are reported to the CDC and the estimated number of cases that actually occur. Closing this gap will require effort from the entire food safety community, which includes both the food industry and consumers.

While licensing, monitoring, inspection, and enforcement of food service safety regulations in food service facilities are necessary at the local level to ensure compliance, the key to food safety is a comprehensive approach toward the food safety education of food service managers, food service personnel, and the general public.

## Major Facts About Foodborne Disease

### *What Is a Foodborne Illness?*

An outbreak of foodborne illness is defined as two or more people becoming ill from a common food eaten at the same time and/or place. Cases of illness therefore make up outbreaks of foodborne disease when the agent of disease is microbiological.

Chemical poisonings, whether incidental or accidental, and physical hazards in foods, such as hard foreign objects, are classified as an illness when one case is confirmed. Therefore, for these incidents, one case is an outbreak. The ability to confirm an outbreak of foodborne disease requires timely and diligent epidemiological investigation by all parties involved in the food safety surveillance system. Such investigations must begin at the local level where outbreaks of illness occur. Local health departments should report incidence of foodborne outbreaks to the state level with final reporting to the CDC. This ensures that all actual confirmed cases within the United States are summarized.

### *Types of Foodborne Illness*

Most foodborne illnesses are primarily a function of the gastrointestinal tract (GI); therefore, the symptoms that result are primarily nausea, vomiting, abdominal cramps, diarrhea, and occasionally fever. Some agents of foodborne illness attack other body organs or systems, e.g., botulism impacts the central nervous system. The two major types of foodborne illness are food poisonings and food infections. However, illnesses from chemicals in food and injury from physical agents are also grouped as types of illness related to foods.

The three principal types of agents that cause foodborne illness are biological, chemical, and physical in nature. Of these, the biological agents produce the majority of the illnesses, although the importance of chemicals and physical agents cannot be overlooked. Examples of important foodborne illness agents and their likely sources are provided in Table 1 on page 22.

### *Who Is at Risk for Foodborne Illness?*

While everyone is at risk for contracting a foodborne illness, the severity of illness in healthy human individuals may be less than in certain susceptible populations. Susceptible groups who may experience severe illness and death from disease agents include the very young; the elderly; persons already suffering from an illness, injury, or are immunocompromised (such as those with AIDS); persons on antibiotics and individuals with nutritional deficiencies. Other groups at risk include chronically ill patients and pregnant women. It is especially important to educate all segments of the population regarding their risk of illness from food, especially those persons who are most at risk or those persons caring for those most at risk. Any comprehensive food safety and protection program must include all facilities that serve food to all segments of the population. These include such institutions as nursing homes, childcare centers, hospitals, jails, and restaurants.

### *What Are the Major Contributors to Foodborne Outbreaks?*

There are many factors that can lead to contamination of foods that then cause a foodborne illness/outbreak. The three most important factors that are found consistently during a foodborne illness investigation are:

- Lack of hand washing and poor personal hygiene by food service personnel
- Inadequate temperature control, i.e., refrigeration and/or cooking
- Cross-contamination of raw foods with ready-to-eat foods



**Table 1** Examples of important foodborne illness agents.

Principle Type	Illness or Agent	Likely Source or Cause
<b>Biological</b>		
Bacteria	Salmonellosis Campylobacteriosis Shigellosis <i>Listeria</i> <i>E. coli</i> 0157:H7	Improper cooking of poultry Improper cooking of poultry Lack of hand washing Vegetables and contaminated processed foods Improper cooking of beef
Protozoa	<i>Cyclospora</i>	Alfalfa sprouts
Viruses	Hepatitis A, norovirus	Poor personal hygiene
<b>Chemical</b>		
Natural	Scombroid poisoning	Fish (tuna, mackerel)
Accidental	Cleaning agents Food additives	Improper labeling Overuse
<b>Physical</b>		
Hard foreign objects	Metal fragments	Can opener

### Responsibilities of the Local Board of Health and Health Department

With an understanding of the public health importance of food safety, a board should also know what makes up a comprehensive and effective program. The components of an effective food safety program are strengthened by having an effective and proactive local board of health. The board ensures that the local public health agency has the necessary resources to support each of the elements, as well as having measurable objectives to fully assess the program's accomplishments. The overall intended goal for a food safety program must be to reduce or eliminate the incidence of illness, injury, and death related to the preparation, storage, serving, and transportation of food in homes and food service and retail establishments. Effective food safety programs contain the following components:

- A solid regulatory framework with an effective enforcement strategy
- Comprehensive licensing and permitting criteria
- A monitoring and inspection program
- A surveillance and investigation program
- Ongoing education and training for food service workers, consumers, and health agency staff
- A communication and public relations strategy



- Regular program assessment
- An effective, knowledgeable, and proactive local board of health

#### *Enforceable Food Safety Code or Regulation*

The foundation for an effective food safety program is its reliance on enforceable state or local food regulations. Such regulations provide information on how to achieve food safety by establishing clear rules and regulations surrounding the licensing and inspection of food service establishments within a jurisdiction. A food safety code or other food safety regulations also provides clear guidelines for addressing violations and challenges to the authority of the local public health agency and the board of health to enforce the rules and regulations. Some state and local boards of health have adopted the FDA's Model Food Code for enforcement at the local level. In addition to the adoption of an enforceable food code, boards of health should also adopt guidelines for the enforcement of regulations and procedures to address repeat violators or any noncompliance of the established food safety regulations.

#### *Comprehensive Licensing and Permitting Criteria*

A comprehensive licensing/permitting and surveillance program establishes a tracking system for food service facilities. This tracking system assures the regulation of the facility through the inspection and surveillance process. In order to obtain an operating license or permit, food service facilities must meet certain operational requirements. These requirements often change from jurisdiction to jurisdiction. Local board of health members should familiarize themselves with their jurisdiction's requirements for obtaining a food service license or permit.

A comprehensive food safety program also requires the routine inspection of food service facilities with an educational component for managers and staff. Proper education of food service staff, with focus on good hygiene and food safety practices, should serve as the primary route for the prevention of foodborne illnesses.

#### *Monitoring and Inspections*

There are two basic approaches for monitoring and inspecting the food industry. The traditional approach makes routine, unannounced visits to food service establishments to ensure compliance with applicable food codes or regulations. Historically, these inspections have generally involved an examination of the facility from a cleaning and maintenance perspective. It has also involved looking for food contamination hazards that exist at the time of inspection.

This approach has been effective in keeping food service and retail establishments in compliance with applicable regulations and the public's demand for clean and sanitary establishments. However, this approach has not focused enough attention on the risks associated with food preparation procedures. A newer and more effective approach to regulating the food service and retail food industry is the Hazard Analysis Critical Control Point (HACCP) system. Introduced in the 1960s as an effort to assure 100% safe food for NASA astronauts, HACCP has become a widely recognized and accepted method used in the food processing industry intended to achieve safe food products.

With the food industry's adoption of the HACCP system, guidelines for its use and implementation were published in the FDA Model Food Codes of 1997, 1999, 2001, and 2003. More and more states are utilizing the inspection system and replacing the more traditional approach to food service and retail establishment inspections with this newer program. The HACCP system inspection model focuses completely on prevention by identifying the hazards and possible risks that exist at each individual stage of food production.

A critical control point is any activity or procedure in a specific food system process where loss of control may result in an unacceptable health risk. Control is then applied to prevent or reduce the risk. The HACCP system focuses on all critical points in food production from the beginning to the end rather than just concentrating on only treating the symptoms and not the cause, as in the traditional approach. HACCP identifies the critical control points at each stage where contamination may occur and then minimizes the possibility of contamination through sound food safety and sanitation practices.

#### *Investigating and Responding to Foodborne Outbreaks (Surveillance)*

An effective food safety program should have a clear process for investigating and responding to a foodborne outbreak. This means that health agency staff not only have the capacity to effectively respond to a foodborne outbreak, but also must partner with laboratories, epidemiologists, and healthcare professionals. To properly investigate the outbreak, they must also have the technology (both hardware and software) to collect and analyze the data, and have a process for revising policies and procedures to improve the food safety program or the inspection and monitoring process.

#### *Education and Training*

There are three types of educational components of an effective food safety program.

The first is to have ongoing training for the health agency staff. Regular updates and training on inspection techniques and new methods utilized by the food industry will keep food safety program specialists up-to-date and better prepared to respond to changing issues in the food service industry. An academically prepared and adequately trained, certified, and standardized staff in food safety and foodborne illness surveillance will improve the efficiency and outcomes of a food safety program.

The second educational component is the education of food industry workers. While the National Restaurant Association, American Hotel and Motel Association, and other private groups provide training and education programs for food industry employees and management personnel. In many jurisdictions, local public health agencies also provide such programs. Some states and localities now certify managers in food safety and sanitation for employment in food service establishments. Other jurisdictions provide training through quarterly food safety training seminars for food service managers or use a quarterly newsletter to disseminate information to food industry employees.

Educating consumers about food safety and proper food handling techniques is the final element of the education and training component. With a method for responding to consumer complaints or reports of foodborne illnesses, public health agencies are in a good position to educate consumers and teach them how to remain informed about food safety issues. Through press releases, news bulletins, websites, and public service announcements, the health agency may help inform residents of the proper preparation and sanitation standards involved when preparing their own meals and those of their families, remind people about seasonal issues (e.g., food safety during barbeques, picnics, etc.), reach people during a suspected outbreak, and encourage consumers to report any foodborne related illness to the health agency.

#### *Effective Communication and Public Relations Program*

Good communication, as with most public health efforts, is mandatory in gaining community support for the food safety program. Communicating this effort to the public, elected officials, medical professionals, and to other local governing bodies will strengthen a local program by adding additional resources to address foodborne illnesses in the community. Boards of health should also ensure that their public health agency remains proactive and visible

to the public through positive interaction. Too often, negative attention is focused upon health agencies during a foodborne outbreak. If a community is aware of the hard work and dedication of the health agency, a negative event may not ruin the efforts and reputation of the health agency.

### *Program Assessment*

Another element of an effective food safety program is to have a regular assessment of the program. Data collected from the monitoring and inspection process or a foodborne outbreak should be used to identify strengths and weaknesses of the program. Without a regular program assessment, resources may be wasted on program elements that do not reduce the incidence of foodborne illness or mortality. In addition, the assessment process should also recommend policy and regulation changes to the board of health.

### *Local Board of Health Support*

The final element of an effective food safety program is how well the local board of health fulfills its obligations to the program. Although the board's role is detailed in the next section, it is an important component of the entire program. Because boards of health approve the budget and provide oversight, the members need to ensure that their actions are compatible with the overall goals and objectives of the food safety program.

## **Board of Health's Role in the Food Safety Program**

Boards of health are responsible for fulfilling the three public health core functions: assessment, policy development, and assurance. Each component of the food safety program requires local board of health action, usually allocating the necessary resources and requiring accountability to fulfill the program's objectives. However, it is in this role that local boards may be most creative in finding solutions and introducing innovations to their local public health agency.

### *Assessment of Current Program*

The local board of health assumes various roles in the intricate and often perplexing food safety network. Assessment is a major responsibility for the board. In reviewing the food safety program needs of each individual community, it is necessary to conduct a needs assessment. During this process, data is collected on the incidence and prevalence of foodborne illnesses and disease complaints within the community. Gaps in program services are noted, and the major contributors to the program are identified. Once collected, the information is analyzed with input from the community and a plan is developed to address the identified needs. The plan should be based on the established priorities and identify the necessary resources required to achieve the program's goals.

A local board of health must also ensure that the local health agency is using current codes and regulations to address food safety in their communities. Because codes and regulations change, board members must ensure their local public health agency is current on regulatory changes.

### *Policy Making*

Many intangible elements of any public health program result from the policies practiced by the local board of health. While some of these practices may require funds, many do not. An inexpensive benefit for food safety programs is a good relationship between the local board of health and the health officer. By developing a strong relationship with the health officer, food safety supervisor, and, quite possibly, the food safety staff, board members will have the most current information available regarding the food safety program.

This will help board members understand the status of the current program as well as any unusual occurrences such as foodborne outbreaks and chronic food safety violators. It will also help identify what additional resources or services are necessary for the current program to improve.

While local boards of health work with their health officer, the health officer in turn works with the staff. It is possible the food safety supervisor may attend board meetings to provide a report on current activities. The board should be encouraged to question and discuss the program with the supervisor. Program changes and problems, however, should be addressed through the proper chain of command.

Requiring all parties to recognize their own roles ensures the program's success. The local board's role is to allocate resources, ask questions, provide program accountability and oversight, and to establish or recommend policies. The health officer should hire trained staff and disperse resources on their behalf for their programmatic needs. The staff should execute the program's objectives, gather data for analysis, and provide input when assessing future goals.

#### *Allocate Sufficient Resources*

One of the primary ways in which boards serve the food safety program is through the allocation of resources, typically money. Funds dedicated to the food safety program may be used for staff, technology, training and education, or public relations. Local boards of health should ask for a clear accounting and justification from the health officer and food safety staff regarding the financial needs of the program and make the necessary allocations based on the information.

There are a number of ways in which food safety programs are funded. In some instances, license and permit fees are set at a level high enough to cover program costs. Fees may also be charged for training and certification activities offered to food safety employees or consumers. Grants also may be available for food safety training programs. In other cases, boards may have to allocate supplementary resources to cover additional costs of the program. Boards should also consider the need for emergency or contingency funds that may occur with an unanticipated food safety event.

#### *Effective Oversight of a Food Safety Program*

Knowledge about effective program components will help boards of health in their governance and oversight role. As mentioned earlier in this guide, the local board's role is to question and provide program accountability and oversight, allocate resources, and to set or recommend policies. The health officer should hire trained staff and advocate on their behalf for their programmatic needs. The staff should execute the program's objectives, provide data analysis, and input when assessing future goals. The actions or activities needed for effective oversight are detailed in the following sections.

#### *Identify Measurable Objectives*

The first and most important measurable objective is to decrease foodborne illnesses and outbreaks in the community. This is measured by the number of foodborne illnesses reported within a given year either by individuals or from local hospitals and doctors.

Board members should be aware of the previous year's figures to determine a baseline. A comparison with surrounding jurisdictions will also help determine the status of the current food safety program. Incidence rates that are higher than surrounding areas may indicate a need for improvement in the current food safety program or a better reporting system.



Other measurable objectives include the number of citizen complaints reported during a given year, the number of critical violations (those that can cause a foodborne illness within food establishments), and the number of overall violations among food establishments. A monthly chart tracking the different violations is a good way to determine the areas on which the food safety program must focus. The local board of health should ensure that the staff uses the data collected when responding to current conditions. For example, if there are more temperature violations than cleaning violations for a given month, the health agency may want to hold an educational session for food operators regarding proper temperature control. The board of health should also be aware of how many inspections the local public health agency staff are conducting each month and how much time environmental health professionals spend inspecting specific food service operations. These numbers are extremely important especially if a cost analysis determines the license fee amount for food operations.

#### *Conduct a Regular Program Assessment*

Regular evaluations of the food safety program are an important function of a local board of health. Evaluations should be conducted annually and provide the board with feedback on the effectiveness and efficiency of the specific program. In order to have an effective evaluation, program goals and objectives must be established. Evaluations provide valuable information to determine if changes are needed in the focus of the current program.

The board of health is responsible for requesting the food safety program's goals and objectives from the health officer. In addition, periodic updates to gauge progress towards the goals should also be included in the board's actions.

#### *Maintain Enforceable Food Safety Regulations*

In order to have a high-quality food safety program, all local public health agency staff must be consistent in the enforcement of the established food safety regulations. Staff must treat every food service establishment equally and give no preferential treatment to certain establishments. When enforcement actions are necessary, consistency is mandatory for a successful prosecution.

A board of health supports this program component by ensuring that there are enforceable food safety regulations. By working with the health officer and the food safety staff, the board must ensure that the regulations provide clear rules and policies surrounding the licensing and inspection of food service establishments, have clear guidelines for addressing violations and challenges to the authority of the local public health agency and the board of health, and outline a procedure for enforcing the regulation.

#### *Provide a Policy and Procedures Manual*

A policy and procedures manual will help boards of health, the health officer, and the food safety program staff understand the expectations and objectives of the program. The manual should detail each participant's specific role and is a vital resource for all parties involved. For example, a section on how to conduct hearings for chronic food safety violators may help the board of health effectively remove the danger posed by the health threat, validate the staff's recommendations, and ensure that there is fair and consistent treatment of each food safety regulations violator. Strict adherence to a policy and procedures manual will also help if legal actions become necessary.

#### *Establish a Strong Relationship With the Health Officer*

By developing a strong relationship with the health officer and, to some extent, the food safety staff, board members will have the most current information available regarding the food safety program. This will help board members understand the status of the current program as well as any unusual occurrences such as foodborne



outbreaks and chronic food safety violators. It will also help identify what additional resources or services are necessary for the current program to improve.

In addition to developing a positive relationship with the health officer, board members should be aware of how a health officer may address the staffing needs of the food safety program. Some elements of successful staffing are discussed in the following paragraphs.

#### *Secure Qualified and Adequate Staffing Levels*

Qualified, sufficient staffing may be the most important component of a successful food safety program. Without a highly qualified and competent staff, it is impossible to have a quality food safety inspection program. The amount of time spent inspecting each establishment would greatly diminish, resulting in the lack of food safety education to food operators, less cooperation by operators or food handlers due to misunderstandings, and the potential for decreased monitoring of food establishments.

Education is the most important component of any food safety inspection system. Environmental health specialists cannot expect food operators to understand the regulations without first educating them on proper food safety procedures. Once a relationship is developed between a food service operator and an environmental health professional, they are better able to work together to correct the violations. Along with cooperation and education, food operators also begin to feel good about their operations and are more conscious of food safety procedures. This can be a time consuming process that may involve several thorough inspections. Unfortunately, if health agency staffing levels are inadequate, environmental health professionals are more apt to rush through their inspections, missing the key component of education, and possibly missing critical violations within an establishment. This defeats the purpose of a high-quality food inspection program and eventually could lead to an increase in foodborne illnesses.

Having equitable wages for the food safety staff is also critical for a high-quality food safety program. Food protection, in the way of education and enforcement, is one of the most important functions in today's society in order to prevent foodborne illnesses and to provide a healthy, safe environment. To properly educate food operators and the community, the local health agency staff must be knowledgeable about the science of food safety and the prevention of foodborne illnesses. The staff must also know the regulations that pertain to an individual food program and how to enforce regulations within their jurisdiction.

Qualified staffing for the food safety program may include Registered Environmental Health Specialists. In most areas of the country, a 4-year college degree is a required along with intense training and a passing score on an exam to receive this certification. Without equitable wages for environmental health professionals, there could be a higher turnover rate that might lead to an inadequate or untrained staff and, ultimately, a poor food safety program and higher rates of foodborne illness.

#### *Proper Education and Training of Staff*

As previously mentioned, the proper training and education of environmental health specialists is a requirement for a high-quality food safety program. In addition to a 4-year college degree in a science or health-related field, environmental health specialists are required to satisfy continuing education requirements in order to renew their licenses or registrations. This helps environmental health professionals understand their evolving roles that may change from year to year. Regulations are constantly changing due to new scientific information and emerging diseases. Every year, new technologies are invented that may help in the prevention of foodborne illnesses. These



are just a few reasons why it is so critical that environmental health specialists remain educated on current issues so that they can be proactive in educating food service operators as well as the public.

#### *Ensure Use and Availability of Modern Equipment*

The primary goal of any food safety program is the prevention of foodborne illnesses. The local public health agency must be able to support qualified environmental health specialists and have the proper and most current equipment available to monitor certain situations within a food service establishment. For example, a laser thermometer is very beneficial in a large establishment because it acts as a rapid trouble shooting guide when checking temperatures of various food items and hot and cold holding equipment. When temperatures are unsafe, a probe thermometer ensures accuracy. Other equipment essential for thorough inspections include light meters, flashlights, sanitizer test strips, and the most appropriate hardware and software.

In order to conduct professional educational seminars for food service operators and members of a community, environmental health specialists also need access to modern multimedia equipment. A computer and projector for presentations or audio-visual equipment for viewing food safety videos may be necessary.

The local board of health should request proposals for up-to-date equipment from the food safety staff. The proposals should include the cost of the equipment, a justification for the expenses to be incurred, and, most importantly, what benefit the equipment will provide to the staff person and the program. The local board should then review proposals and make the necessary budget allocations to purchase or lease the equipment. If the equipment is too expensive to purchase immediately, then a plan for its eventual acquisition should be made.

#### *Ensure Legal Support for Program*

It is crucial to have legal support for any food safety program. The local health officer or a local board member should develop and maintain a strong relationship with the prosecutor for their jurisdiction. The prosecutor must also be aware of the policies and procedures set forth by the board of health. These are important issues when determining the status of a community's food safety program. There are many cases when food industry education no longer works and stronger enforcement actions, such as closing an establishment, are necessary. This is a very difficult decision for most boards of health and often involves legal advice and prosecution.

Communication is extremely important when working with the prosecutor to ensure that all parties are striving towards a common goal. The last thing a board of health wants to happen is to go into a prosecution case unprepared. If the health agency makes a mistake, it could ruin the reputation of the food safety program or even the food establishment. Lawsuits can also result from an ill-prepared case. This is why it is equally important that the prosecutor understands the regulations that pertain to food service operations and the intent of the health agency as it relates to a given situation.

Boards of health must ensure that legal support is available by asking the health officer about options for legal service. Legal support may be engaged for more than the food safety program. Board members should ask their health officer about the agency's legal counsel. The board should also ensure that financial resources are available to engage legal representation at the level needed for the agency's protection.

#### *Ensure Access to Certified Laboratories*

If a foodborne outbreak occurs, the board of health must ensure that its health agency has access to laboratory services 7 days a week, 24 hours a day for the testing of food or stool samples. In some areas, the state health department assists in this important matter, but there should always be a local back-up plan. Having a plan in place



ensures that the local public health agency is striving to be prepared, which is a good indicator of a high-quality food safety program. When a foodborne outbreak occurs, quick action by environmental health specialists may actually prevent a much larger outbreak. If able to test food or stool samples in a rapid fashion, environmental health specialists can better focus on stopping the spread of disease.

The board ensures that this access exists by allocating the necessary financial resources. As part of the regular assessment process, board members should review the effectiveness of their laboratory relationships and make changes as necessary.

### *Promote Community Food Safety*

Community food safety is as important as the other training and education programs. Boards of health have the responsibility to ensure that the health agency staff promotes food safety throughout the community and jurisdiction. While the enforcement of food safety laws and regulations are mandatory for a successful food safety program, educating the food safety industry and the public are essential to reduce foodborne illnesses. This monumental task can be accomplished by raising the community's awareness regarding safe food preparation and handling procedures.

### *Educate the Community*

It is equally important to educate the public as well as food service operators on food safety issues. The public can be an extremely important asset to a successful food safety program. If the community is educated on proper food handling and preparation procedures, it can actually serve as the eyes and ears of the local public health agency. It is also very important that members of a community know where to go if there is a question or concern regarding a particular food service operation. Addressing the concern in a timely manner may greatly reduce the possibility of a foodborne illness. By educating the public on food safety issues, the local public health agency makes the food safety program much stronger. Education must always be the primary route to food safety.

### *Educate the Consumer on Food Safety in the Home*

To decrease the possibility of a foodborne illness, local public health agency staff must educate the public on proper food safety procedures and practices. The risk of contracting a foodborne illness at home is much greater than at a licensed food service establishment due to the number of meals eaten in the home and the different variety of foods consumed. If members of the public are educated on basic food handling techniques, basic sanitation, and proper preparation and storage procedures, they will have a better understanding of what is required of food service establishments and will become more knowledgeable consumers.

### *Provide Food Safety Media Releases*

Food safety press releases offer an opportunity to develop a strong relationship with the media as well as the public. Timely press releases regarding food safety grilling procedures in the summer time or safe turkey preparation practices during Thanksgiving reinforce positive customer relations between the health agency and the public. A timely and effective media release can significantly decrease the potential for a foodborne illness.

## **Current Issues in Food Safety**

Boards of health should also make sure that their food safety programs remain up-to-date to reflect changing food trends. Organic, all-natural, local, and raw or unprocessed foods are all gaining popularity, but reflect new challenges for food safety programs. Farmers markets are gaining a resurgence as local food movements grow in popularity. It is the board of health's responsibility to ensure that farmers markets are following special food safety

considerations: food samples handed out should meet minimum sanitation levels; dairy products, meat, seafood, eggs, tofu, cut tomatoes, or other potentially hazardous food need to be kept at proper temperatures; good hygiene always needs to be followed; and many states require processed foods to be created in approved facilities. Raw or unpasteurized milk is also gaining popularity, but boards should make sure that milk producers are inspected and that milk remains fresh and kept at proper temperatures, or consumers are at risk for *salmonella* or other foodborne illnesses. Organic food is also a large and profitable segment of the food industry now. While organic food does not have as many pesticides, there is an increased potential for mold growth and other organisms. The USDA also has adopted organic certification and labeling, so there are standards for organic items. Boards of health should be aware of these designations and issues, and ensure that organic food grown or sold in their communities meets the same quality and standards as other food.

### **The Role of the Other Parts of the Food Safety Network**

Ensuring that safe, wholesome, unadulterated food is presented to the public is everyone's responsibility. The vast interconnected food safety network must assume varying responsibilities and make every effort to reduce the incidence and prevalence of foodborne disease. Each segment of this network must play a specific role in accomplishing this task. The overall public's health free from foodborne illness is dependent on this coordinated and well-communicated effort.

#### *The Food Industry*

All segments of the food industry have a responsibility of producing and processing foods that are safe. This means employing the best available technology based on the most sound food science research that can be used in the production of foods. The industry must also take the lead in using a systems approach in the production, processing, and preparation of foods. An across-the-industry approach employing such scientifically based systems as HACCP will give greater assurances that foods are free of contaminants when they reach the consumer. These methods should be employed at all levels of food production from processing to food service. The food industry, which is involved in quality assurance programs, must continue to conduct its own research to assess risks in the manufacturing processes. The food industry must also be a leader in educating and training its employees. All levels of employees, from upper management to supervisors to food service employees, should be instructed in safe food processing, production, and preparation practices. Education, motivation, and self-monitoring using the latest scientific approaches are key to food safety assurance from the food industry.

#### *The Governmental Sector*

All levels of government are involved in the surveillance of the food system. Each level, while having a specific role, assumes a vital responsibility in the monitoring of the overall safety of the food supply. There are many agencies at the federal level that share responsibility for food safety (see Figure 1 on page 32). The federal government is the leader in the network's coordinated effort to ensure the safety of food. It works with all other segments of the food safety network to provide guidance, assistance, and enforcement of issues ranging from regulatory approach, research, monitoring and surveillance, and education.

In 1998 the federal government established the Council of Food Safety and the Joint Institute on Food Safety Research. This initiative has established programs aimed at improving food safety, such as FoodNet and PulseNet. As a result of this research initiative, several foodborne disease cases implicating the disease agents *Shigella* and *E. coli* 0157:H7 have recently been linked using DNA fingerprinting.

**Figure 1** Federal food safety network.

<b>Food and Drug Administration</b>	<b>Department of Agriculture</b>
Center for Food Safety and Nutrition	Animal and Plant Health Inspection Service
Center for Veterinary Medicine	Agriculture Research Service
Joint Institute for Food Safety	Food Safety and Inspection Service
Centers for Disease Control and Prevention	National Academy of Sciences
Council on Food Safety	National Alliance for Food Safety

### *The Professional Society/Academic Sector*

There are numerous professional organizations and societies that play a role in educating and communicating information to their professional memberships and the public. The National Environmental Health Association, the American Public Health Association, the Association of Food and Drug Officials, and equivalent state and local organizations represent those professionals who provide the inspection and monitoring activities within the food industry. It is especially important that these individuals are academically prepared, adequately trained, and certified in food safety and foodborne illness surveillance. The National Restaurant Association and the American Hotel and Motel Association, through their educational foundations, assume a similar responsibility of providing training and education programs for food service industry employees and management; equivalent state and local organizations also share in this role.

Academic institutions should provide state-of-the-art educational opportunities in food safety and sanitation to individuals entering the food industry and the food safety surveillance system. They are also the leaders in food science and safety research. Professional organizations such as the American Society of Microbiology, NSF International, Underwriters Laboratories, Inc., the Institute for Food Technologists, the International Association of Food Protection, and the International Food Information Council in conjunction with the food science and food safety research community are actively involved in the communication and collaboration of the current food safety initiative. This will continue, and academic institutions will play a greater role in the preparation of students entering the food safety field.

### *The Media*

All components of the media network play an important role in informing the public about food safety issues. The majority of the public is informed about food safety issues through the media, usually in headline epidemic stories. The media have the responsibility and opportunity to properly inform the public about food safety in a balanced and unbiased approach. They should use the food safety experts within their markets to convey to the public the real issues involved in the safety of food. This awareness of food safety has increased over the past 10 years as a result of several major multistate outbreaks of food-related illnesses. The media, the government food safety network, and the food industry should work together to positively convey the food safety message to the public.

### *The Consumer*

While it is the responsibility of the consumer to stay informed about food safety issues, local boards of health should ensure that consumers have access to home food safety information or programs. Consumers must stay informed on the proper preparation and sanitation standards of care involved in preparing their own meals and those of their families. They should also learn to report to the local health department any illness that they or their

family members incur that they believe could be food related. Informed food safety consumers are critical for an effective food safety system.

## **Conclusion**

The local board of health provides guidance and direction to the local health agency on many issues regarding the public's health. This includes providing leadership on food safety. In particular, the function of the local board of health regarding food safety is to ensure that all of the necessary components of a comprehensive food protection program are in place for the protection of the public's health. As described, local boards of health should ensure that food safety programs have a regulatory framework and adequate staffing and funding. Local boards of health may also be responsible for conducting hearings, issuing and revoking licenses, and making certain that staff, food service agencies, and consumers receive regular education and training. Boards should regularly review food protection programs to guarantee that there is a proper mix of education and enforcement activities. Such reviews should also ensure that food protection programs are effective in preventing foodborne illness.

As a politically appointed or elected body, the board of health should ensure that the climate for food safety within its jurisdiction remains favorable, and it needs to persuade policy makers that an effective food safety program can only be accomplished with the necessary resources. History indicates that when disease outbreaks are apparently low within a population, the first programs to be cut are those that are preventive. When that happens, a resurgence of disease usually follows. Because the occurrence of foodborne illness is underreported, it is crucial that prevention-based programs continue to receive the necessary resources.

By staying informed about food safety issues in general and about the food safety surveillance system within their communities, local boards of health will provide support for the local health agency in their efforts to minimize foodborne illness. Local boards of health should stay informed about other efforts provided by other state and local agencies regarding food safety. Food safety should be given a high priority in every community. Communicating this effort to the public, medical societies, and local elected governing bodies will strengthen the local food safety program by adding needed resources to address the foodborne disease issue.

In sum, food safety is a major concern in the United States. The gap between the reported cases and estimated cases of foodborne illness and the cost to the economy are enormous. The food industry is complex and multifaceted. Food safety requires a multidisciplinary approach by the industry, government, professional organizations, the scientific community, the media, and the consumer to adequately address all of the related issues.

The local health department historically has played a vital role in the protection of the public's health from foodborne illness in food service facilities. This role will continue and will grow in the future as this important public health issue stays in the forefront of everyone's concern. Local boards of health play a key role in ensuring that the public they represent receive the best protection in food safety by actively overseeing the local public health agency's food safety program.

## **Questions and Considerations for Local Boards of Health**

1. Have there been any foodborne illness outbreaks in your community recently? Were they investigated?
2. Does your board of health have a clear understanding of its responsibilities with food safety?
3. Does your board of health highlight restaurants or vendors that consistently excel at food safety?
4. Does your community have adequate food safety education?
5. Does food safety staff receive regular education and training to remain up-to-date with food safety issues?
6. Does your board of health or health department have an effective working relationship with state or federal food safety officials?



## Resources for Additional Information

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- United States Department of Commerce. National Oceanic and Atmospheric Administration. Seafood Inspection Program. Available at <http://seafood.nmfs.gov>
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Voluntary National Retail Food Regulatory Program Standards – April 2009. United States Food and Drug Administration. Available at <http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/ProgramStandards/ucm180269.htm>





# Drinking Water

## Do We Have a Problem?

The United States long ago adopted a view that anyone, anywhere in the country, should expect safe clean water from any tap. Indeed, the Safe Drinking Water Act of 1974 has resulted in a comprehensive system of federal and state controls governing municipal water supplies. Private supplies, however, largely remain under the purview of local officials. Recent events suggest that although our drinking water usually is safe, serious problems may still emerge in both rural and urban settings.

*Albany, New York, September 1999*

Visiting the county fair turned into a life-threatening experience for hundreds of people near Albany, New York. An infectious strain of *E. coli* bacteria washed into the groundwater from a local barn. The fair got its drinking water from local wells, so the contamination spread quickly to those thirsty people using the local supply. More than 600 people were known to be infected. At least 58 people were hospitalized with bloody diarrhea, abdominal cramping, and fevers. At least two deaths were attributed to kidney failure caused by the bacteria; a 79-year-old man and a 3-year-old girl died from doing nothing more than having a drink of water.

*Milwaukee, Wisconsin, April 1993*

Watery diarrhea, abdominal cramping, fever, and nausea ravaged the population of Milwaukee, Wisconsin. Approximately 400,000 individuals were affected, with hundreds hospitalized and several immunocompromised victims dying. Drug stores and supermarket shelves were emptied of anti-diarrheal medicines. Too widespread an outbreak to be food-borne, the problem could only have been in the water supply. Yet, standard bacterial tests indicated no signs of problems, and water treatment plants were meeting performance standards. It took approximately 1 week to discover that the cause of this outbreak was a protozoan parasite, *Cryptosporidium*, coming through one of Milwaukee's major water treatment plants.

These two incidents teach us many things, but two of the most important lessons are that rural settings present special problems of contamination because they lack substantial protection from regulatory controls. The other lesson is that municipal settings, even though protected by comprehensive treatment and other regulatory requirements, can still present unreasonable risks to a community.

Local health departments often provide the first (and usually only) line of defense in protecting the drinking water quality of rural areas. Although city dwellers have other agencies protecting their water quality, they may turn to the local health department for answers about the risk from their water and in response to disease that may originate, or may be perceived of as originating, from their taps. Health departments need to be prepared to respond to these questions independent of regulatory authority.

## Drinking Water Contaminants

Water can have biological, chemical, and physical contaminants. Some contaminants result in acute (or immediate) effects; others present a threat only following chronic (or long-term) exposure. Table 1 on page 40 gives a summary of typical sources of the most important contaminants. It is vital when evaluating the potential for water contamination to consider the source. For example, groundwater ordinarily doesn't have to be checked for sediments because solids can't get into the aquifer (underlying layer saturated with water). Similarly, radon gas can be a problem only in groundwater because it quickly evaporates out of any surface water.

**Table 1** Key drinking water contaminants.

Type	Example	Typical Sources
<b>Biological</b>		
Bacteria	<i>E. coli</i>	Water in contact with wastewater
Viruses	Hepatitis A	Water in contact with wastewater
Protozoan	<i>Giardia</i> & <i>Cryptosporidium</i>	Normal surface water inhabitant
Parasites	Parasitic Worms	Fecal contaminated water (typically tropical diseases)
<b>Chemical</b>		
Nitrogen	Nitrate	Fertilizer
Metals	Lead	Home plumbing
Chlorination byproducts	Trihalomethanes (THMs)	Chlorination
Pesticides	Atrazine	Agriculture
Taste and odor producers	Hydrogen sulfide	Groundwater
Salt	Road deicing salt	Cold climate locations
<b>Physical</b>		
Solids	Sediments from erosion	Agriculture
Radiation	Radon	Underlying rock

Many contaminants are too difficult and expensive to evaluate routinely, so indicators are used. Of particular note is the use of coliform bacteria to measure possible contamination of water with wastewater or other fecal sources. Coliform bacteria are not (generally) harmful themselves, but they are indicators of pollution from organic sources containing pathogens. The total amount of material in water can be easily measured through testing for suspended solids, dissolved solids, and turbidity. These measures are not specific for the individual constituents of water, but they are useful measures of the magnitude of the material in the water. It is important to remember that good quality water has material in it—evaluating the nature and concentration of that material is key to determining water quality.

### Sources of Contamination

#### *Groundwater*

About half of the water used for drinking in the United States is groundwater. Groundwater is underground or subsurface water. Groundwater comes from surface water percolating through overlying soils and it resides in the pore spaces between particles of soil and other geologic materials. Formations that have all the pore spaced

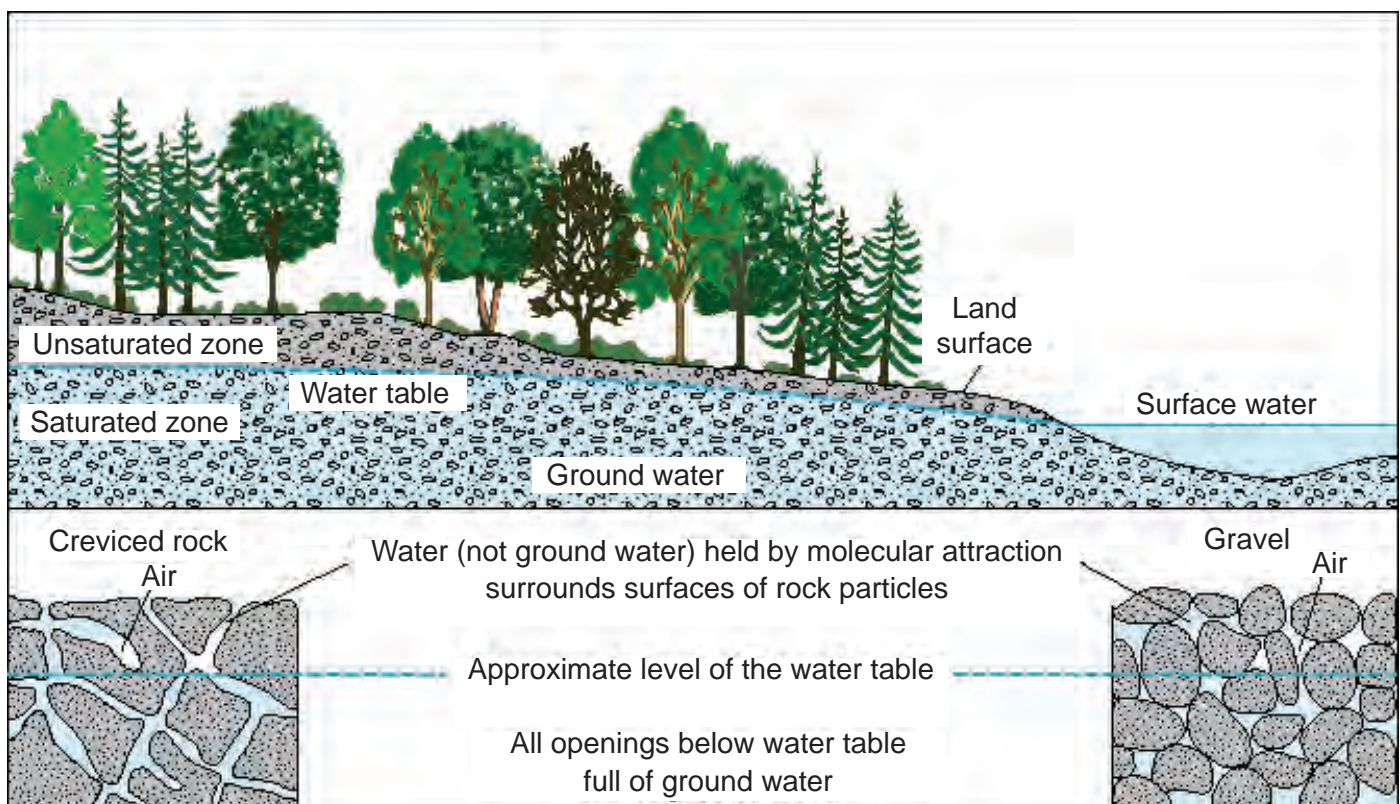
saturated with water are called saturated zones or aquifers. The top of the aquifer is called the water table. Figure 1 shows how groundwater is located in an underground saturated zone but can intercept surface water. Water wells extend into aquifers to allow water to be collected and pumped to the surface. Groundwater does not (generally) exist as underground rivers or pools—instead it is captured between particles above an impermeable layer that restricts water movement further downward.

As surface water percolates downward, sediment loads (including microscopic bacteria, viruses, and protozoa) generally are filtered out. However, all troublesome sediments may not be captured if the aquifer is very shallow. For example, a farm may have an animal feedlot that hosts a multitude of pathogens on the surface. If the aquifer is too close to that pollution source, bacteria may be insufficiently filtered by the soil and move into a neighboring well.

Other primary sources of groundwater contamination are pollutants discharging directly into the ground. The rural environment provides another excellent example. Many homes in the country are not connected to wastewater treatment plants. These homes often dispose of their wastewater through the use of on-site treatment. If the wastewater comes into contact with the aquifer, pathogens and other pollutants in the wastewater can be transferred into the water supply. A critical need in providing safe drinking water is to separate its source from any contamination with wastewater.

Chemical contamination also is a threat to groundwater through direct discharge. Flammable liquids, such as solvents used for industrial cleaning, are often stored in underground tanks. Leaking of these materials has been a major problem throughout the United States, often polluting aquifers used by major population centers (including areas in Long Island and Los Angeles).

**Figure 1** Groundwater aquifer.



### *Surface Water*

Municipal areas draw heavily on surface water for their drinking water supplies. Surface water sources—lakes, reservoirs, and rivers—are not (with a few exceptions) suitable for drinking without treatment. Good quality surface water supports life, but we don't want "life" in our water glasses. Again, keeping sources of contamination, such as wastewater, away from surface water is critical to controlling the safety of the water supply.

Surface water treatment is complex and largely done at the municipal level. Relatively few individuals directly use surface water from personal sources, such as a local pond or a roof-top collection system. However, those that do must be careful in removing and destroying contaminants that occur in these systems. Local surface water supplies are not protected by federal and state government regulation, so contamination may go undetected until it results in a major adverse health effect.

### *Water Treatment*

Somewhat paradoxically, municipal treatment of water almost always includes adding a chemical that is quite toxic. This chemical is chlorine, and its intention is to destroy disease-causing microbes in the water. Chlorine is excellent in accomplishing this goal, and the United States rarely faces water-borne disease outbreaks. However, treatment includes maintaining low levels of chlorine in the water to prevent survival of pathogens anywhere in the treatment and water delivery system. This means that trace levels of this chemical are delivered to the municipal taps. In addition to concerns about the chlorine, byproducts of chlorination are formed. Such byproducts include chloroform, one of a group called trihalomethanes (THMs). Many of these byproducts are known or suspected to have adverse health effects, such as causing cancers. However, they are permitted in water because the benefits of chlorination in protecting against acute disease outbreaks are seen to vastly outweigh the risks of chronic disease possibly occurring from these byproducts. Nevertheless, the public may disagree with this approach to water quality management. Individuals may take matters into their own hands and purchase bottled water or use home purification systems that remove chlorine and its byproducts. Health departments may be looked to as a source of information about this controversial issue even though they generally have no direct role in influencing municipal water treatment.

Fluoride is added to water in all municipal systems except in those communities where voters specifically voted not to fluoridate (a very tiny percentage of the population). There is no individual option as to whether there should be fluoride in the water—if no ballot issue is approved to prevent fluoridation, then all members of that community receive fluoridated water. Unquestionably, fluoride has been extraordinarily successful in preventing dental caries. However, some people are beginning to question fluoride's safety, particularly with regard to possibly affecting the bone strength of the elderly following a lifetime of consumption. Although local health departments usually have no direct role in influencing fluoridation, they may be looked to for community leadership in providing health information concerning this treatment practice. The local health department can also provide a valuable service in educating individuals who do not consume water from a municipal supply about the benefits of fluoride.

### *Home Plumbing*

Another source of contamination is the home plumbing system. Historically, lead was used generously in better quality water fixtures and as solder. It is now known that lead can leach into water and present substantial problems to consumers. Although lead in water systems is now regulated, old systems have little regulation. Furthermore, older homes with lead in their water systems may also have substantial problems with old leaded paints. Although lead in paint typically is a much larger problem than lead from water supplies, the combination from both sources may be particularly troublesome.

Individuals also are at risk from backflows. Plumbing changes may inadvertently result in connections between wastewater and potable water lines. For example, a hose in a drain may siphon back into the drinking water line. Although building codes include safety features to prevent such occurrences, building modifications may be done with little understanding of this threat. Individuals doing their own plumbing may be particularly likely to fail to provide adequate backflow prevention. Health department programs may be of great value in educating “do-it-yourselfers” about these threats.

Similarly, contamination of drinking water can occur if water pressure is too low in a system. Water pipes tend to leak—if the water pressure is high, the water leaks out and contamination cannot migrate against that flow. If water pressure is low, a leak may result in contamination moving into the drinking water line because there is no pressure preventing this movement. For example, low pressure in a water pipe underlying a sewage leach field may result in movement of contaminants into the water supply.

### **Public Health Significance**

Availability of a safe water supply is of paramount importance to public health. The regulatory system in the United States has been successful—with a few rare exceptions, such as the outbreak of *cryptosporidiosis* that occurred in Milwaukee—in protecting municipal systems from pathogen contamination. Adverse health effects from chronic exposure to trace contaminants in municipal water remain a controversial issue. Individuals may try to avoid this risk by turning to alternative supplies. However, non-municipal systems do not have comprehensive regulatory protections, so using these alternatives may increase actual health risk to the consumer. Furthermore, even bottled water, regulated by the Food and Drug Administration (FDA), has less regulatory protection than provided by the Environmental Protection Agency (USEPA) for municipal systems.

Individuals in rural areas who use local wells (or surface water supplies) have very few protections from contamination. Few people realize that, although municipal water supplies are very well regulated, there is generally little governance of non-public supplies. As people move to the country and population density increases, soils can become saturated and groundwater may be inundated with on-site sewage contamination. Alternatively, local homes too close to feedlots and other sources of animal wastes may have contaminated water supplies. In either case, local residents become vulnerable to water-borne disease and health problems such as diarrhea (which usually are not reported). It is difficult to link adverse health outcomes to a local contaminated water supply even though growing populations are using an unregulated, non-public water supply.

### **Responsibilities and Options Available to Local Health Departments**

Often, the local health department is the principal authority responsible for individual water supplies in areas not served by municipal systems. Health department programs that provide protections to local water supplies typically include:

- Assessment of site suitability
- Specification or approval of well design
- Specification or approval of specific well location
- Well remediation and decontamination
- Well water sampling, analysis, and data interpretation
- Well closure planning and regulatory programming



- Non-community, private water system inspection and sampling
- Community and individual education

Local health departments often have formal responsibility to provide these protections through a regulatory program governing well construction during property development. Some areas also require health department checks of rural water quality as part of property transfer. To a growing extent, lenders are also requiring checks of rural water quality as part of the process of qualifying for a loan. Often, the health department will conduct the sampling, analysis, and interpretation as part of this process. Rural developments often have water wells and on-site waste treatment systems in close proximity; it is typically the charge of the local health department to ensure that the water supply is protected from contamination from the wastewater.

In addition to its formal role in helping to protect rural drinking water quality, local health departments can play a key leadership role affecting municipal supplies. If there is a water problem, or perception of a water problem, the local health department is often turned to for advice. Local health departments need to serve as part of the team that interacts with the community and provides education. For example, if disease characteristics of water-borne origins are reported in a community, the health department usually will be best positioned to identify whether a problem exists and to interact with the municipal water purveyor. Alternatively, if the municipal water system has a problem (e.g., a pipe break that potentially allows contamination of the system), the health department is well placed to help inform and educate the public about the nature, duration, and severity of the problem. The public typically will not know (or care) that municipal water quality is not an activity regulated by the health department. If the public perceives that the water presents a threat to its health, the health department will be turned to as a primary resource. Certainly response to any act of bioterrorism targeting a municipal water treatment supply would require active local health department participation. It is imperative that the health department not only meets its obligation toward protecting water in the rural setting, but also be a leader in helping the community with issues concerning municipal water quality.

### **Current Issues and Opportunities**

The continuing importance of local health departments in helping individuals with their private systems is obvious. The potential for contamination of private systems, with serious consequences, is substantial. Although the majority of the population is using municipal supplies, a substantial number relies on local systems (see Figure 2). The local health department often provides the only external support to these systems. However, there are additional roles for the local health departments to play in trying to ensure safe drinking water for all.

#### *Private Water Systems*

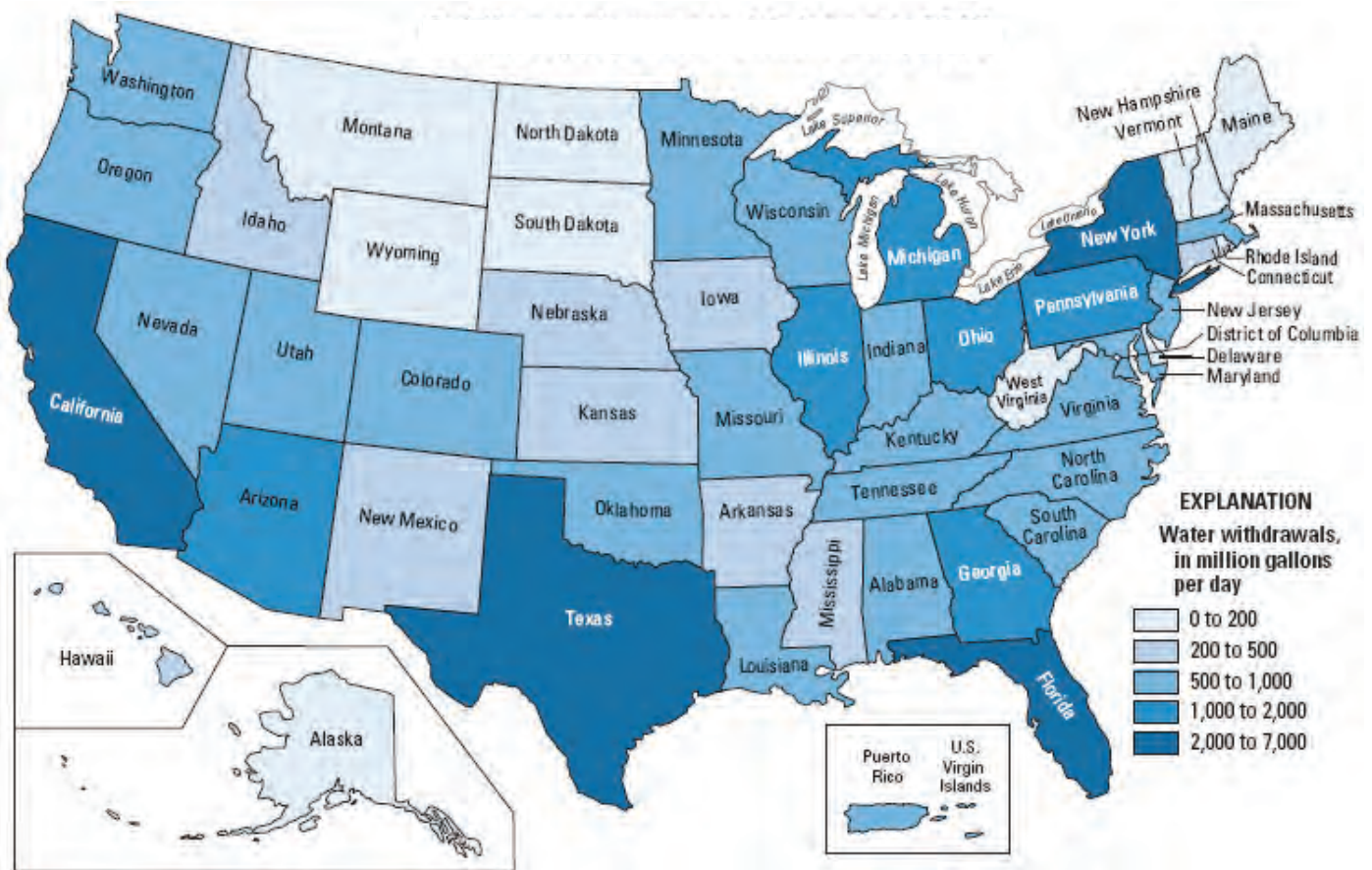
The USEPA has authority governing public water systems, those systems having at least 15 service connections or serving 25 or more people for at least 60 days annually. Thus, a small private system could serve multiple families and still have no regulatory protection other than at the local level.

#### *Sampling, Analysis, and Data Interpretation*

Individuals often have concerns about their water quality and do not know where to turn for help. The local health department can effectively play a primary role in providing answers to their questions. In municipal areas, this role may largely involve directing individuals to the proper resource or referencing the annual water quality report (see listing in “Resources for Additional Information” section at the end of the chapter). In rural areas it may mean providing a convenient and inexpensive investigation service. Typically, this investigation involves sampling for coliform bacteria as an indication of possible water supply contamination. Health departments also may be able



**Figure 2** Public water supply withdrawals, by state, 2005.



to direct consumers to other sources for more comprehensive evaluation should issues arise such as possible chemical contamination.

### *Education*

People generally don't think about their plumbing—water comes in when you turn on the tap and water leaves through the drain. As long as this happens without change, little thought is given to possible health hazards. However, as systems age and population densities increase, existing systems may fail to deliver safe drinking water. Providing people with the knowledge to properly maintain and inspect their own systems is a critical, although not mandated, function that may be adopted by local health departments. Similarly, getting people to understand and think about how their own activities, such as how pouring used oil down a sewer can pollute their own watershed or aquifer, can be an effective tool for changing behavior and protecting water quality. Boards of health should promote educational events to spread awareness of how individual actions can affect drinking water quality. These programs should include information about how household pesticides or disposing of medicine by flushing it down the toilet can cause drinking water to become contaminated.

### *Local Planning*

Providing a safe water supply to a large degree depends on protecting the source water. This may be a large groundwater aquifer, local wells, or surface water sources. The compatibility of land uses should be considered with regard to water quality. For example, a suburban housing complex that is dependent on on-site wastewater

disposal and individual wells and is located on sandy soils that allow little filtration of wastewater will almost inevitably result in water quality problems. Alternatively, inappropriately abandoning wells can provide a conduit for pollution to enter aquifers without protection from filtering through the soil. Planning needs to consider the appropriateness of local systems and the need to develop or link to municipal systems.

Similarly, watershed protection needs to be provided to ensure the adequacy of surface water sources. For example, heavily developing a watershed around a drinking water reservoir is asking for trouble. (Yet, the desirability of housing around water drives up the incentive for developing such land!) The use of Geographic Information Systems (GIS) to produce computer-generated maps linking land, demographic, and health features of a region shows particular promise as a planning tool. Local health departments can contribute to and use such tools in making community decisions that have long-term implications on water quality.

The cumulative impact of many small sources of contamination to a surface water or to a groundwater source is seldom considered by the individual polluter. For example, someone spreading lawn fertilizer may logically conclude that the relatively small amount of material being added to a watershed is negligible compared to the overall amount of nutrient addition. However, it is the entire community sharing these kinds of thoughts that will result in many small inputs that lead to excessive loading and substantial resource degradation. Planning can take into account typical human behavior and control development and activities to provide necessary environmental protections.

### *New Legislation*

In the past decade, several court cases have challenged the jurisdictional scope of the Clean Water Act. Two closely decided U.S. Supreme Court cases, *Solid Waste Agency of Northern Cook County v. Army Corps of Engineers* in 2001 and *Rapanos v. United States* in 2006, greatly reduced the scope of the CWA, undermining decades of clean water protections. The rulings found that the EPA and the Army Corp of Engineers did not have authority over all waters in the United States, only those that were connected, navigable waters. Wetlands, ponds, and other non-adjacent waters were not included under the Clean Water Act protection.

These court findings have created confusion over the EPA's authority and permitting rights, and many waterways could be in danger of losing their protections. Senator Russ Feingold (WI) has introduced new legislation to help protect the country's water supply. The Clean Water Restoration Act of 2009 will solidify the protection of drinking water, as well as lakes, rivers, and streams, by removing the word navigable from legislation. This change, along with including protection for isolated waters, will help close the loopholes found by the Supreme Court in the past decade.

### **Conclusion**

Local boards of health must make important decisions in protecting their communities' drinking water quality. Most obvious is the need to ensure that their local health departments meet the needs of the rural areas that do not have protections associated with being part of municipal systems. As populations increase and more people use non-municipal (private) systems, this role will increase in scope and importance. Yet, the regulatory role remains small, and education and other innovative health department programs must take priority in ensuring the protection of the rural drinking water supply. Alternatively, municipal drinking water has comprehensive regulatory protection from agencies other than local health departments. However, as the key local health agency, health departments need to be involved in issues affecting the water supply, such as planning, emergency response, and education. There must be recognition that having a safe water supply is a basic necessity in maintaining good health. Again, it is the responsibility of the board of health to ensure that its department takes an active



and comprehensive leadership role reflecting the characteristics of the community and its associated needs to guarantee the continual supply of safe drinking water.

## Questions and Considerations for Local Boards of Health

1. Has your board of health reviewed the health department's programs to assess private water wells?
2. Has your board of health conducted a needs assessment to determine what drinking water needs should be addressed in your community?
3. Has your board of health advocated for improved drinking water?
4. Has your board of health passed any regulations regarding drinking water quality in your area, such as banning the use of pesticides at schools or other public places?
5. Has your board of health educated people about the disposal of medications?
6. Has your board of health secured sufficient funding for drinking water programs and water well assessments?



## Resources for Additional Information

American Water Works Association. Available at [www.awwa.org](http://www.awwa.org)

Barzilay, J. I., Weinberg, W. G., & Eley, J. W. (1999). *The water we drink: Water quality and its effects of health*. New Brunswick, NJ: Rutgers University Press.

Edzwald, J. K. (Ed.). (2011). *Water quality & treatment: A handbook on drinking water* (6th ed.). New York, NY: McGraw-Hill.

Spellman, F. R. & Drinan, J. (2000). *The drinking water handbook*. Boca Raton, FL: CRC Press.

United States Environmental Protection Agency. Ground Water and Drinking Water. Available at <http://water.epa.gov/drink/>

United States Environmental Protection Agency. Water: Consumer Confidence Report Rule. Available at <http://water.epa.gov/lawsregs/rulesregs/sdwa/ccr/index.cfm>

Water Quality Association. The WQA Glossary of Terms. Available at [www.wqa.org/glossary.cfm](http://www.wqa.org/glossary.cfm)



# Wastewater

## Public and Environmental Health Significance of Wastewater Management

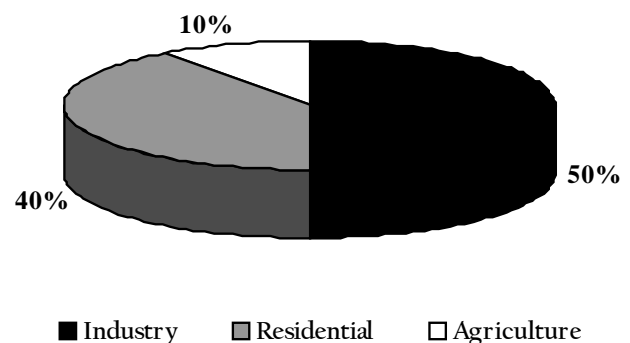
### *What Is Wastewater and Where Is It Generated?*

Wastewater may be defined as “water that has served its original purpose and is intended for treatment and/or disposal.” Wastewater may be generated from discrete point sources (Figure 1), such as industrial wastes, or diverse nonpoint sources, such as agricultural or urban runoff. Primary water uses that generate wastewater include drinking, washing, solid and liquid waste processing, cooling, and irrigation. Major sources of wastewater include residential, industrial, and agricultural sources (Figure 2). A typical resident uses about 45-60 gallons of water per day—a family of four may generate up to 240 gallons of wastewater per day.

**Figure 1** Wastewater from discrete point source.



**Figure 2** Approximate relative volumes of wastewater, based in primary water use sectors in the United States.



Primary wastewater contaminants of public health concern are microbiological disease agents (pathogens) and chemical poisons (toxins). Other biological, chemical, and physical wastewater contaminants may also disrupt natural aquatic systems (e.g., siltation of rivers and streams due to erosion). Seventy-five percent of domestic wastewater is connected to municipal wastewater collection and treatment facilities. The remaining wastewater is discharged to a decentralized on-site wastewater treatment system. Up to 40% of new construction depends on decentralized on-site wastewater treatment systems.

Levels of contaminants in wastewater may be determined directly. However, it is often quicker and more economical to test *indirectly* for indicators of contamination. For example, coliform is a group of bacteria used to indicate water contamination. *Total* coliform includes the subgroup fecal coliform and other bacteria that may indicate water contamination. The fecal coliform group excludes some nonfecal coliform bacteria and is often used to measure surface water or groundwater contamination from sewage. *Escherichia coli* have been suggested as an even more specific indicator of human fecal contamination of water.

Wastewater management usually focuses on treatment and disposal. However, water use reduction may be of greater management potential. Almost all of the water that is used by a home, business, or industry is discharged as wastewater, except for a small amount that evaporates. Therefore, decreased water usage reduces wastewater generation. Examples of water use reduction technology include low-flush toilets, low-flow showerheads, and modified industrial processes. Innovative local health departments should work toward reducing wastewater



generation through promoting water use reduction. Local planning and utility agencies should also be included in these efforts.

### *Routes of Exposure*

Humans can be exposed to wastewater contaminants through several routes, including drinking (ingestion), swimming or bathing (dermal exposure or skin contact), and breathing aerosols (inhalation). These exposures may potentially result in adverse health effects, primarily from microbial and chemical contaminants. Drinking untreated water from a well, lake, or stream contaminated with wastewater may transfer infectious agents such as bacteria, viruses, and protozoa, or chemical poisons such as metals, solvents, or pesticides. Ingestion is the exposure route that generally has the highest risk for causing illness because contaminants gain direct access to the body. Some chemical toxins and pathogenic microorganisms may be transmitted through inhalation of aerosols (suspension of tiny water droplets in air). Usually the least hazardous route of exposure is direct skin contact during bathing or swimming. Unless there are open sores to allow pathogenic bacteria or chemical irritants to enter body tissues or bathing water is accidentally swallowed, water contaminants are usually not present in high enough concentrations to present a significant risk of illness through dermal exposure.

### **Decentralized (On-Site) Wastewater Treatment Systems**

In areas where there is no access to centralized collection and treatment systems, developers often use an on-site wastewater treatment system that serves an individual residence, a group of residences, or a commercial facility. An on-site system allows wastewater to be treated near its source. The systems are “decentralized,” because there are no collection sewers or a single treatment plant to treat wastewater for an entire service area. On-site wastewater treatment systems are also commonly referred to as septic systems, septic tank/soil absorption systems, septic tank/drain field or leach field systems, septic tank and subsurface wastewater infiltration system (SWIS), or private sewage disposal systems.

A conventional on-site system consists of a septic tank and a soil absorption system. The septic tank is used to provide separation of the solids from the liquids and to provide limited anaerobic decomposition of the organic materials.

A septic tank must be periodically pumped and cleaned to remove accumulated solids. The mixture of solids and liquids removed from a tank is called septage. Septage is usually treated in an off-site facility. It may also be applied to the soil in a land treatment facility or delivered to a centralized municipal wastewater treatment plant.

The wastewater from a septic tank is discharged into a subsurface soil absorption area where soils and soil microorganisms trap and destroy pathogens, remove nutrients, and degrade suspended and dissolved solids that are not removed in the septic tank. The treated wastewater then moves down through the soil, where it serves to recharge ground water and adds to base flows for surface waters, aiding in long-term sustainability of water supplies for the future.

On-site systems provide numerous benefits for many types of communities and conditions. In smaller communities with low population densities, on-site systems are often the most cost effective option. If properly planned, sited, designed, installed, operated and maintained, on-site systems can provide the level of treatment necessary to protect public health and meet water quality standards.

On-site systems may also aid in watershed management by avoiding potentially large transfers of water from one watershed to another. Local aquifers may be recharged by discharging wastewater into subsurface waters, thus maintaining a sustainable groundwater supply and a consistent base flow for surface waters. Other water reuse



opportunities, such as irrigation using on-site wastewaters, may be available close to the point of wastewater generation. However, such uses may require additional treatment (such as disinfection), and may also involve additional permitting requirements.

Some of the more common types of on-site septic systems are summarized in Table 1 on page 54. The use of many of these systems is controversial. If ideally sited, constructed, and operated, all may work quite well. However, it is often extremely difficult to ensure that all proper conditions are met and maintained. Many systems that depend on extensive maintenance fail. It is vital for local officials to know what works in their community, and for the board of health to ensure that past practices are evaluated to determine their adequacy in protecting water quality and public health.

Despite the many benefits, on-site systems may also pose challenges for local public health officials. For example, many on-site systems in use today do not provide the treatment level necessary to adequately protect public health and water quality. Many inadequate systems were initially installed as temporary solutions with the assumption that centralized collection and treatment facilities would soon replace them. More than half of existing on-site systems are over 30 years old. At least 10% of these older systems cause wastewater to back up onto the ground surface or into a home each year. In many areas of the country, the local public health agencies do not have records of many of these older systems within their jurisdictions.

In addition, some situations and locations are not appropriate for any type of on-site wastewater treatment system. Allowing on-site systems to be installed on such unsuitable locations and in unsuitable soil conditions could result in adverse effects on public health and the environment through contact with inadequately treated wastewater. Property values may also be negatively affected when wastewaters are not treated properly. All on-site sewage systems have a limited life expectancy and will ultimately fail.

### **The Local Health Agency's Roles and Responsibilities Regarding Wastewater Treatment Programs**

A local health agency's responsibilities vary based on the types of wastewater treatment facilities in an area or community and the specific government regulations that apply in a given jurisdiction.

#### *Role in Centralized System Programs*

Local health agencies usually do not have a formal role in centralized municipal wastewater management. A municipality or other publicly owned agency assumes the responsibility for the treatment of wastewater, which is regulated by state and federal rules.

However, when problems occur with centralized systems, a local health agency is often the first called to investigate complaints. Such problems may include fish kills, algae blooms, aesthetic concerns such as bad odors or appearance, or hazardous chemicals in wastewater.

Local health agencies are also responsible for identifying potential sources of illness that occur in their communities, which can include exposure to wastewater and associated pathogens.

Local health agencies may consider appointing a liaison between municipal wastewater operators and the health agency to clearly identify ways to communicate during outbreaks and to proactively work together to prevent waterborne diseases and nuisance complaints.

**Table 1** Common on-site wastewater treatment systems.

System Type	Media	Comments
Gravel	Gravel and surrounding soil, protected by cover of filter material to prevent media clogging	Common, economical system, but requires proper soil infiltration characteristics
Gravelless	Surrounding soil, with effluent distributed by engineered system	Engineering system types vary (often proprietary)
Sand filter	Sand, with upper influent distribution and lower effluent collection and discharge	Outflow (effluent) may require disinfection prior to surface water discharge
Aerobic treatment plant (ATP)	Surface area supports bacterial ( <i>biofilm</i> ) growth and biological treatment as inflow ( <i>influent</i> ) passes through	Effluent may require further treatment prior to discharge (often proprietary)
Mound	Coarse sand and topsoil layered above ground level with grass cover level	Used for sites where soil factors are very limiting (low soil permeability or high water table)
Built up	Sand, gravel, and/or soil layered above and below ground level	Used for sites where soil factors are also limited
Serial distribution	Effluent discharge laterals are installed at different levels perpendicular to terrain slope	Design and installation must be proper to ensure even effluent distribution
Drip irrigation	Effluent is slowly discharged, often through intermittent dosing	Proper soil infiltrative capacity important (relatively new technology, often proprietary)
Pressure distribution	Low pressure pipe systems	Can be used in shallow soils; they work effectively because the entire system is periodically “dosed” allowing time for soil to absorb wastewater

### *Role in On-Site System Programs*

In rural areas, where many on-site wastewater treatment systems are used, a local health agency is often the only direct regulatory authority that provides oversight and enforcement of wastewater management.

Most regulations in use today do not address the issue of system performance. Rather, regulations are prescription-based, which means that jurisdictions using prescriptive codes specify the types of systems that must be installed and the types and depth of soils that must be present. If site conditions are unacceptable, the prescribed systems cannot be used, which has resulted in restrictions in development options for many areas. For example, in Florida,

the United States Department of Agriculture's Natural Resources Conservation Service criteria determined that 74% of the soils have severe or very severe limitations for conventional on-site systems.

Prescription-based regulations also require mandatory setbacks of on-site systems from seasonally high water tables, property lines, wells, surface waters, and other landscape features. The lengths of these setbacks vary widely among different jurisdictions. If prescribed systems are sited, designed, and constructed according to regulatory requirements, the systems are then presumed to meet public health and water quality standards. Ongoing monitoring of performance is usually not conducted to see if standards are being met. In many cases, prescriptive standards are protective of public health and the environment.

A new model that focuses on system performance to regulate on-site systems has been proposed. Performance requirements establish specific and measurable standards that are necessary to achieve the required level of environmental and public health protection for a specific area and water resource. These standards may be expressed as numeric limits (e.g., contaminant concentrations) or as narrative descriptions of desired conditions or requirements (e.g., no leaks, odors, cracks, or surfacing wastewater). Many states and local health agencies are adopting or considering the use of performance requirements to achieve protection of public health and environmental quality.

### **Goals for On-Site Programs**

Traditionally, a local public health agency directs on-site wastewater activities towards the following goals:

- Reduce the risks to public health by:
  - Reducing health risk from wastewater backup into homes
  - Preventing wastewater discharges to the ground surface to avoid direct public contact
  - Preventing ground water and well water contamination due to pathogens, nitrates, and toxic substances
  - Protecting shellfish habitat and harvest areas from contamination with pathogens
  - Minimizing risk from the reuse of inadequately treated effluent for drinking water, irrigation, or other uses
  - Minimizing risks from inadequate management of septage
  - Minimizing risk of public contact with on-site system components
- Abate public nuisances by:
  - Eliminating odors caused by inadequate plumbing or treatment processes
  - Eliminating odors or other nuisances related to transportation or disposal of septage

More recently there has been increased focus on developing goals to prevent on-site system related surface and groundwater quality degradation and adverse impacts on water quality, including goals related to the protection of environmental resources. These goals include:

- Prevention and reduction of adverse impacts on water resources due to contaminants and pathogens discharged from on-site systems

- Prevention and reduction of nutrient over-enrichment of surface waters, which may result in algae blooms or low dissolved oxygen in surface waters
- Protection of sensitive aquatic habitat and life

### **The Local Board of Health's Responsibilities Regarding Wastewater Programs**

In most jurisdictions, a local board of health or other governing body (e.g. county commissioners, city council) oversees the activities of the health agency. Local boards of health are charged with the assessment, policy development, and assurance of public health in their communities. While local board of health members do not perform or engage in the services provided by the health agency, they are responsible for ensuring that the necessary resources (time, money, personnel) are available to provide the appropriate health programs or services to the community.

To provide safe wastewater management in the community, the local board of health must remedy existing problems and identify potential problems before they exist. An assessment of the effectiveness of the on-site program through a structured and regular evaluation process provides valuable information for maintaining and improving the program. The procedure to accomplish this includes:

1. Assessment of the community's wastewater management needs
2. Development or recommendation of policies and programs to meet the community's wastewater management needs
3. Assurance that the personnel, training, and resources are available to support necessary wastewater management programs

These topics are discussed individually in the following sections.

#### *Assess the Community's Wastewater Management Needs*

If they do not already have the information, the local board of health should evaluate existing wastewater policies and programs to determine if they meet the community's wastewater management needs. Such an assessment identifies problems, evaluates the means for improvement through new technologies or program enhancements, and ensures that funding is available to sustain programs and achieve intended outcomes.

Depending on local circumstances, a comprehensive program evaluation may require significant resources and time. The board may appoint one or more local health agency staff members to conduct the evaluations. For a more wide-ranging review, however, a program evaluation team may be formed that consists of service providers, elected officials, interested citizens, and representatives from public health agencies and environmental protection organizations.

The first step in conducting a successful assessment program involves gathering data. Local boards of health that succeed in finding viable solutions to their wastewater needs use data to clearly understand their current situation before proposing changes. Without a good base of information, it is difficult, time-consuming, and frustrating to make informed decisions regarding solutions. Many kinds of information are readily available, but sources and completeness of data may vary from community to community.

Based on the data collected, the extent of any existing and potential future problems in the community may be defined. The local board of health should evaluate the cumulative impacts that different types of wastewater

treatment systems may have on a region or a community in terms of water quality and in future growth and development.

Policies and programs to be evaluated may include: (a) Sanitary ordinances and regulatory codes; (b) appeal and variance procedures; (c) local health agency workforce capabilities; (d) comprehensive land use plans, economic development plans, and zoning ordinances; (e) evaluation of partnerships and coordination with other agencies; (f) community water resource protection goals; and (g) assessing the adequacy of public education, outreach, and community involvement programs.

#### *Develop or Recommend Policies and Programs to Meet the Community's Wastewater Management Needs*

There are many ways to effectively develop a wastewater program that protects both public health and environmental quality. Based on the information gathered during the assessment phase, the local board of health should define goals for managing community wastewater. These goals include the development of wastewater regulatory and management programs to:

- Protect public health and environmental resources
- Meet land use planning needs
- Address types and quantities of wastewater generated in the community
- Meet the limitations imposed on selection of technologies by local site and soil characteristics
- Assure adequate community water resources (especially important for water rights in western states)
- Provide for ongoing operation, maintenance, and monitoring of on-site systems

Making an informed decision involves having adequate knowledge of potential solutions that are applicable to the data collected. To accommodate wastewater generated within the jurisdiction, the local board of health, in cooperation with environmental protection agencies, must make decisions on whether to utilize centralized or decentralized systems, or a combination of both. The specific types of the selected system must provide adequate protection for public health and for the water resources found within the community.

Appropriate plans and tools must be developed to achieve a community's wastewater goals. These tools include regulatory codes, permitting processes, certification programs, and public education programs. Proactive participation by local health agency staff and local board of health members in community land use planning decisions should be considered to provide input on public health issues.

When using on-site systems, the board should ensure that ongoing management requirements for the specific technologies selected are developed, as well as defining the type of legal and responsible management entity that will be employed and providing financial options for funding a management program. The use of an advisory committee by the local board of health is often the key to effective community decision-making concerning wastewater treatment strategies. Members of the committee must be willing to contribute their expertise over what may be a long period of time.

The committee should reflect the demographic make-up of the community regarding the economic, educational, and geographic distribution of the population. An ideal committee also includes persons of diverse talents, such as environmental health scientists, accountants, community educators, community organizers, planners, lawyers, and



technical experts. Even critics of various wastewater solutions may be valuable members of an advisory committee to ensure that all points of view are considered.

*Assure that the Personnel, Training, and Resources are Available to Support Necessary Wastewater Management Programs*

After developing a comprehensive wastewater management program, the local board of health should investigate ways to assure that local health agency staff, training opportunities, and resources are available to support necessary wastewater management programs. If more complex alternative on-site systems are utilized in a community or area, more local health agency staff may be necessary to review designs and conduct inspections during and after construction. Adequate staff must also be available to oversee public education and system management programs to ensure that appropriate materials and guidelines are used and that the programs are achieving their desired goals.

In the past, training in on-site wastewater treatment has not been readily available. On-site systems were traditionally not covered in depth in most university curricula, and opportunities for continuing education were few. However, in recent years, many states have developed training centers and programs dedicated to on-site wastewater education. These programs typically target system regulators, health agency staff, pumpers and haulers, and system designers and installers. Some programs have expanded their focus to target other small community audiences, such as public officials, homeowners, and students. An *On-Site Wastewater Training Directory* that describes training center programs and centers is available on the National Small Flows Clearinghouse website at [www.nsfcwvu.edu](http://www.nsfcwvu.edu).

Management programs may be provided by a local health agency itself or by a private service entity with local health agency oversight. The United States Environmental Protection Agency (USEPA) guidance materials, *Voluntary National Guidelines for Management of On-Site and Clustered (Decentralized) Wastewater Treatment Systems* and *Handbook for Management of On-Site and Clustered (Decentralized) Wastewater Treatment Systems*, provide valuable information on how a management program may be set up and implemented. The information can be obtained online through the USEPA Septic (On-Site) Systems web page at <http://cfpub.epa.gov/owm/septic/index.cfm> or by email at [decentralized@epa.gov](mailto:decentralized@epa.gov). A comprehensive and effective on-site wastewater management program may require more funding resources than have traditionally been required in the past. Base funding to a local health agency provided through local and state government agencies and permitting fees should be set at levels high enough to cover the cost of programs and services provided to the community. Ongoing management programs may be funded through different types of fee-for-service mechanisms.

Various grants and loans are available at local, state, and federal levels to finance wastewater projects, including the USEPA, U.S. Department of Agriculture Rural Utilities Service, and the U.S. Department of Housing and Urban Development community development block grant (CDBG) programs. Success in obtaining funding from the USEPA and other agencies is enhanced if the project can demonstrate fiscal, managerial, and technical capacity. Fiscally, the project must have sufficient revenue, creditworthiness, and good fiscal management and controls. Managerially, the project must demonstrate ownership accountability and adequate staffing, while technically, the project must show that continuing technical knowledge is available to support it, the adequate infrastructure to maintain it, and the ability to make changes over the long-term. By developing these types of capacity, the wastewater project should be self sustaining in the future.



**Conclusion**

To protect the health of the citizens in a community and the community's environmental resources, members of a local board of health should actively seek to understand how on-site systems function, proactively work to assess their community's needs, develop policies and programs to meet those needs, and assure that support is available to implement policies and programs. For questions or additional local board of health resources, please contact the National Association of Local Boards of Health.

## Questions and Considerations for Local Boards of Health

1. Have there been any incidents of wastewater overflows or contaminations in your community?
2. Does your local health department promote water use reduction?
3. Has your board of health reviewed local regulations regarding on-site wastewater disposal? Are these regulations being enforced?
4. Is your board of health aware of areas in your community where septic systems are not appropriate? Have there been efforts to develop on these types of sites?
5. Has there been any history of homeowners with failing septic systems filing litigation against health officials or boards of health?
6. Are all on-site wastewater treatment systems properly permitted and monitored?
7. Have there been nuisance complaints about on-site wastewater treatment systems? Have these complaints been investigated?
8. Has the local health department or board of health evaluated the cumulative impact that wastewater management has on the local community?

## Resources for Additional Information

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# Solid Waste

## Introduction

Solid waste results from various sources, such as animal wastes, hazardous wastes, industrial and medical wastes, food wastes, mineral waste, and nonhazardous wastes. In addition to recognizing the numerous sources of waste, the management of solid waste requires understanding treatment and disposal options; legal aspects, such as policy development, enforcement, regulation, and reporting; and the transportation of wastes. Boards of health around the nation have varying levels of authority for implementing, improving, or investigating solid waste management.

The growing volume of solid waste generated by communities is a concern for public health officials. Some of the concerns include aesthetics (e.g., the visual appearance of many collection sites and odors associated with solid waste), the potential for groundwater contamination, an increase in vectors (rodents, insects, etc.) that may spread diseases, and other issues regarding sanitation. To handle these matters, boards of health and local health agencies must determine the appropriate means of collecting, storing, and transferring wastes; the location of landfills; and the practice of recycling, when possible, to reduce costs and improve environmental conditions. In addition, boards of health may be responsible for overseeing the regulation and licensure of the conditions and facilities of solid waste disposal.

Although boards of health are responsible for assuring that solid wastes are managed appropriately in their communities, a board's specific responsibilities will differ depending on geographic location as well as particular circumstances. Their responsibilities and/or policy decisions may have to address abandoned landfills, open dumps, tire repositories/reservoirs, special wastes (such as medical wastes), low level radioactive wastes, construction/demolition debris, and sludge disposal. Disputes may arise between the standards set with city, county, or private entities wanting special actions or consideration.

In general, boards of health have limited control over the regulations for industrial and agricultural solid waste products. However, boards usually have greater decision-making capabilities regarding the nonhazardous waste category known as municipal solid waste (MSW), which refers to the waste produced by individuals in both urban and rural areas. Because of the important role that city and county boards of health may play in managing MSW, this chapter will focus on this specific type of waste.

This chapter cannot address all of the possible municipal solid waste issues that may be presented to boards of health. Rather, the goal of this chapter is to provide a guide for board of health members to review and consider when discussing their solid waste mandate. It will attempt to give a general response to questions about why solid waste is a public health issue and what boards of health or health departments can do to address such issues.

## Municipal Solid Waste (MSW)

Three terms are often used to describe municipal solid wastes:

- *Garbage* usually consists of highly decomposable products, such as food waste products.
- *Trash* comprises various bulky waste items, such as a tree stump or branches, discarded mattresses, and old or nonworking appliances.
- *Rubbish* is nonputrefying or slowly decomposable or combustible items, such as paper, glass, metal cans, and wooden products.

Municipal solid wastes include everyday trash items, such as packaging, yard wastes, glass, paper, food scraps, appliances, and batteries. It should be noted too that this category of waste refers to trash from both urban and rural areas and city and county jurisdictions. MSW does not include debris from construction or demolition, wastewater treatment sludge, or nonhazardous industrial wastes.

### **Solid Waste Management – Dilemmas and Decisions**

Many solid waste management practices in the United States are changing. Technical requirements for operating MSW facilities and their placement have increasingly stringent mandates. Simply placing solid waste products in selected areas to fill voids, e.g., using the “out of sight/out of mind” approach, or burying items are no longer environmentally or socially acceptable. Guidelines stressing that governments (federal, state, local) buy and use products made from recycled materials have stimulated progressive communities to find ways to reduce landfill loads and to offset certain expenses of waste management programs. Other methods are under consideration as attention is drawn to the issue and municipalities address solid waste management challenges.

Effectively managing the elements of the waste stream requires a presentation of facts for local decision makers to consider, review, and utilize. The difficulty of correctly perceiving the sheer volumes of solid waste can sometimes be reduced if one considers that, “on average,” each person in the United States generates 7 pounds of solid waste per day, of which 4.62 pounds is municipal solid waste. Nationwide, this amounts to approximately more than 250 million tons per year; an amount that, if placed in one location uncompacted, would cover an area of 400 square miles, 6 feet deep.

Two important pieces of legislation apply to municipal solid waste. The Solid Waste Disposal Act (1965) was the original legislation applying to waste; it was replaced in 1976 by the Resource Conservation and Recovery Act (RCRA). These pieces of legislation address disposal practices and regulations for the nation. In addition, these acts place emphasis on volume reduction and recycling whenever possible and encourage the development of integrated waste management plans that have been successful in some regions. Although the growth of regulations and guidelines has helped some communities make effective solid waste disposal policies, other communities have been confronted with increasingly expensive decision-making actions that have produced concern, confusion, and on occasion, confrontational situations.

#### *Landfill Disposal*

Approximately 135 million tons of municipal solid waste was discarded in landfills in 2008—the majority of solid waste ends up in landfills. Adverse environmental impacts result from the failure to assume full responsibility for proper waste disposal practices. Improperly operated landfills have been linked to soil, surface, and groundwater contamination. Decision makers create and enforce policy with environmentally aware citizens, government, and facility operators. All elements of society are learning that the public good is best served by the organized and controlled management of municipal solid waste. Because landfills have a finite lifetime, often underestimated, communities are necessarily faced with the need to site more new landfills while managing and maintaining old ones.

Boards of health, with input from their communities, should clearly define the goals for the desired collection system, periodically review the system’s performance, and regularly evaluate and adjust the system’s goals to conform to the changing needs in the community. Examples of the issues that should be considered are the level/quality of service needed, the community’s long-term waste management goals, the roles to be played by public and private sectors, appropriate mandates for sites to address various waste streams (e.g., infectious waste, biosolids, waste tires, household hazardous items, etc.) that may require special oversight and management needs, available funding mechanisms, and existing labor/service contracts that may affect decision making.



Once local board of health officials (including board of health members) have defined the goals of the community's MSW system, they should determine the appropriate roles for public and private sectors, and consider if a municipal department, a contracted private firm, or a combination of public and private haulers will operate the collection system. A clear organizational structure and management plan should be developed regardless of the option chosen.

Local boards of health and local officials may wish to explore alternative mechanisms for funding collection services. Some of the most common methods used are property taxes and special solid waste services fees. Many communities consider user-based fees that can stimulate waste-reduction efforts and reduce existing tax burdens. Decisions about how residents prepare waste for pickup and the methods used to collect it also affect each other and must be coordinated to achieve an efficient, effective system. These decisions may include the following:

- Guidelines and ordinances specifying how residents should prepare solid waste and recyclables for collection.
- The point and frequency of collection from the determined ports (e.g., curbside, backyard, etc.).

Because there are numerous types of collection vehicles and optional features, specific equipment design information must be determined. Benefits of a transfer facility may be appropriate for some communities, which may lower collection costs, reduce fuel and maintenance costs for collection vehicles, increase flexibility in selecting disposal facilities, and allow other options that may reduce operational costs. There is a need also to consider drawbacks, such as difficulty with locating sites and issuing permits, as well as the construction and operating costs that make the facility undesirable for some communities.

Finally, the layout of the routes and the collection schedules should be developed for the selected collection system. Efficient routing decreases labor, equipment, and fuel costs. As in all organizations, good personnel management is essential to an efficient, high-quality waste collection system; hiring and keeping well-qualified personnel are crucial.

At each phase of this process, board of health members may play an important role in the management of solid waste. During the goal planning stage, it is important for board of health members to actively partner with other agencies to develop community goals. In addition, members may also be called upon to analyze budgets, site locations or permitting practices, develop hiring processes for collectors and enforcers, set fee schedules, advise other agencies or officials, monitor standards, and educate the public about solid waste disposal and reporting standards.

#### *Landfill Operations – Landfill Hazards*

Nonhazardous solid waste landfills provide for the environmentally sound disposal of waste that cannot be reduced, recycled, composted, combusted, or processed in some other manner. Even with the practices mentioned above, a landfill is needed to dispose of the residues of those processes. The federal government sets minimum national standards applicable to municipal solid waste landfills, and these federal regulations are then implemented by the states. For board of health members, the guidelines may vary at county and/or municipal levels but should always meet or exceed federal mandates. It should be stressed that good design and operation will also limit the effort and cost necessary for maintaining the landfill after final site closure.

Building a landfill requires large sums of money and long periods of time, so careful planning by the developers of new or expanding landfills is important. Some of the cost elements and time periods include siting, design, and construction; operation, monitoring, and administration; and eventually closing and the post-closure maintenance



for a minimum of 30 years with possible remedial actions. There are a number of processes suggested by technical firms and governmental agencies to attempt to meet the requirements set forth by existing mandates. Boards of health that are involved with planning for a landfill should consult with the United States Environmental Protection Agency (USEPA), governmental agencies, the public, technical firms, and anyone who may assist with the numerous details of building a landfill (see Figure 1).

**Figure 1** Sixteen phases of landfill operations recommended by the USEPA.

The use of landfills to dispose of MSW requires careful consideration regarding the location, management, and closure plans for the site. The USEPA recommends that local authorities consider the 16 phases of landfill operation carefully before constructing new landfills.

The 16 phases are:

1. Estimating landfill volume requirements.
2. Investigating and selecting potential sites.
3. Determining applicable federal, state, and local requirements.
4. Assessing landfill options for energy and materials recovery.
5. Considering the site's final use.
6. Determining the suitability of sites.
7. Designing the fill area to satisfy plan/permit requirements.
8. Establishing a leachate management plan.
9. Instituting groundwater monitoring.
10. Setting up a gas management plan.
11. Preparing landfill final cover specifications.
12. Obtaining plan and permit approvals.
13. Operating the landfill.
14. Establishing financial assurance for closure and post-closure care.
15. Closing the landfill.
16. Providing post-closure care.

Additional information on landfill development, management, and closure can be obtained from the USEPA at [www.epa.gov](http://www.epa.gov).

Adherence to the proper procedures during the operation of a landfill is extremely important and requires constant attention. Following procedures religiously will minimize rodent and vector numbers and the concern of transmissible diseases and health hazards. Procedures are based on "typical" situations and serve only as guidelines for a municipality, with each making the necessary adjustments required in their particular situation.

One of the problems associated with the decomposition of municipal solid waste in a landfill is the production of methane gas. The methane gas usually seeps through the compacted matter and accumulates to form pockets



of gas, thereby creating the possibility of an explosion under certain conditions. If the landfill site is located near homes or businesses, there is a potential for the methane to enter basements, which creates the potential for very dangerous situations. Boards of health can take proactive measures to ensure that enactment and enforcement of the landfill operating policies occur.

An additional concern is the potential contamination of groundwater and/or surface water by leachates. Leachates consist of a watery solution containing dissolved products from surrounding materials in the landfill. If leachates are not properly contained by the correct placement and use of standardized liners, the solution may leak into surrounding groundwater and/or surface water. If liners are improperly installed or not used, this problem has the potential to become pronounced, and boards of health must not only take action to clean up potential problems but work to reduce the risk of occurrence.

Although one would seldom consider common household products a threat, the combination of such items may quite easily produce toxic chemical mixtures. Further, certain organic compounds, pesticides, heavy metals, and other pollutants from residential, commercial, and/or industrial locations may be found in the leachates from landfill sites. The presence of considerable numbers of hazardous pollutants can be easily confirmed by a random visual inspection of items sent to landfill. For too long it has been too easy to flush or place wastes in the trash. Therefore, boards of health must work to establish baseline levels of soil contaminants before using a site for landfill purposes, provide monitoring of wells by regularly scheduling tests over the life of the facility as well as after its closure, make plans of action/remediation if the levels should ever exceed those allowable, and address the issue of soil erosion during and after landfill construction and operation.

All of these issues need the individual consideration of boards of health and their communities to ensure that the best available and most cost-efficient technology is employed to achieve community public health goals. There is no one method that will work nationwide because of geographical, geological, hydrological, and even meteorological differences.

#### *Recycling – An MSW-Reducing Alternative*

As the amount of municipal solid waste produced in the United States continues to grow, recycling has become crucial to help manage waste. Recycling reduces the amount of waste that ends up in landfills and incinerators. Recycling also reduces the impacts of industrial production and is an important factor in making communities more sustainable. Recycling select solid waste ultimately saves energy, reduces emissions of greenhouse gases, and conserves scarce natural resources. Recycling can also provide many types of business opportunities in the fields of collection, processing, and manufacturing.

Recycling can reduce the emission of greenhouse gases by reducing energy consumption from producing virgin materials, reducing emissions from incinerating waste, reducing methane emissions from landfills, and lessening the amount of trees used for paper, since trees absorb carbon dioxide. It is estimated that recycling reduced greenhouse gas emissions of carbon equivalent by 2.5 million metric tons in 2005.

While recycling programs are widespread these days, issues to consider when implementing one include space needs, safety, accessibility, short- or long-term storage of recyclables, appropriate separation and shipping potentials, options for separation/collection, using existing public sanitation workers for waste and recyclables, using private haulers for recyclables only, initiating buy-back centers, program organization and budgets, ongoing program publicity and promotion, and education.

In 2008, 61 million tons of municipal solid waste were recycled. Boards of health can take an active role in increasing this number by promoting and expanding recycling programs in their community. Boards can make sure that there is a comprehensive recycling program in county buildings and local schools. Board of health can also host events to gather electronic waste, hazardous household waste, fluorescent lights, and other items that aren't typically included in traditional recycling programs. Boards of health can sponsor educational campaigns to promote the importance of recycling to the community. Boards of health can also look into implementing recycling and resource recovery programs for waste organic material, which can produce fuel, compost, mulch, and energy.

Methods for effectively involving the community in recycling and other solid waste programs are described in the next section.

#### *Source Reduction: An Option for MSW?*

Source reduction means lessening waste by not producing it. According to estimates from the United States Congress, the appropriate technology and adequate economic conditions already exist to reduce solid waste generation by 50% in the next few years. Source reduction implies reducing the volume or toxicity of waste at the source by changing the material-generating process; it includes incorporating reduction in the design, manufacture, sale, purchase, and use of products and packaging. Other terms are often used to mean source reduction, including *waste reduction*, *waste prevention*, *waste minimization*, *pollution prevention*, and *recycling*. While a number of individuals and businesses selectively participate in this kind of effort, it would be very difficult to mandate to communities. The option should be addressed at individual community levels, taking into account situations or conditions that favor such action.

#### **Facility Siting – A Necessary Success**

Facility siting and permitting has become the most contentious and difficult part of the solid waste management process. Finding sites that are both technically feasible and environmentally and socially acceptable can be difficult. Many communities have experienced intense political conflicts centered on uses of technology, acceptable levels of risk, and distribution of decision-making power, and board of health members must mediate between the various interests and opinions. Behind-the-scenes decision making (also known as the “decide-announce-defend” model) is seldom acceptable to the public.

When creating a siting strategy, consider the following:

- Address possible negative impacts early in the project development.
- Develop a public involvement plan.
- Use the political/technical expertise of public officials and citizens.
- Consult with the relevant public sector at every stage.
- Provide accurate, useful information about all aspects of the project, including risks, and maintain a dialogue with the public.
- Keep the process flexible and negotiable.
- Use only accurate and truthful information.
- Realize that successful siting may involve compensation issues.



Federal, state, and local governments enact laws to ensure that proposed projects meet minimum technical and legal criteria. Obtaining required permits for projects depends on the type of facility being planned and local, state, and federal laws. Permitting ensures that a proposed project will not unduly affect the health and environment of the community and that it will be consistent with local public policy. While boards of health may not be able to affect changes in obtaining permits for sponsored projects, they may be able to determine permitting regulations for their community. In addition, boards of health may also be responsible for the enforcement of such regulations. Persons requiring permits could include landfill operators, facility operators, and solid waste haulers.

### *Public Involvement and Education*

A successful waste management program requires widespread public participation. Such participation can best be obtained through early and effective public education programs that must continue even after the program is in full swing. Communities comprise different mixes of homeowners, apartment dwellers, business people, students, age groups, income levels, and cultures. Planners should know their community well enough to design programs that meet their specific needs.

The objectives of a public involvement plan should:

- Include enough detail so that everyone involved in implementing the plan knows what he or she is expected to do and when.
- Include enough detail to permit development of budget, staff, and schedule estimates.
- Allow agency management or policy boards to assess the adequacy of the activities planned in relationship to the anticipated public interest.
- Clearly communicate to the public how and when they will have opportunities to participate.

The following seven cardinal rules of risk communication that the USEPA published in 1988 are still excellent standards to consider today when working with the public or with the private sector:

1. Accept and involve the public as a legitimate partner.
2. Plan carefully and evaluate your efforts.
3. Listen to the public's specific concerns.
4. Be honest, frank, and open.
5. Coordinate and collaborate with other credible sources.
6. Meet the needs of the media.
7. Speak clearly and with compassion.

The USEPA's Office of Solid Waste proposes a six-stage education plan using the seven points above to help recognize the desired outcome. The plan is briefly reviewed below.

1. An "awareness" stage has a goal to let people know that different ways of handling waste may be preferable and provides them with new ideas.

2. After people have been made aware of waste management issues, they seek more information in the “interest” stage. Program planners must use a variety of methods to inform people at this stage. Voluntary programs require strong emphasis on promotion; mandatory programs should make clear what is required.
3. Next is the “evaluation” stage during which individuals decide whether to participate. For even well-promoted programs, initial participation is about 50%. Making program requirements clear and easy to comply with increases participation.
4. During the “trial” stage, the individuals try the program. If they encounter difficulty, they may opt to discontinue participation. Well-publicized hotlines and clearinghouses provide additional instruction and information.
5. Next, at the “adoption” step, participation should continue to grow. Ongoing education programs solicit constructive feedback and provide new program information when necessary.
6. Not the least important is the sixth stage noted as “maintenance” during which ongoing incentives and education keep participation rates high.

Moving the community toward a consensus on the proper combination of waste management programs revolves around the concern, involvement (of various interest groups), issue resolution, alternatives, consequences, choices, implementation, and evaluation that are achieved. The ability to communicate, promote, and encourage the public/community to be participants, promoters, and beneficiaries of an efficient and successful program of any kind requires the correct and complete united effort of a public education process.

For boards of health, then, solid waste management not only requires learning about the issues surrounding landfills, recycling, permitting, and siting, it also may involve learning how to effectively communicate with the public and developing the necessary strategic plans for implementing projects. Making solid waste management decisions may also require interacting with other environmental agencies or organizations, state and federal agencies, community leaders, and others. Board of health members may have varying responsibilities regarding solid waste policy development, implementation, and enforcement, to assure the safe management of solid waste. From collection to transfer to disposal and post disposal land use, board members should work within their means to be vital forces for the safe and appropriate management of solid wastes.



## Questions and Considerations for Local Boards of Health

1. Does your board review how solid wastes are managed in your community?
2. Are there abandoned landfills, open dumps, tire reservoirs, places that produce medical waste, construction debris, or radioactive waste, or other locations that may be hazards to health?
3. Is your board of health familiar with the different types of municipal solid waste?
4. Has your board of health explored alternative mechanisms for funding municipal solid waste collection services?
5. Has your board of health defined the goals of your community's municipal solid waste collection system? Does it review the system's performance?
6. Has your board of health been involved with planning for a landfill? Have you collaborated with other agencies on this plan?
7. Have your board taken proactive measures to ensure the enforcement of landfill operating policies? Has your board arranged for the testing of soil around landfills for contaminants?
8. Does your board of health promote recycling programs or host events to gather waste not typically included in traditional recycling programs?

## Resources for Additional Information

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# Hazardous Waste

## What is Hazardous Waste?

Hazardous wastes, as a subset of hazardous materials, are inherently dangerous. Like hazardous materials, these wastes can cause severe damage to the environment and subsequent health effects in people. It is important to know what constitutes hazardous waste, where or how people are likely to come in contact with it, and what negative impacts it can have on the health of people and the well-being of the planet.

The word *hazardous* is defined as “depending on chance, involving or exposing one to risk” and “marked by danger, perilous,” and is synonymous with dangerous. Waste can be defined as “an unwanted byproduct of a manufacturing process, chemical laboratory, or similar operation.” Together, these words represent a grouping of unwanted material, usually from an industrial source, which is capable of producing a harmful effect if improperly handled. Examples include waste solvents, paints, inks, lubricating oils, cleaning solutions, and pesticides.

A more legal description of hazardous waste is found in the Resource Conservation and Recovery Act (RCRA) where the definition delineates those wastes that are regulated under this specific piece of legislation. The RCRA definition of hazardous waste includes two categories:

1. Listed waste is any of the approximately 400 wastes or waste streams itemized or “listed” in Parts 261.31–261.33 of the Code of Federal Regulations. These wastes have been placed on the list because scientific study or past experience has shown them to be potentially harmful to humans or the environment.
2. Characteristic waste is any waste that exhibits one or more of the following harmful characteristics:
  - a. Toxic wastes include materials that are capable of causing acute or chronic health problems in humans. These wastes include heavy metals, such as arsenic, and certain pesticides.
  - b. Ignitable wastes are those that have a flashpoint less than 60° C (140° F) or that are capable of spontaneous combustion. Examples include organic solvents, oils, plasticizers, and paints.
  - c. Corrosive wastes are strong acids or bases (substances with a **pH** of 2 or less or 12.5 or higher, respectively) that can eat away living tissue and materials commonly used in standard containers. Battery manufacturing residues and alkaline cleaning agents are corrosive.
  - d. Reactive wastes are hazardous because of their tendency to react violently with air or water or to explode or generate toxic vapors. Old munitions, firecrackers, dynamite, and certain metals and acids represent this type of waste.

The primary emphasis of this chapter will be on the hazardous wastes described above. These wastes are regulated nationally by the United States Environmental Protection Agency (USEPA) under RCRA and under other related hazardous waste laws. The purpose of RCRA and the other laws is to ensure that hazardous wastes are recycled, treated, or disposed of in a way that will not harm the public’s health or the environment.

Excluded from regulation under RCRA but discussed in this chapter is what is commonly known as *household hazardous waste*. This type of waste can be similar or even identical to industrial hazardous waste. It can also have the same potential for causing land and groundwater pollution. In addition, unsuspecting sanitation workers may be harmed by the waste during the course of handling and transporting what they believe is normal municipal waste.

The basis for excluding household hazardous waste has rested in the belief that ordinary citizens generate relatively small amounts of hazardous waste and that such small quantities have an insignificant impact when mixed with large amounts of regular municipal trash. However, many state and local health departments have taken a more critical view of this situation and have opted to initiate household hazardous waste programs aimed at dramatically reducing the hazardous waste going to sanitary landfills from homes and offices. Because of the rising trend to have organized household hazardous waste programs run by public and environmental health agencies, further discussion will be given to this special type of hazardous waste.

Beyond the scope of this chapter are other types of waste also considered hazardous but outside the purview of RCRA. These wastes include radioactive waste, regulated by the federal Nuclear Regulatory Commission (NRC) under the Atomic Energy Act, and biohazardous or medical waste, sometimes regulated separately from the normal municipal waste stream by state and local health departments under individual state laws.

### **Where Is Hazardous Waste Found and How Did It Get There?**

Hazardous waste is generally regarded as a byproduct of industry that must be stringently controlled during handling, storage, and treatment at designated facilities and then vigilantly stewarded in special landfills after disposal. While this describes where we would expect to find the majority of hazardous waste, it overlooks several locations where dangerous substances may be found.

#### *Households*

One of the more common repositories for hazardous substances is the home. A quick glance below kitchen sinks, into bathroom or laundry storage cabinets, inside the medicine chest, or on that ever-popular shelving in the garage will usually reveal a wealth of hazardous chemicals just waiting to grow old and useless and ready for the trash bin.

Household hazardous waste can take the form of partially full containers of paint, pesticides, fertilizers, floor wax, rust remover, automotive chemicals, old pool or spa supplies, and general purpose cleaners and polishes, along with old batteries, spent printer cartridges, broken thermometers, burnt-out fluorescent light bulbs, and the like. Some of these items and containers will be accumulated until the homeowner can take them to a household hazardous waste center or cleanup event. Most of this material will end up in the household trash as part of the municipal waste stream headed for the sanitary landfill.

#### *Leaks and Spills*

Leaky containers or tanks can be found almost anywhere in a community and are not limited to industrial sites. Accidental spills of hazardous chemicals can release dangerous substances to air, surface waters, and soil. The air and surface waters immediately begin to distribute their poisonous burden to areas far removed from the original release. Once in the soil, toxic substances can eventually find their way to groundwater supplies. Horror stories abound of damage to the environment and people made sick and dying from such mishaps.

#### *Illegal Dumping*

Another threat to the environment and human health comes from intentional, illegal dumping of hazardous waste, commonly referred to as “midnight dumping.” Individuals or companies who have generated the waste seek an inexpensive and hassle-free solution to their hazardous waste problems by literally dumping it on someone else’s property. Leaking, corroded drums of undetermined contents have been known to appear overnight in a farmer’s field along a back road. Liquid hazardous waste can easily be disposed of by placing a drum on its side, opening the

spigot, and driving down the highway while the hazardous waste sprinkles out on the road to become everyone's problem.

### *Food Chain Contamination*

One of the most unnerving places to find hazardous waste is in the food chain. When chemicals are accidentally or intentionally released into the environment, they can travel long distances before they dissipate. Along their journey, the chemicals may be taken up by plants or animals in the area, causing these organisms to become contaminated. The plant or animal may bioaccumulate the hazardous waste, meaning that the organism increases the amount of the chemical in its tissue with repeated exposures over time. People eating these tainted plants and animals can fall victim to relatively high amounts of the bioaccumulated contaminant even when the overall level of the contamination is quite low in the environment.

### **The Public and Environmental Health Significance of Hazardous Waste**

In discussing the significance of hazardous waste in the public and environmental health arena, three major topics need to be addressed:

- The *scope of the field* of hazardous waste encompasses several areas, each with issues that affect the health and well-being of individuals and communities.
- There are several affected groups or *stakeholders* involved in the various areas of hazardous waste (generation, disposal, treatment, enforcement, remediation, emergency response, etc.), all of whom have an interest in how and where this waste is managed.
- The *magnitude of the potential exposure* to hazardous waste and the public's concern over the issues embroiled in its management make this a significant health problem.

### *Scope of the Field*

The major areas of hazardous waste are noted below, each with a short description of the activities and issues involved in the area. Also noted are additional sources of information and agencies to contact for assistance in problem-solving and program development.

*Enforcement of hazardous waste laws and regulations.* Table 1 on page 78 briefly summarizes some of the more important federal agencies and laws involved in regulating hazardous waste. State and local agencies may also be called on to enforce federal hazardous waste laws and regulations. Individual states often have their own hazardous waste laws and administer their own programs through state and local agencies.

*Industrial hazardous waste management.* Companies that produce hazardous waste are called generators and are regulated according to how much waste they produce. Generators of more than 1,000 kg (2,200 lbs) of hazardous waste per month are called large quantity generators (LQGs) and are the most heavily regulated. Operations that generate less than 1,000 kg per month are called small quantity generators (SQGs). If a company generates less than 100 kg per month, they are given a special classification as a conditionally exempt small quantity generator (CESQG).

Companies that generate, transport, treat, store, or dispose of hazardous waste are required by law to properly manage the waste under their control. Hazardous waste that is not reused, reclaimed, or recycled on site is usually sent by a regulated hazardous waste transporter to a permitted treatment, storage, and disposal facility (TSDF).

**Table 1** Federal agencies and laws regulating hazardous waste.

Agency	Legislation	Provisions
U.S. Environmental Protection Agency	Resource Conservation and Recovery Act (RCRA)  Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)  Clean Air Act  Clean Water Act  Safe Drinking Water Act  Toxic Substances Control Act	Sets standards and issues permits for generators, transporters, and TSDFs  Provides for Superfund activities such as emergency cleanup and long-term containment of hazardous waste dump sites  Sets emission standards for hazardous air pollutants  Sets standards for toxic discharges to water Prepares national contingency plan for spills, coordinates spill response, levies penalties, and recovers costs  Regulates the underground injection of wastes that could contaminate drinking water  Regulation of manufacturer, use, distribution, and disposal of chemical substances  Obtains industry data on product use and health effects of chemicals
Department of Transportation	Hazardous Materials Transportation Act	Regulates interstate commerce of hazardous materials
U.S. Fish and Wildlife Service of the Department of the Interior	Fish and Wildlife Coordination Act	Research, technical assistance for spill response, monitoring for contaminants and effects on fish and wildlife
Consumer Product Safety Commission	Consumer Product Safety Act	Sets and enforces standards for household products, requires labeling, bans unsafe products

At the TSDF, the waste is rendered nonhazardous, less hazardous, or it will be recycled, destroyed, or otherwise properly contained to prevent harm to people or the environment.

*Remediation of contaminated sites.* Contaminated hazardous waste sites pose a difficult problem for the owners of the sites and many others. Assessments must be done to determine the severity and extent of the pollution, then a cleanup or remediation project must be initiated.

At the federal level, contaminated sites are overseen by the USEPA under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as the Superfund legislation. The USEPA has the National Priorities List (NPL) of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. A federal facility site map for all NPL sites is available online at [www.epa.gov/superfund/sites/npl/npl.htm](http://www.epa.gov/superfund/sites/npl/npl.htm).

An important source of information on Superfund sites is the Agency for Toxic Substances and Disease Registry (ATSDR). This federal agency works to prevent exposure and adverse health effects from exposure to hazardous substances from waste sites, unplanned releases, and other sources of pollution present in the environment. ATSDR provides public health assessments of waste sites, health consultations concerning specific hazardous substances, response to emergency releases of hazardous substances, applied research in support of public health assessments, information development and dissemination, and education and training concerning hazardous substances.

*Emergency response for releases and spills.* At the federal level, the Superfund Amendments and Reauthorization Act, (SARA Title III) or also known as Emergency Planning and Community Right-to-Know Act, was the legislation passed to direct emergency management of hazardous chemical spills. The USEPA is the lead agency in enforcing SARA Title III requirements, but numerous other agencies and groups also participate in planning, response, and other related functions. The primary grouping of organizations for planning and coordination of response to releases/spills is the National Response Team. Representatives of 15 federal agencies serve on this team, including the USEPA and the United States Coast Guard.

SARA Title III also provides for emergency notification in the event of a spill. When a release exceeds a certain quantity, known as the *reportable quantity*, the National Response Center must be notified immediately. Each state should also have a State Emergency Response Commission (SERC) appointed by the governor and composed of representatives from various state agencies, private organizations, and public interest groups. Each SERC is further broken down into Local Emergency Planning Committees (LEPCs) with representatives of elected officials, local government administrators, firefighters and other emergency response personnel, emergency medical personnel, and many other potentially affected groups, including the local environmental health agency. When an accidental release or spill happens, the local environmental health agency will also usually respond to the incident. Local boards of health may wish to become involved in their Local Emergency Planning Committee and be a part of the community planning and education process for emergency response.

*Household hazardous waste.* Although household hazardous waste is not covered by RCRA, and in fact is specifically excluded under this law, many state and local health departments consider it to be a significant problem. There are numerous programs across the country specifically aimed at reducing the amount of household hazardous waste that goes to the municipal landfill.

Local boards of health across the country have been successful in helping to implement workable community programs for educating the public on the problem and for providing collection centers or clean-up events.

#### *Related Stakeholders*

In addition to the public or environmental health agencies that write regulations and ensure compliance with hazardous waste laws, several other groups or stakeholders are affected by local provisions, policies, and decisions on hazardous waste matters. These additional stakeholders might include:



- Community residents and property owners whose health and property may be affected by mismanaged generation and handling of hazardous waste, contaminated sites, accidental releases, and/or household hazardous waste.
- Regulated industries that generate, transport, treat, or dispose of hazardous waste. They are required to comply with all federal and state laws and regulations concerning hazardous waste. They should also prepare for emergencies and accidental releases, willingly provide community right-to-know information, and conduct their businesses in a way that protects their neighbors and the environment.
- Neighboring schools, shops, and businesses in close proximity to the regulated industries described above. They may be office buildings located near manufacturing plants, warehouses situated in industrial complexes, or even the neighboring shops to a dry cleaning operation in a strip mall. They may also be facilities built beside or on historically contaminated sites such as Superfund sites.
- Emergency medical personnel in hospitals and clinics within the area who may be called on to treat the victims of industrial or household chemical mishaps, long-term contamination exposures, and accidental releases of hazardous waste.
- Emergency response personnel include the fire department, Hazardous Materials (Haz-Mat) team members, Emergency Medical Technicians (EMTs) and ambulance responders, and police department/public safety personnel.
- Financial institutions provide business and/or property loans and, therefore, have a vested interest in the past and present uses of the properties that could potentially lead to contamination of the soil or groundwater. Since contamination can easily migrate, they will also be interested in the past and present disposition of neighboring properties.
- Insurance companies underwrite the potential losses and liabilities of regulated industries, as well as neighboring businesses, residents, and property owners. They are usually interested in the past or present uses of chemicals in a business or on a property. They are also concerned with past and present contamination of an insured site or a neighboring site.
- Real estate agencies and their associated members represent buyers and sellers of business property and private property. They are responsible for ensuring that certain legally required notification is given regarding the properties they represent, including disclosure of past or present uses of the property, real or potential contamination of a site, and right-to-know information on neighboring properties.
- Sanitation workers are the people who collect, transfer, sort, and dispose of municipal waste and who are sometimes unknowingly exposed to hazardous waste in the form of household hazardous waste.

Local boards of health may have members who represent some of these stakeholders. When gathering information for decision making, it may be useful to consult representatives from some or all of these stakeholder groups.

### *Magnitude of the Exposure to Hazardous Waste*

Magnitude of exposure can be measured in many ways. This discussion will look at the amount of hazardous waste generated in the United States, the number of contaminated sites identified for remediation, and the number of accidental spills involving hazardous waste.



*Amount of hazardous waste generated in the United States.* Even as the number of companies that generate hazardous waste grows and the types of wastes designated as hazardous are increasing, the amount of hazardous waste produced each year has been on a steadily downward trend during the last two decades. However, there is still a large amount of hazardous waste generated per year in the United States and around the world.

Several new categories of waste were added to the USEPA's list of regulated hazardous waste in 1990. In 1991, 277 million tons of hazardous waste were generated, treated, and disposed of in the United States. The majority of waste was managed as wastewater. Three percent was recycled, up ten-fold from just 6 years earlier. The percentage of recycled hazardous waste continues to increase, while the percentage that goes to land disposal is decreasing.

By 2007, the amount of regulated hazardous waste produced by large quantity generators in the U.S. fell to 50 million tons. The five states that generated the largest amount of hazardous waste that year were Louisiana (15 million tons), Texas (13 million tons), Michigan (2 million tons), Mississippi (2 million tons), and Ohio (1 million tons). Together, the large quantity generators in these states accounted for over 75% of the total amount of hazardous waste produced in the U.S.

An interesting aside to industrial generation of hazardous waste is to see what has happened to the unregulated hazardous waste coming from households. Since 1980, the number of household hazardous waste collection programs in the United States grew from virtually none to more than 3,000 programs. The number of these programs continues to grow, making the amount of hazardous waste going to municipal landfills decrease proportionally.

*Number of contaminated sites identified for remediation.* Under the Superfund Law, CERCLA, the USEPA is required to identify contaminated sites, assess the types and the extent of the contamination, and place them on the NPL according to their hazard ranking or likelihood to cause harm. When the NPL was first initiated in 1983, there were 406 sites placed on the list. The listing is dynamic, with sites going on the list as they are identified and assessed and sites going off the list when they are cleaned up (remediated).

As of February 2011, there were 1280 sites on the National Priorities List. An additional 62 sites have been proposed for inclusion on the list. The USEPA deletes sites from the NPL when they are cleaned up and no further action is required under Superfund. A total of 347 sites have been deleted from the NPL.

In addition to federal Superfund sites, individual states may have responsibility for initiating cleanup at contaminated sites within their boundaries. Such sites are usually designated as state Superfund sites and are not included in the figures above.

*Number of accidental spills or releases involving hazardous waste.* The National Response Center is the sole federal point of contact for reporting chemical or oil spills. This organization then contacts other emergency teams, as needed, to respond to the spill. Table 2 on page 82 lists spill totals for years 2001-2008.

Certain minimum quantities have to be released before the National Response Center gets involved. Smaller spills and releases are handled at the local level and are not reflected in the NRC totals for incidents per year.

While the number of spills seems to be increasing over the years, reports are that the quantity of material released is decreasing.

**Table 2** Spills per year reported to the National Response Center.

Incident Type	2001	2002	2003	2004	2005	2006	2007	2008
Fixed	12,441	11,917	11,975	12,975	13,017	13,621	11,931	10,123
Unknown	333	323	476	215	184	177	170	305
Vessel	627	933	1,109	1,109	1,134	1,197	1,451	2,053
Mobile	0	0	0	236	971	565	113	53
Pipeline	0	0	0	0	0	0	0	18
Total	25,754	27,185	29,848	32,938	33,083	29,438	27,427	29,203

### Responsibilities and Options

Local health departments can play an important role in protecting the community from hazardous waste. Although boards of health rarely have direct regulatory authority governing hazardous waste management, they do have knowledge of the community and an ability to identify hazards. In addition, many boards of health help protect their communities by ensuring that their public health agencies offer public education and consultation regarding the control of household and industrial wastes. Boards of health and their health agencies in larger municipalities sponsor annual household hazardous waste collection days; other public health agencies maintain household hazardous waste collection facilities. Finally, local boards of health can become involved in decisions and policies concerning Superfund sites in their area and emergency response planning activities.

### Current Issues and Opportunities

Several current issues concerning the management of hazardous waste are worthy of attention. Two such issues, both with far-reaching national implications, are discussed below.

#### *Pollution Prevention and Waste Reduction*

Preventing pollution became a national goal with the passage of the Pollution Prevention Act of 1990. This piece of legislation outlined public policy on how to avoid creating pollution from hazardous waste. The act established the following four goals:

- Waste should be prevented or reduced at the source whenever feasible.
- Waste that cannot be prevented should be recycled in an environmentally safe manner whenever feasible.
- Waste that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible.
- Disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner (Kindschy, Kraft, & Carpenter, 1997).

The federal government has also outlined a program of waste reduction. While pollution prevention tries to stop the production of hazardous waste before it is created, waste reduction seeks to reduce or eliminate existing sources of waste. Waste reduction includes:



1. Source reduction, which involves activities such as:
  - Reducing spillage
  - Better inventory management
  - Improved operational and maintenance procedures
  - Substitution of hazardous materials with nonhazardous or less hazardous substances
  - Installation of more efficient processing equipment
2. Volume reduction, including the following:
  - Segregating hazardous waste from nonhazardous waste
  - Concentrating the waste into a more compact form
  - Recovering materials from the waste stream that can be reused
  - Recycling usable portions of the waste

The Pollution Prevention Act of 1990 and the federal waste reduction program have had a significant impact on how American industries think about hazardous waste. While the economy expands, the amount of hazardous waste generated in the United States continues to decrease. Several states have adopted policies similar to those of the federal government, increasing the success and effectiveness of the national policy.

### *Environmental Justice*

Environmental justice is a concept of awareness and sensitivity to the disproportional impact of chemical pollution and waste treatment facilities on low-income and minority neighborhoods. There has been a history of African American communities being disproportionately exposed to pollution from hazardous waste sites and chemical plants, particularly in the South. The environmental justice movement gained national attention in 1982 after more than 500 protesters were jailed following the siting of a landfill in Warren County, North Carolina. The EPA defines environmental justice as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.”

In 1994, President Clinton signed an executive order, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, which directs federal agencies to take action to make environmental justice part of their mission. The order directs agencies to take steps to make sure that existing laws are implemented immediately to redress disproportionate environmental harm. The USEPA’s Office of Solid Waste and Emergency Response has developed an Environmental Justice Action Plan to incorporate environmental justice into the office’s programs and priorities. Local boards of health could have a large impact on whether environmental justice is being carried out in their communities.

## Questions and Considerations for Local Boards of Health

1. Has your board of health educated the public about household hazardous waste or hosted any household hazardous waste collection days?
2. Are there any Superfund sites in your community? Has your board of health provided information to or collaborated with the EPA about the Superfund site?
3. Has your board of health ensured there is an emergency response plan in place for hazardous waste spills or releases?
4. Does your public health agency provide education or consultation about the control of industrial waste?
5. Has your board of health investigated if there are instances of environmental injustice in your community?
6. Has your board of health held a public forum to hear concerns or gather information about hazardous waste in your community?



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# Vector Control

## Public Health Significance

Mosquito-borne infectious diseases are globally important emergent/resurgent infectious illnesses affecting human populations. The current nationwide epidemic/epizootic of West Nile Virus (WNV) in the U.S. underscores the ease with which emerging infectious pathogens can invade this country in today's era of modern transportation, highly mobile populations, and changing ecosystems. The human, equine, and wildlife epidemic of WNV infection began in the summer of 1999 in northeastern United States. In 2008 alone, there were 1356 confirmed cases of human illness with 40 fatalities. The significant increase in virus activity since 2002 indicates that WNV has become established as a major health threat in North America.

In addition to West Nile Virus, the country is also at high risk for introductions of diseases such as malaria, dengue/dengue hemorrhagic fever, yellow fever, Rift Valley fever, and others that move with ease in humans, animal reservoir/carrier hosts, or mosquitoes. The WNV outbreaks and the increased risk for new diseases have raised public concern regarding the preparedness of public health agencies to identify and handle sporadic outbreaks associated with vector-borne diseases. It also points to the importance of having in place an adequate and well-funded vector surveillance and control network.

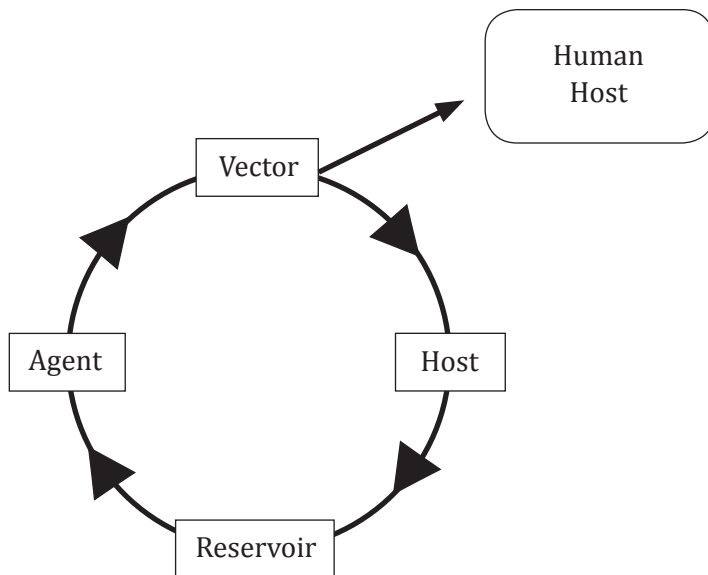
## *Definitions and Transmission Mechanisms*

All living organisms are capable of being parasitized by other organisms. Sometimes the parasitizing organism and its host can exist in a mutually beneficial (symbiotic) relationship. At other times both the host and the parasite can coexist with no apparent harm to the host. However, in some cases the parasite causes detrimental changes in the host. These detrimental changes, when they reach the level of being recognizable, are what we term disease. A zoonotic disease is one that normally takes place within vertebrate animals. Sometimes these diseases can be transmitted to humans by contact with animals (e.g., petting zoos); other times the disease agent can be transmitted by an arthropod or other vector (Friis & Sellers, 1996).

A reservoir is the place that a disease agent (bacteria, virus, etc.) is normally found. A reservoir can be the physical environment as in the case of *Clostridium botulinus*, a common bacteria found in the soil. A reservoir can also be an animal, as in the case of the *Escherichia coli* bacteria, that is commonly found in the gastrointestinal tract of mammals and other warm-blooded species (e.g., chickens).

A host is an animal species parasitized by the disease agent. In some cases the same animal may serve as both the reservoir and as the host. Rodents are an example of animals that are both the reservoir and a host species for bubonic plague. For many zoonotic and vector-borne diseases, humans are an incidental or accidental host, i.e., a host that is not a normal part of the transmission cycle (see Figure 1 on page 88), who comes into contact with the vector, either through a change in human behavior or a change in the environment that causes a relocation of the disease reservoir or vector.

A vector may transmit a disease agent by either mechanical transmission or biological transmission. The former is essentially a passive method by which the infectious agent is carried on the surface of the vector's body or by ingestion of the organism. The disease agent does not develop on or within the body of the vector prior to transmission to a person. Examples of mechanical transmission are flies and cockroaches carrying organisms from fecal material to food consumed by humans. Biological transmission requires the disease agent to either multiply or undergo a sequence of developmental stages inside the vector prior to passage to a human or animal. The classic

**Figure 1** Generalized vector-borne disease transmission cycle.

example of this process is the transmission of the malaria parasite from human to human. This requires a special mosquito type (*Anopheles*) and specific developmental times in both the mosquito and the human.

#### *Decline and Re-Emergence*

As long ago as 120 years, blood-sucking (*hematophagous*) arthropods were shown to transmit disease agents. These vectors and the diseases they carried were responsible for more human disease and deaths than all other causes between the 17th and 20th centuries (Gubler, 1991). However, the use of public health control measures, coupled with the invention and application of insecticides, temporarily eliminated and/or minimized the threat of epidemic levels of vector-borne diseases in the United States by the 1960s. Unfortunately, a re-emergence of vector-borne diseases began to be seen in the 1970s in the Americas and has since intensified. In addition, the emergence of new vector-borne diseases has been noted in several parts of the United States. Murphy (1998) notes the following reasons for the acceleration of new pathogens:

1. Expanding population of humans and livestock, resulting in increasingly large numbers of people and livestock living in close contact.
2. Advancement of transportation, resulting in immigrants and travelers moving great distances in less time than the incubation period of most infectious diseases.
3. Massive ecologic and environmental changes brought about by human activity.
4. Bioterrorist activities supported by hostile governments and individuals.

D. J. Gubler (1998) of the Centers for Disease Control and Prevention's (CDC) Division of Vector-Borne Infectious Diseases notes that the increase in vector-borne diseases has also been impacted by a failure of vector-borne disease control programs. He lists two additional factors that have impacted these programs:

1. Loss of public health infrastructure with a subsequent loss of financial support.
2. The reliance on quick-fix solutions, such as insecticides and drugs.



### The Primary Vectors

There are more than 16,000 cases of vector-borne disease reported to the CDC annually. A majority of these are due to the hematophagous arthropods; others are due to mammals that serve as the vector. Table 1 lists the arthropods and mammals of public health interest, along with the reservoir and causative agent, of the prominent or emerging diseases in the United States.

**Table 1** Selected vector-borne diseases.

Vector	Disease	Causative Agent	Reservoir
Mosquitoes	California encephalitis Dengue Eastern equine encephalitis La Crosse encephalitis St. Louis encephalitis Western equine encephalitis West Nile fever Yellow fever	Bunyavirus Flavivirus Alphavirus Bunyavirus Flavivirus Alphavirus Bunyavirus Flavirus	Birds (?) Humans, etc. Birds (?) Birds (?) Birds (?) Birds (?) Birds (?) Humans, etc.
Ticks	Colorado tick fever Lyme disease Powassan encephalitis Relapsing fever Rocky Mountain spotted fever	Bunyavirus Sphirocete Flavivirus Spirochete Rickettsia	Small mammals Deer, mice Ticks, mammals Humans, ticks Ticks
Lice	Relapsing fever Trench fever Typhus (epidemic)	Spirochete Bacteria Rickettsia	Humans Humans Humans
Fleas	Bubonic plague Typhus (endemic)	<i>Yersinia pestis</i> Rickettsia	Rodents, etc. Rodents, etc.
Rats, mice	Hantavirus pulmonary syndrome	Hantavirus	Mice
Skunks, foxes, bats, coyotes	Rabies	Human rabies virus	Vertebrate Animals

Arthropods that are of public health interest but that are not hematophagous include “filth-breeding flies” and cockroaches. The house fly, blow fly, and bottle fly are examples of the former group. Both the fly group and cockroaches are considered mechanical vectors of disease pathogens. As previously stated, mammals can also serve as disease vectors. In the United States rodents such as rats and mice serve as the vector for hantavirus; other mammals, such as foxes, skunks, and coyotes, serve as the vector for rabies.

### *Elimination or Coexistence*

The elimination of vectors such as fleas, mosquitoes, ticks, and rodents from their natural habits, despite very expensive and sustained efforts, has historically proven to be impractical and ineffective. While the elimination of vectors in areas known to house pathogens is usually considered futile, the control of the many vectors where people live, work, and play is extremely important in the prevention and control of vector-associated human diseases. Thus, local control and management of the vector and its habitat are of the utmost importance.

### **Role of the Local Board of Health**

Boards of health are responsible for fulfilling the three public health core functions: assessment, policy development, and assurance. Each function is critical for the development and implementation of effective vector control policies. The core functions and how they work for local public health agencies are detailed below.

#### *Assessment*

Local public health agencies assume a critical role in the prevention of the spread of disease and are therefore responsible for ensuring that appropriate steps are taken to prepare for a vector-related threat. Because there are several key duties with which local boards of health should assist, it is crucial for agencies to ensure that assessment efforts are coordinated appropriately. These include: learning from past mistakes, conducting a community profile, monitoring and detecting disease through surveillance efforts, and identifying resources within the community. Assessment is vitally important to the health and protection of the community, and therefore, must be integrated into a vector control plan to best assure a well-coordinated response.

Vector control strategies used in previous decades, particularly the use of chemical insecticides, have proven to be harmful to humans, wildlife, and the environment, and have even had an adverse affect on beneficial insect populations. The frequent and widespread use of Dichloro-Diphenyl-Trichloroethane (DDT) in the 1950s proved to be successful for controlling insects in the beginning. However, it was not taken into consideration that insect populations are able to sustain, often remarkably, rapidly changing environmental and evolutionary conditions. Thus, those insect populations unaffected by DDT were able to reproduce a population of insects resistant to the chemical. This prompted the use of harsher, more powerful chemicals, and a cycle of events that was repeated throughout the next few decades. It is crucial to learn from past mistakes and have a comprehensive understanding of disease-carrying vectors in order to properly protect national and global health and security.

An important way to determine needs for vector control is to complete a community profile or needs assessment. These are a process used for identifying gaps between “what is” and “what should be” within a given population. Results can be used to design, modify, or establish objectives for programs. Assessments can also be used to evaluate progress, and should therefore be conducted on a regular basis to assure that goals are being met.

#### Surveillance

Surveillance is a dynamic process that involves monitoring and detecting disease transmission within a given population. Methods of surveillance include:

**Monitoring insect and rodent population growth and habitats**

**Observing changes in weather or environmental conditions that may cause an increase in breeding and disease transmission**



**Reviewing past data to determine potential risks within the area**

**Examining levels of disease activity and reports of infection**

Because surveillance must be tailored according to the probability of vector activity within a given jurisdiction, a universally applicable system does not exist. It is imperative for local health departments to partner with other agencies when performing both active and passive surveillance activities to communicate and exchange pertinent information, share resources in the event of a vector-related threat, and determine what control strategies, if any, need to be taken.

Active surveillance involves activities related to vectors that are endemic within a given jurisdiction. These activities should be outlined in a vector-control plan approved by the board of health, and may vary depending on the specifics of the activity. Boards of health are responsible for the following activities:

- Ensuring that there is follow-up for new cases of specific diseases to prevent or control the spread of infection.
  - Partnering with community organizations that are active in monitoring and identifying vector activity and the presence of pathogens. This may include trapping wild birds and rodents for the purpose of blood sampling, acquisitioning mosquito traps for adult population counts, and surveying breeding grounds for increased activity.
- Ensuring that passive surveillance activities are done, which may include the following:
  - The reporting of all human cases and vector-borne illnesses to state departments of health and local hospitals and clinics, as well as participating in state and national disease reporting networks. From this information, it will be determined whether or not there are reoccurrences within any particular geographic regions.
  - Receiving updates from wildlife personnel and others who collect and submit samples to public health laboratories for analysis.
  - Reviewing past data and meteorological statistics to prepare for potential risks (e.g., a growth in insect populations or an increase in the risk for disease during the summer months).
  - Analyzing maps of high-risk populations using local census or other community data.

#### *Policy Development and Implementation of Control Strategies*

Local public health agencies are required to play a key role in the implementation of control strategies, particularly during a vector-borne disease threat or in preparation for a potential outbreak. This involves developing a comprehensive community action plan that incorporates preventative measures with emergency response tactics, as well as making community members aware of steps that have been taken in an effort to protect the population's safety and well-being.

#### An 'Integrated' Approach to Pest Management

Because of a general concern and the awareness we now possess for environmental health issues caused by the broad scale application of chemical pesticides, a safer method of vector control is essential. For this reason, it is crucial for communities to incorporate the advancement and application of Integrated Pest Management (IPM) practices. IPM is an environmentally-aware approach to pest management, combining an array of common-sense practices that ultimately have the potential to reduce the need for pesticides and avoid unnecessary economic and

environmental damage. The five basic steps involved in this process are inspection, identification, establishment of threshold levels, employment of two or more appropriate control measures, and evaluation of effectiveness.

*Inspection* involves determining both the location and extent of the infestation. This requires the person inspecting the premises to note damages to the structure or to commodities, determine the conditions conducive to the infestation, identify harborage areas and sanitation deficiencies, and locate avenues of possible entry. Regular observation of insect and rodent populations is crucial. Traps, visual inspections, and record keeping are all effective methods for inspecting insect and rodent populations.

*Identification* requires having baseline knowledge of pests that are common to the area, including their habits, habitats, life cycles, breeding grounds, and biology. In particular, it is helpful to know which pests are harmful versus those that are harmless or even beneficial. This knowledge enables the inspector to determine which control measures to employ.

*Establishment of threshold levels* involves estimating the amount of damage the pest population could cause and the cost associated with implementing particular control measures, and comparing these values to the estimated market value. Other factors must be considered, including the health and safety risk created by the pest, legal restrictions on pest infestation, and the level of pest tolerance exhibited by the community.

*Employment of two or more appropriate control measures*, the fourth step of the Integrated Pest Management approach, requires the design of a program that uses more than one strategy or control measure. Many types of control measures are available to the pest management professional. These measures fall into the five major pest control types listed below:

- Sanitation – This measure requires the elimination of pest harborages, water, and food sources in an effort to inhibit the survival of pests. This non-chemical control can prove to be quite beneficial when community cooperation is achieved.
- Mechanical – Mechanical control involves the use of traps (sticky, electric, light, snap, multiple catch), barriers (screens, nets, seals, caulk), and other manual methods (snares, vacuums, heat and cold) to prevent pests from entering an undesired location.
- Cultural – Cultural control, or habitat modification, requires manipulating a pest's environment to make it less favorable for establishment and spreading.
- Biological – This option involves the use of parasites, predators, or pathogens to control or manage pests. Examples include mosquito-eating fish, fungus, and parasitic wasps.
- Chemical – Chemical controls are used as a last resort when other methods are deemed ineffective. The targeted spraying of synthetic pesticides is the preferred, more economically-sound choice compared to broadcast spraying of non-specific pesticides. This approach is only effective for adult mosquitoes that are active at the time of chemical application. An important aspect of chemical application is the continued monitoring of the mosquito population for resistance, to assure responsible pesticide application practices.

*Evaluation of effectiveness* is the final step of the Integrated Pest Management (IPM) process. Follow-up inspections enable the pest management professional to assess and adjust control measures that have been employed in an effort to exercise best proven practices.





## Public Education

Public health education is the cornerstone of good vector-control programs. The board of health plays an integral role in public education, especially regarding controversial issues or in episodes of potential epidemics. These public education efforts have the goals of prescribing protective measures, relaying control information, and eliminating or reducing panic. These activities include the following:

- Boards of health should define the vector-borne diseases in the jurisdiction and then educate groups at risk. An example of such activity would be speaking with hunting, fishing, and camping groups regarding vector risks and disease potential of hantavirus, plague, and lyme disease, among others.
- Local boards of health should produce definitive literature about the vector-borne diseases.
- Working relationships with area media should be developed. The media can be used to relay information about risk, control and preventive measures, and the activities of the local health department.
- Local boards of health should provide a mechanism for the delivery of public advisories to minimize exposure, define risk activities, and inform the public of control measures that may be of concern (e.g., larvaciding and aerial spraying).
- Local boards of health should provide for the education of the public regarding domestic and personal hygiene, which can impact the transmission of filth-carrying arthropods capable of pathogen transmission.
- Protection against vector-borne disease is important year round, but even more so during the summer months. Boards of health should provide informational materials and guides and specifically work with the media to convey proper safety messages to the masses during this time.

## *Assurance*

Assurance requires boards of health to be part of a comprehensive approach of continuous and ongoing vector control activities. Because public health data, abnormal vector activity, and early warnings of potential threats are often gleaned from surveillance activities, it is crucial for public health agencies to continuously form and maintain alliances and partnerships for the purpose of ongoing surveillance. Evaluation of program and control measures, ongoing educational opportunities, and continuous enforcement of the established vector control plan are also ways in which boards of health and public health agencies can assure that their jurisdiction is prepared for a threat of any kind. Vector control efforts cannot be abandoned simply because there is an absence of a threat. Rather, vector control activities must be uninterrupted to assure that communities are well-prepared to face a threat of any kind to ensure the well-being of the community.

## **Emerging Issues**

With the decline of insecticide use, certain insects and vectors that were thought to be obsolete or rare are now becoming much more common. Bed bugs outbreaks have become much more prevalent starting in 2001. This increase can be attributed to a change in vector control strategies, increased travel, and/or the use of previously owned furniture. Bed bugs survive by feeding on blood, and though they have not been classified as vectors, they do have the ability to cause physical and psychological discomfort.

Bed bug bites can cause an allergic reaction to the saliva injected at the site, causing raised, inflamed welts and possibly intense itching. Airborne bed bug allergens can exacerbate bronchial asthma, and numerous bed bug bites can contribute to anemia. Since bed bug outbreaks previously were rare, there is little current research about bed bugs. Some health jurisdictions have taken on this need—New York City has established a bed bug advisory board



to examine and evaluate the bed bug problem. There is currently no requirement to report bed bug infestations to any public health entity, but many boards of health have created bed bug education programs.

Recent studies have found that the prevalence of insects and vectors can cause allergic and asthmatic reactions. In the United States, the National Cooperative Inner-City Asthma Study (NCICAS) found that 77% of mild or moderate asthmatics 4-9 years of age were sensitized to a minimum of one allergen tested, and a high prevalence of them were sensitive to cockroach and mouse allergens (Bonney, Kampen, & Sweeney, 2008). Exposure to cockroaches early in life has been shown to cause asthmatic reactions in children with a family history of allergies. Also, cockroach allergens appear to be more of a risk factor for asthma than allergens produced by dust mites, dogs, or cats. The link between vectors and asthma, especially cockroaches, can place an extra health burden on children and families living in urban or inner city areas.

The increase and reemergence of vectors and vector-borne diseases has also been tied to climate change. Climate change has the potential to affect vector-borne diseases both directly and indirectly. Increased temperature and rainfall can cause higher amounts of vectors to breed or allow them to survive longer. Increased temperatures can also cause vectors to thrive in environments where they wouldn't previously, exposing potentially new populations to diseases. Other consequences of climate change, including natural disasters, can cause an increase or facilitate the survival of vectors. Finally factors that exacerbate climate change, such as deforestation, can also aid in the breeding of vectors. More research is needed to know the full impact of climate change on vector-borne diseases, but the potential is high for climate change to exacerbate an already growing problem.

## **Conclusion**

Boards of health and public health officials have a duty to protect and promote the safety of their respective communities. There are numerous diseases from various vectors that currently attack communities within our country every day. Any one of these diseases has the potential to become a large epidemic: the vector is present, the pathogen is present, and the potential hosts are numerous. Public health officials must plan for the possibility of an epidemic and be prepared to act quickly if one occurs. Boards must ensure that sufficient resources are available, develop solid policies and procedures to support vector-control activities, facilitate collaboration between all public entities within their jurisdiction, and continuously evaluate the effectiveness of the established vector control program.



## Questions and Considerations for Local Boards of Health

1. Does your board of health conduct community assessments regarding vectors and vector controls?
2. Does your community have a vector surveillance program?
3. Does your community report local vector data to the state?
4. Has your health district or community implemented Integrated Pest Management?
5. Does your board of health education about vectors and vector-borne illnesses?
6. Have there been reports of bed bug outbreaks in your community?

## Resources for Additional Information

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# Injury Prevention

## Introduction

One balmy spring day, a 4-year-old boy eagerly jumps on a merry-go-round for a quick ride. To save expense, this particular playground toy has been locally built by the well-meaning local parks and recreation department maintenance shop. Despite direct supervision by his father, nobody had foreseen a fault in the design of the merry-go-round, and the boy's finger is caught and immediately severed. As a result the boy experiences traumatic pain requiring costly surgery, his family must suffer through the mental anguish over concern for their son, and a lawsuit for negligence will eventually be settled against the county that owns the park. In court it is stated that "if they would have purchased a merry-go-round from a reputable company aware of safe design features, this never would have happened." Unfortunately, "they" is the local board of health that funded the playground as part of a community wellness program.

Did the board in this case actually have a responsibility for the safety of the merry-go-round? More generally, do boards of health have duties for any and all threats to the public well-being and safety, including matters of personal choice where the risks may be uncertain? If not, how is the board of health to decide which problems belong to it, and which are better left to other groups or personal choice?

## Board of Health Responsibilities

The responsibilities of a board of health are serious and may have life or death implications for the community members it protects. As in the story about the little boy's finger, these duties may not be clearly defined or intuitive. Traditionally, local boards of health implemented public health controls for highly visible issues, such as disease control, safe drinking water, or wastewater management. But owing to emerging local industry, geography, or politics, some boards may face serious, major problems in lesser known program areas.

This chapter examines some of those less recognized public health issues. The topics covered include injury prevention, occupational health and safety, recreational waters, and radiation. These programs are discussed in terms of their potential to cause illness or death in the community and the responsibilities of the local board of health. To assist with implementation, specific guidance concerning the board of health's role regarding such issues is offered. A first critical theme underlying this discussion is that many illnesses and deaths can be prevented through the creation of proactive safety measures and programs. Second, boards of health have a responsibility to ensure the health of all community members, but especially of those who are at increased risk of illness or death.

Certainly all boards of health want to do the best job possible, but to succeed they must be aware of both their emerging and ongoing public health responsibilities. In addition, for both ethical as well as legal reasons (e.g., the Americans With Disabilities Act), boards of health must take special notice of community members at elevated risk of disease or injury.

## Injury Prevention

Injury prevention has been and remains a somewhat controversial issue insofar as governmental regulations of individuals' actions are concerned. For example, resistance to the use of seatbelts or motorcycle helmets has been successfully presented as a "freedom of choice" issue to some legislatures, despite overwhelming evidence of the effectiveness of such safeguards and the costs to society of caring for many injured drivers and cyclists. When framed in such a manner, the responsibilities of the board of health for individual injury prevention (i.e., the board's duty to act) have been unclear.

Injury is a public health issue, despite arguments regarding personal freedom. In homes or in public places, unintentional injury and violence account for approximately 30% of all years of potential lost life (YPLL) in the United States, exceeding losses from stroke, heart disease, and cancer combined (1994 estimate). The federal funding of efforts to reduce the public health toll from injury, however, is relatively minimal when compared with the funding for cancer and heart disease.

Boards of health can reduce injuries and do have legitimate responsibilities in this area. Where injury reduction programs have been implemented, they have often resulted in greatly improved public safety, reduction in loss of life, or both. Table 1 illustrates a number of approaches that have been applied successfully in a variety of different public injury situations.

**Table 1** Examples of effective injury prevention interventions.

<b>Injury Problem</b>	<b>Intervention</b>
Bicycle injuries	Bicycle helmet use, mandatory helmet laws, bike lanes and paths
Choking and suffocation	Legislation and product design changes (e.g., refrigerators with magnetic locks, warnings on plastic bags, toy size regulations, crib modifications)
Falls among the elderly	Weight-bearing exercises, multimodal programs (visiting nurses, exercise programs, hazard elimination), protective pads
Fire and burns	Smoke detectors, legislation concerning flammability of children's clothing, safe preset temperatures on water heaters
Motor vehicle crashes	Safety belts, air bags, depowered air bags, child safety seats, sobriety checkpoints
Poisoning	Child resistant packaging, bittering agents, carbon monoxide alarms, Poison Control Centers
Source: Harborview Injury Prevention and Research Center: Best Practices	

While research at the federal and state levels and the availability of local acute treatment facilities are important for injury prevention efforts, the board of health's support of injury prevention programs and increased community awareness and acceptance of prevention measures are critical to successfully reduce a community's injury burden.

Boards of health have a role in preventing injury that occurs in homes, public places, and in the workplace. The major issues surrounding each of these areas are discussed below.

### *Household Injury and Safety*

The majority of people spend over 90% of their time indoors, and over half of that time is spent in a domestic setting. Because of this, certain housing features are essential for injury prevention (e.g., hand rails and stair risers of specific dimensions, as specified under housing codes). Children and the elderly are at particular risk of household injury because they may not have the mental abilities (e.g., infants), physical strength (e.g., the elderly),





or awareness to avoid injury. Local boards of health have a responsibility to ensure the safety of both young and old at-risk citizens, issues of domestic privacy notwithstanding.

To increase the public's understanding of in-home injury risks, boards of health can disseminate training and educational materials at frequently visited community locations, such as recreation centers, the post office, libraries, and doctors' offices. This material should also include information on the Poison Center Network that assists with unintentional overdoses of prescription drugs, cleaners, or lawn and garden poisons. The Poison Center Network itself was the outcome of concerned public health specialists and board of health officials working together. The same approach can be employed to reduce domestic injury hazards to children and infants, as demonstrated by the current movement to implement effective bicycle safety programs, including the wearing of bicycle helmets.

Boards of health can also build coalitions with community groups and the national SafeKids programs to distribute car seats to needy families, support car seat inspection training activities, and inspect car seats for correct installation. Such coalitions can also provide bicycle helmets and present bike helmet education programs to children.

One of the most effective ways for boards of health to reach the elderly (persons aged 65 and older) who are also at risk for unintentional injury is through the economic support and public promotion of direct care services. Services for the elderly that have been developed in other communities include Meals-on-Wheels and the Visiting Nurses Association. These programs provide not only important nutritional services and primary healthcare to older adults, but they may also alert concerned community members to the illness or injury risks in a senior citizen's environment.

Finally, boards of health can effectively protect the population overall through:

- Implementation of a local building code.
- Adoption of a nationally recognized electrical code.
- Education of the public about consumer product safeguards (e.g., power tools, appliances, and domestic electronics).
- Promotion of electric company public service announcements (PSAs) regarding overhead electric lines.

### *Safety in Public Places*

The role of the local board of health with respect to public places is well recognized and clear: The board should endeavor to provide an environment free of unusual hazards at all community assembly areas. Injury prevention efforts might include exercise of existing health department powers, educating other governmental entities that typically pay less attention to public health issues but with resources to affect changes (e.g., social workers, police or fire departments), or enacting ordinances to ensure a reasonably safe environment.

Public areas that may need board of health attention include playgrounds, schools, community centers, pools, gymnasiums, parks, recreational areas, public assembly areas, municipal streets or operations, and accessible yet privately held concerns.

*Playgrounds, schools, and community centers.* Purchasing policies and practices should be in place to ensure that all playground equipment is obtained only from reputable suppliers. For compelling reasons related to both ethics

and product liability, such suppliers typically pay special attention to the elimination of pinch and strangulation points or unusual hazards in the design and fabrication of their equipment. Likewise, consideration should be given to play surfaces to ensure that appropriate nontoxic, shock-absorbing materials with a long wear-life are utilized. Needless to say, security and traffic isolation issues should be a concern at the design or renovation stage of any playground.

Schools and community centers can pose unique injury hazards by making available sometimes hazardous exercise equipment to at-risk populations. Since prudent risk management mandates adequate liability insurance coverage for these places, health and safety assessment services may be available to the board from the insurance company. Finally, facility maintenance procedures should be reviewed to assess readiness and suitability of emergency medical capabilities (e.g., on-site CPR or portable electroshock devices) and personnel for snow and ice removal.

*Municipal operations and streets.* The local board of health should examine its responsibilities regarding community operations and streets, e.g., their oversight role for waste landfills, recycling centers, and pedestrian traffic. Opportunities to better safeguard people exist in the form of pedestrian-vehicular separations/barricades, the development of safer intersections and crosswalks, and—especially—with the designation of hazardous materials routes. No single governmental entity can claim a monopoly on the skills or knowledge necessary to mitigate such hazards. In fact, the resources of the local health board may be desired inasmuch as hazardous materials routes can involve at-risk populations at hospitals, schools, elder care facilities, and the like.

*Private concerns.* Although the variety of potential injury-producing situations on private property is immense, the health board has a legitimate and implied duty to act where prudent controls of such problems for at-risk populations are not otherwise in place. Examples of hazards that boards of health should consider include the confined space hazards posed by dumpsters, old refrigerators/freezers at uncontrolled dumpsites, or abandoned tanks, and the attractive hazards posed by open trenches, heavy equipment, or other construction-site risks. The board of health can control the risk to the community that these hazards pose by recommending or enacting ordinances.

## **Occupational Health and Safety**

In the workplace of the 2000s, the paradigm from the 1900s that “safety is simply common sense” has given way to advanced techniques to anticipate, recognize, evaluate, and control workplace safety problems. With over one million named chemicals in existence it must be recognized that keeping workers safe has become the job of individuals with specialized training and skills.

When most people think of occupational health or workplace safety, they think “OSHA,” the Occupational Safety and Health Administration. OSHA is actually an acronym for both the federal law and the agency charged with ensuring safe workplaces. Most state or federal occupational safety and health programs do not cover all employees in the state, leaving open the need for board of health involvement under certain circumstances. About half of all states have agreements with OSHA to operate state workplace safety programs for the federal government.

Workplaces of concern to a board of health might include libraries, legal offices and courthouses, road service garages, and other places where county or municipal workers are stationed. Boards of health should ensure that the following basic requirements for workplace safety are being met:

- Employers are furnishing a workplace free of any obvious or common hazards.
- Workplace inspections, including air monitoring, are conducted to identify any hazards to determine compliance with permissible exposure limits for specific chemicals.



- Hazards of repetition and/or high force operations are evaluated to prevent repetitive stress diseases or other ergonomic hazards.
- If legally authorized, health department inspections are regular, thorough, and appropriate.
- Inspectors have access to workplace records (listings of hazardous chemicals, job hazards, records of injuries and illnesses) from employers and/or state agencies as needed.

Once a responsible party (employer or board of health) has conducted an inventory of workplace hazards, it is ethically and legally prudent to strive to eliminate or otherwise control those hazards. In doing so, there exists a rank-order preference for the implementation of such efforts (Table 2).

Board members and departments of health with occupational safety and health problems have at least three resources available to them. OSHA Outreach Training is provided on a no-cost basis from the OSHA Training Institute to certain OSHA-regulated entities. Third-party contractor training concerning workplace safety is available for a fee. Finally, many states' worker safety programs, Workers' Compensation insurers, or state-run insurers may provide technical assistance on issues in this area as well.

**Table 2** Steps in implementation of workplace safety controls.

Rank-Ordered Step	Comments
1. Engineering controls	<ul style="list-style-type: none"> <li>• Physical changes are not always the most expensive approach.</li> <li>• If engineering fixes are properly maintained, they hold the greatest promise of long-term effectiveness.</li> </ul>
2. Administrative controls	<ul style="list-style-type: none"> <li>• Use in addition to engineering changes.</li> <li>• Directed at reducing the time persons spend in hazardous locations.</li> <li>• Education and training qualify.</li> </ul>
3. Personal protective equipment	<ul style="list-style-type: none"> <li>• Use as a last resort.</li> <li>• Must include training.</li> <li>• Use with efforts at engineering and administrative control.</li> </ul>

## Recreational Waters

Swimming and other water-related activities are excellent ways to get the physical activity needed for a healthy life, and millions of people enjoy oceans, lakes, rivers, pools, and spas each year. Given the popularity of swimming, it is important for local boards of health to support programs intended to prevent water-related adverse health events, such as sunburn and other injuries, drowning, and recreational water illnesses (RWIs). Recreational water programs are typically divided into two distinct groups: The first group contains treated recreational water venues such as pools, hot tubs, water parks, water play areas, and interactive fountains, while the second group includes untreated venues like oceans, lakes, rivers, and beaches.

Historically, drowning has been the most visible cause of morbidity or mortality with respect to recreational waters. Every day, about 10 people die from unintentional drowning. Of these, two are children aged 14 or younger. Drowning is the sixth leading cause of unintentional injury death for people of all ages, and the second leading cause of death for children ages 1 to 14 years (Hubbard, 2009). However, over the past two decades, there also has been a substantial increase in the number of RWI outbreaks associated with swimming in treated venues. Boards of health, now out of necessity, must have an increased focus on the prevention of recreational water illness along with the prevention of drowning.

Recreational water illnesses (RWIs) are caused by germs spread by swallowing, breathing in mists or aerosols of, or having contact with contaminated water in swimming pools, hot tubs, water parks, water play areas, interactive fountains, lakes, rivers, or oceans. RWIs can also be caused by chemicals in the water or chemicals that evaporate from the water and cause indoor air quality problems.

RWIs include a wide variety of infections, including gastrointestinal, skin, ear, respiratory, eye, neurologic, and wound infections. The most commonly reported RWI is diarrhea. Diarrheal illnesses are caused by germs such as Crypto (short for *Cryptosporidium*), *Giardia*, *Shigella*, norovirus, and *E. coli* O157:H7.

Crypto, which can stay alive for days even in well-maintained pools, has become the leading cause of swimming pool-related outbreaks of diarrheal illness. From 2004 to 2008, reported Crypto cases increased over 200%, from 3,411 cases in 2004 to 10,500 cases in 2008 (Centers for Disease Control and Prevention, n.d.). Although Crypto is tolerant to chlorine, most germs are not. Keeping chlorine at recommended levels is essential to maintaining a healthy pool. However, a 2010 study found that 1 in 8 public pool inspections resulted in pools being closed immediately due to serious code violations such as improper chlorine levels (Centers for Disease Control and Prevention, n.d.).

Boards of health should ensure recreational water programs include the following core functions and features: measurable objectives that allow proper assessment of recreational water programs, enforceable regulations that provide clear rules and policies, internal policies and procedures that state the expectations and objectives of the program, properly educated and trained staff, sufficient resources, and community education. The CDC's Healthy Swimming website contains resources for public health professionals, including model aquatic codes, educational materials, and training information.

*Information on Healthy Swimming and Recreational Water (from the Centers for Disease Prevention and Control)*

- There are 8.8 million residential and public-use swimming pools in the United States.
- In the United States during 2007, there were approximately 339 million pool visits each year by persons over the age of six.
- Forty-one percent of children aged 7-17 years, and 17.4% of adults in the United States, swim at least six times per year.
- There are over 6.6 million hot tubs in operation in the United States.
- Sunburn is a risk factor for both basal cell carcinoma and melanoma (types of skin cancer). In 2003, a total of 45,625 new cases of melanoma were diagnosed in the United States, and 7,818 persons died from the disease.
- Over 12% (13,532 of 111,487) of pool inspections conducted during 2008 resulted in an immediate closure, pending the correction of the violations.



- A total of 78 recreational water-associated outbreaks affecting 4,412 persons were reported to CDC for 2005-2006, the largest number of outbreaks ever reported in a 2-year period.
- Of 48 recreational-water associated outbreaks of gastroenteritis during 2005-2006, 64.6% were caused by one chlorine-resistant parasite: *Cryptosporidium*.
- Of 35 gastroenteritis outbreaks associated with treated (for example, chlorinated) recreational water venues, 82.8% were caused by *Cryptosporidium*.
- Because of its resistance to chlorine, *Cryptosporidium* (Crypto) has become the leading cause of gastroenteritis outbreaks associated with swimming pool venues. Reporting of cryptosporidiosis cases increased 208% from 2004 (3,411) to 2008 (10,500).
- Drowning is the 2nd leading cause of all unintentional injury deaths in children aged 1-14 years and the 6th leading cause of unintentional injury death for all ages.
- Among 0-4 year olds, 69% of drownings for which the location was known occurred in swimming pools.
- In the United States in 2007, almost 32 million individuals participated in motor or power boat activities.
- In 2006, 3,474 persons were injured and 710 died while boating.
- The United States Coast Guard's 2006 statistics stated that approximately 87% of boaters who drowned were not wearing life jackets.

## Radiation

### *Conventional Thinking*

While the public generally fears radiation, there are many natural sources and exposures to such materials that are common yet poorly understood. Benefits from man-made radiation are numerous, and it is for this reason that board of health actions on this topic may include a strong element of public education about risks versus benefits. Key points regarding radiation sources and exposures are listed below:

- The medically produced x-ray is our most frequent and intense man-made radiation exposure.
- Imperceptible radon gas is probably the greatest threat faced by Americans from natural sources of radiation.
- The public is continually bombarded by nonhazardous levels of radiation not only from beyond the planet (i.e., cosmic rays) but from extremely familiar sources including certain dinnerware, foods, and water. For better or worse, there is virtually nothing to be done to reduce such exposures.

### *Risks*

Many domestic products contain radioactive materials that have been evaluated by the U.S. Nuclear Regulatory Commission and found to be safe. One such example is the smoke detector. This device has most certainly prevented more injuries or fatalities than the infinitesimal exposure from its radioactive source could ever cause. Relative to the benefits provided by such uses, there should be no question of the continued safe use of most radioactive materials. Radioactive materials are used or found routinely in industry, medicine, schools, and public buildings in applications, such as material level gauges, exit signs, nuclear fuel rods, compass dials, X-rays, electronics leak testing, cancer treatments, glass, and iodinated salts.

Despite the innumerable positive outcomes from the controlled use of radioactive materials, it is equally true that there are genuine and extraordinarily serious risks from their use by ignorant, poorly trained, or malicious persons or nations.

### *Existing Reactors and Wastes Risks*

What the 1984 toxic release in Bhopal, India, did to the chemical industry, the incident at the Three Mile Island nuclear reactor did to the U.S. nuclear power industry. Local boards of health will likely not need to consider public health or emergency issues related to the siting or construction of new nuclear power facilities since none are planned. However, increasingly at issue is how the existing 115 plants, their local communities, and governing states manage the highly radioactive wastes from such operations. Equally important in the future will be the safe transportation of these materials. Local boards of health should remain receptive to opportunities to interact with other local agencies (e.g., police, fire, emergency management, planning) on such issues, as well as to provide expertise when requested or necessary.

### *Microwave or Radio Wave Hazards*

Many professionals, through articles published in their association journals, suggest there is minimal risk to the public from low energy radiation sources, such as microwave ovens, personal cellular telephones, or roadside telephone transmission towers. Nevertheless, it may fall to the local board of health at some point to evaluate the safety of proposed microwave-generating installations. In such cases the local health department should be charged with conducting a basic review of current literature on any hazards from such sources. While it is not anticipated that the existing scientific picture of low risk for public exposures to microwaves or radio waves will change, the most current medical evidence should always be examined.

### *Low Frequency Electromagnetic Radiation*

The low powered radiation emanating from overhead power lines, computer video display terminals, and similar appliances has not been proved to be hazardous to humans. Like the evaluation of microwave or radio wave hazards, board of health members that find themselves addressing issues related to such exposures should review current scientific findings.

## **Emerging Issues for Boards of Health**

This chapter has attempted to present the key concepts of community public health and to identify some of the more common special issue areas that a local board of health may need to address. Because of changes in social values, styles, fashion, or any number of psychological, technological, or religious elements, board of health members must remain vigilant to new community developments that may deserve their oversight (or even require their intervention). The popularity of tattoos and body piercing has required local boards of health to implement tattoo parlor inspections and education. Because of the invasive nature of tattoos and piercings, these programs are very important to ensure good hygiene. Local health departments, municipalities, or boards of health need to examine what their role might be in exercising prudent public health controls as other new issues and concerns arise (Table 3).

It falls to boards of health to remain vigilant, ensuring that their communities' ever-changing health and safety issues are adequately researched and identified. With public health implications known, the responsibility of the board of health for such matters can be discussed among board members and with other jurisdictional authorities to determine final authority for the issue. At that point, the necessary action—if any—required by the board of health can be determined.

**Table 3** Public trends of potential importance to boards of health.

<b>Trend</b>	<b>Hazard</b>	<b>Control</b>
Tattoo and body piercing parlors	Infectious disease spread	Regulation
Skateboarding parks	Injury	Education
Massage providers	Infectious disease spread	Regulation
Drug paraphernalia shops	Intoxification	Regulation, education
Health food stores	Potent unregulated substances	Regulation, awareness



## Questions and Considerations for Local Boards of Health

1. Does your board of health have a clear understanding of its responsibilities toward public safety and well-being?
2. Has your board of health developed and/or distributed fall and injury prevention educational materials?
3. Does your board of health participate in any community coalitions to promote safety?
4. Are there bike lanes in your community?
5. Have your local officials or board of health adopted a building code and electrical code?
6. Are there any dumpsite or construction sites in your community that pose safety risks?
7. Does your board of health oversee and evaluate a recreational water program?



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## Risk Assessment, Management, and Communication

### Role of Risk Assessment and Risk Management in Public Health Policy and Decision Making

Community health departments regularly offer mandated environmental and public health services (e.g., food inspections). Although necessary to protect the community, many more services may be needed by the community (e.g., child lead poisoning investigations). Some needs may be hidden throughout the disadvantaged or underserved populations within the community. The future of local health protection depends on being able to identify and prioritize the environmental public health needs within the community through risk assessment.

A person born today can expect to live a longer and healthier life than people born at the beginning of the 20th century (Table 1). Improved environmental protection and public health services during the 20th century have played important roles in providing a safer and healthier environment in which to live. Identifying and removing sources of disease and disease transmission have reduced the number of deaths from disease. Identifying and correcting safety hazards have reduced injuries and deaths from accidents. Improvements in the medical field have allowed for earlier diagnosis, better treatment, and cures for diseases and other health problems.

**Table 1** Life expectancy at birth by race and sex, 1930-2005 (data from *National Vital Statistics Report*).

Year	All Races			White			Black		
	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female
1930	59.7	58.1	61.6	61.4	59.7	63.5	48.1	47.3	49.2
1940	62.9	60.8	65.2	64.2	62.1	66.6	N/A	N/A	N/A
1950	68.2	65.6	71.1	69.1	66.5	72.2	N/A	N/A	N/A
1960	69.7	66.6	73.1	70.6	67.4	74.1	N/A	N/A	N/A
1970	70.8	67.1	74.7	71.7	68.0	75.6	64.1	60.0	68.3
1980	73.7	70.0	77.4	74.4	70.7	78.1	68.1	63.8	72.5
1990	75.4	71.8	78.8	76.1	72.7	79.4	69.1	64.5	73.6
2000	77.0	74.3	79.7	77.65	74.9	80.1	71.9	68.3	75.2
2005	77.8	75.2	80.4	78.3	75.7	80.8	73.2	69.5	76.5

The current challenge to public health and environmental agencies is to maintain an active role in improving the quality of life through improving public and environmental health. Agencies must develop strategies to identify problems that impact the health of their communities. Increased development of disease and exposure registries and disease incidence reporting can improve the ability of epidemiological research to identify problems. Clinical and laboratory studies can provide better insight into the mechanisms behind disease transmission, adverse health effects from exposure to chemicals, and injury prevention. These investigative strategies provide important tools in identifying environmental and public health problems that require attention. They also can help to identify

intervention strategies to prevent or at least minimize the impact of the identified problems on the health and well-being of the public and the environment.

It is very important that public health and environmental agencies be involved in identifying problems that impact the overall health of their communities. The practice of reactive or retrospective public and environmental health, however, limits the application of corrective and intervention strategies until after a problem has been identified and studied. *Reactive strategies* limit the ability of the agencies to develop programs and policies that anticipate problems and intervene to prevent problems before they occur. In contrast, *proactive strategies* evaluate community and pertinent scientific data before problems occur to project the likelihood of adverse outcomes and intervene prior to problems developing in the community.

Local boards of health can ensure that local health departments proactively manage community health by supporting the development and training of staff in the use of risk assessment and risk management tools. The tools of risk assessment and risk management are designed to help improve environmental and public health through anticipating and prioritizing problems in a community. Risk assessment is the process of predicting the likelihood that a problem will occur. Risk management is the process of identifying and evaluating intervention strategies to eliminate or minimize the problem. Together these processes help agencies target and prioritize areas of concern and identify strategies to improve environmental and public health. To effectively use these tools, risk communication strategies must be used to involve the public. Risk communication assures public involvement in the process of risk assessment and risk management in order to facilitate a broad-based community understanding of the hazards and risks and participation in improving environmental and public health.

### *Identifying the Problem*

Two major factors, hazard and risk, are important in environmental and public health decision making that uses the risk assessment and risk management process (Table 2). Both must be understood to manage or reduce the impact of situations or conditions on environmental or public health.

**Table 2** Definitions of hazard and risk.

<b>Hazard</b>	<b>Risk</b>
<p>Adverse consequences resulting from exposure at a particular level to a chemical, pathogen, or physical substance or condition.</p> <p><i>Example:</i> 40 micrograms/deciliter blood lead in children results in acute symptoms of lead poisoning, e.g., stomachache, headache, hearing problems, etc.</p>	<p>Likelihood that in a given situation, the conditions or exposure will be adequate to cause the adverse consequence or effect.</p> <p><i>Example:</i> Exposure to lead-based paint, especially ingesting paint chips likely in children 6 months to 6 years old living in pre-1950 housing with deteriorating painted surfaces.</p>

Understanding the hazard requires that local boards of health or health departments identify possible outcomes and evaluate how conditions or exposures can be manipulated. Boards of health should ensure that health department staff does the following:



- Identify the measurements necessary to evaluate the condition or exposure.
- Find what adverse outcomes have been previously documented as a result of similar conditions or exposure.
- Determine if it is possible to quantify the relationship between the condition or exposure and the adverse outcome.
- Establish the level of exposure or condition that does not cause an adverse outcome, thereby making the situation potentially safe.

Managing the hazard requires identifying exposure levels of concern and controlling the exposure to below a level of concern. Hazard identification requires careful review of experimental and epidemiological studies to estimate the impact of exposures or conditions on people or the environment. Guidelines for safe exposure are then developed and conditions monitored regularly to ensure exposure below levels of concern.

It may be necessary for local health departments to develop case-specific guidelines. The following resources may be helpful as a starting point from which to develop the guidelines (see Appendix B: Internet Resources for contact information):

- Agency for Toxic Substances and Disease Registry (ATSDR)
- U.S. Environmental Protection Agency (USEPA)
- National Institute for Occupational Safety and Health (NIOSH)
- Occupational Safety and Health Administration (OSHA)
- National Safety Council (NSC)
- American Industrial Hygiene Association (AIHA)
- NSF International
- American Conference of Governmental Industrial Hygienists (ACGIH)
- Consumer Product Safety Commission (CPSC)

Risk management requires that the local health department be able to estimate the likelihood that a particular situation will result in a condition or exposure sufficient to result in an adverse outcome. Local boards of health should ensure that health department staff does the following:

- Identify the population in the vicinity of the problem.
- Determine if people are likely to be exposed to or encounter the condition.
- Evaluate whether any contact with the condition or exposure is likely to be extensive enough to result in an adverse outcome.

Local health departments must work with the potentially affected community to manage the risks. Managing risk requires reducing the chance for conditions to create exposure at levels of concern. Conditions must be documented. Change in conditions must be anticipated and risk evaluated under current and potential exposure

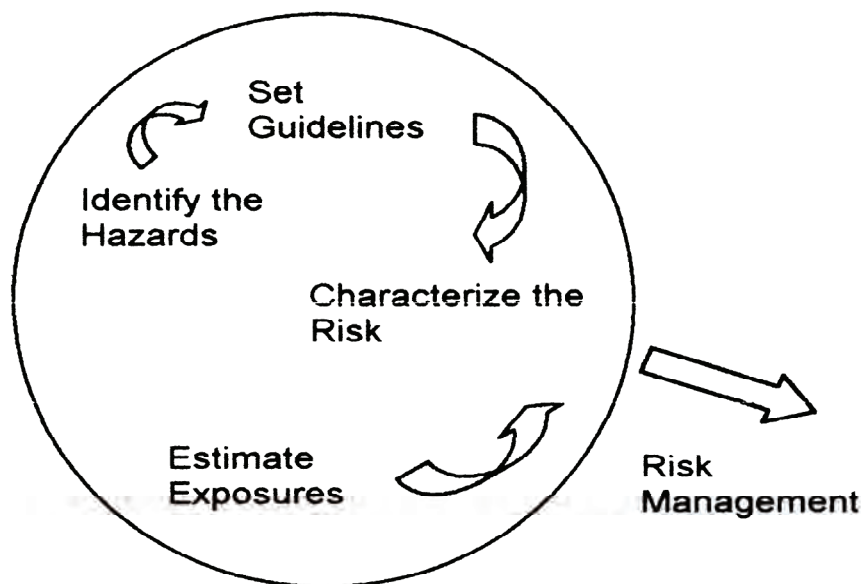
conditions. Controlling conditions to minimize both exposure and the chance of adverse outcomes reduces risks. Local health departments and boards of health should also ensure higher risk groups, including children, pregnant women, and the elderly, are accounted for in risk assessments or risk management plans.

### *Purpose of the Risk Assessment*

Understanding the hazard and risk of a condition or situation is the purpose of conducting a risk assessment (Figure 1). To understand the situation, the risk assessor must systematically:

- Evaluate the potential for adverse effects from exposures (identify the hazard).
- Identify or set a safe guideline for each route of exposure.
- Identify exposure points and estimate exposure levels.
- Predict the adverse outcome from exposure to the chemical, pathogen, or physical condition (characterize the risk).

**Figure 1** Elements of risk assessment.



The quantitative risk assessment should thoroughly characterize the risks. It should also establish the groundwork for identifying the costs and benefits of strategies for risk reduction during the risk management process. Risk assessments benefit from community involvement. Risk communication begins with the first stages of the risk assessment process.

In reality, most risk assessments try to provide a characterization of long-term risk from concurrent exposure to multiple hazards by multiple routes of exposure (e.g., well water and soil contaminated by pesticides and solvents). The risk assessment is only as strong as the available data used to evaluate the hazards and risks (Figure 2). In general, the risk assessment will provide a better characterization of the hazards and risks of short-term exposures to single chemicals, pathogens, or conditions. The quality and applicability of a risk assessment add to the real-life benefits when scientific data are plentiful. Well-developed work-related exposure and epidemiological studies, animal and cellular toxicology studies, and environmental media levels make the risk assessment easier to relate to



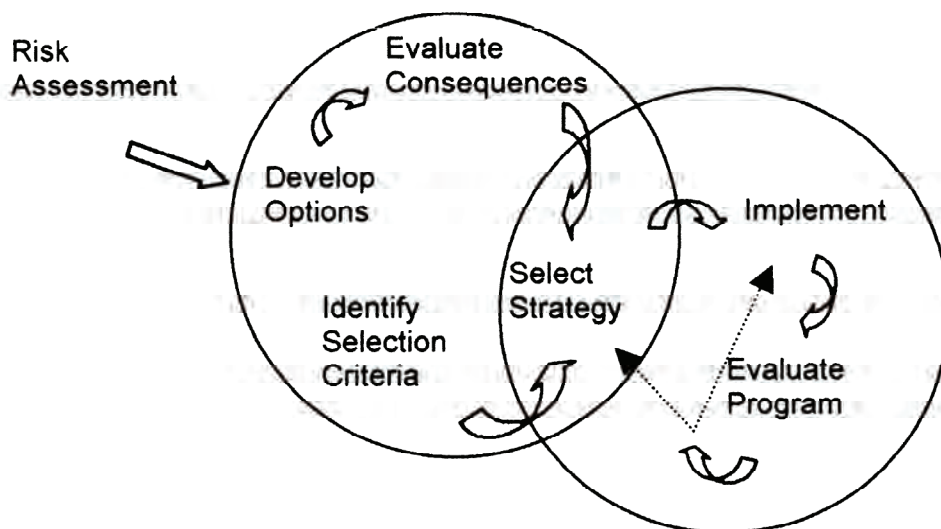
a community situation. The importance of a particular exposure will be easier to evaluate if the exposure route (e.g., inhalation, oral, or dermal) from scientific studies is the same route of exposure in the environment being assessed. Estimates of the cumulative effects of concurrent exposure to various hazards provide the weakest risk assessment since concurrent exposures to multiple hazards are rarely scientifically studied.

Since calculated risk does not always make sense when the professional judgment test is used, risk assessments are best performed by trained individuals. Many local health departments do not have trained risk assessors. It is the role of the local board of health to assure networking with federal and state professionals and/or to support training for local staff on responsibly evaluating risks. Assessments done poorly rarely underestimate risk, but more likely unnecessarily elevate community fears and cost unnecessary management dollars.

#### *Purpose of Risk Management*

Identifying intervention strategies for the management of the hazard and risk is the purpose of risk management (see Figure 3). The process involves identification, evaluation, selection, and implementation of the most appropriate action. Environmental and health department officials should develop community-specific criteria for conducting the risk management phase of hazard and risk reduction. Community leaders and citizens as well as those responsible for conducting risk management should be involved in developing these criteria. Buying into the decisions requires total commitment of all stakeholders.

**Figure 3** Elements of risk management.



**Figure 2** Reliability of risk assessment.

Hazard identification: Characterizing the adverse health effects.

Guidelines identification: Setting a media or body burden, or level for safe exposure.

Exposure estimation: Characterize pathways and levels of exposure in the community involved.

Risk characterization: Comparison exposure estimates with guidelines and estimating and prioritizing risks for intervention.

Risk management includes establishing goals for all populations of a community. The criteria to use when making risk management decisions are: community, environmental, and public health goals; social and political factors; available control technology; costs and benefits; results of risk assessment; and acceptable risk.

Points to be considered in the risk management evaluation include the following:

- Current federal policy is for more protective standards and guidelines for the general population. This policy should be encouraged.
- Current federal policy is to provide exposure limits and not adopt a prevention approach.
- Local boards of health and health departments should adopt a prevention policy based on exposure limits.
- Local boards of health need to ensure that the health and related concerns of their constituency, including disadvantaged and underserved populations, are protected against the concerns of other stakeholders involved.
- Boards of health should ensure that risk assessments are performed.
- Boards need to develop a plan for the implementation, enforcement, and monitoring of risk management policies.

The optimal risk management process should consider: overall protection of human health and the environment; compliance with federal and state environmental or occupational guidelines unless a waiver is applicable; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through the use of treatment; short-term effectiveness; implementability; cost; federal and state regulatory body acceptance; and community acceptance.

The risk assessment and risk management process should *not* be considered a finite project. The prevention program may include a combination of good engineering practices, regulations and administrative controls, compliance audits and exposure/accident investigation, and education and public awareness. Once the risk reduction strategy (or policy) is identified and implemented, the effectiveness of the strategy must be evaluated continually. Periodic evaluation is necessary to ensure appropriate risk reduction or prevention under potentially changing conditions or community response. As hazards and risks change, new directions and programs will need to be identified, evaluated, and implemented.

#### *Purpose of Risk Communication*

Because the risk assessment and risk management process involves a wide range of assumptions, probabilities, and uncertainties, the community involved needs to be a partner in the process. Effective risk communication (Figure 4) involves all stakeholders early and continually in the process. Risk communication improves not only the quality of the risk assessment and risk management, but involves the stakeholders in the decision-making process. Risk communication helps to improve stakeholder acceptance of the decision and enhances the quality of the risk assessment and risk reduction evaluation. Programs to improve risk communication must include involving the community early and often (this includes the media).

#### *Policy for Using Risk Assessment, Risk Management, and Risk Communication*

Environmental and public health policy should be primarily influenced by the need to identify and control hazards and risks in the community. In reality, policy is driven by external regulatory mandates (Figure 5) on a community and the economics of complying with these mandates. Existing environmental programs require



**Figure 4** Seven elements of effective risk communication (adapted from U.S. Environmental Protection Agency).

Accept and involve public and all potential stakeholders as legitimate partners.

Plan communication carefully and evaluate efforts.

Listen (and learn) as well as speak.

Be honest, open, and frank.

Involve the media.

Communicate without jargon, but with compassion.

Build and maintain credibility by coordinating and collaborating with other credible stakeholders.

compliance monitoring, which often limits the ability of an environmental or public health agency to adopt a proactive community-wide risk assessment, risk management, and risk communication process. Policy makers need to identify strategies to reduce the need for reactive and mandatory compliance monitoring and disease and exposure investigations. Proactive risk assessment, risk management, and risk communication strategies may help reduce the burden created by mandated and reactive programs.

The environmental and public health goals of the public have shifted over the last century. This has influenced the legislation controlling how environmental and public health is managed (i.e., a shift toward predicting problems, not just managing problems). Major federal health and safety statutes have included a directive to identify and control environmental and public health hazards and risks. Some require public involvement or at minimum awareness in this process. However, no one risk assessment, risk management, or risk

communication methodology works for all hazards and risks. Environmental and public health programs need to encourage diversity in the methodology to minimize potential error and identify the strongest yet cost effective intervention or prevention strategy. They must also advocate for strong and early involvement by the community.

### Role of Local Boards of Health

Local boards of health are becoming increasingly responsible for identifying and prioritizing the hazards and risks within their communities as governmental decentralization is delegating more responsibility to state and local government. One way for boards of health to prioritize the services they provide is through the risk assessment,

**Figure 5** Legislation requiring risk assessment/risk management.

Food, Drug, and Cosmetic Act (1938)

Federal Insecticide, Fungicide, and Rodenticide Act (1947)

Clean Air Act (1970)

Occupational Safety and Health Act (1972)

Clean Water Act (1972)

Consumer Product Safety Act (1972)

Resource Conservation and Recovery Act (1976)

Safe Drinking Water Act (1976)

Toxic Substances and Control Act (1976)

Comprehensive Environmental Remediation, Compensation, and Liability Act (1980)

risk management, and risk communication process. The following steps can go a long way toward implementing this process:

- Work with board members and health department staff to develop a proactive attitude and policy toward health risk assessment, management, and communication.
- Assure that staff are adequately prepared and trained to do risk assessment/risk management.
- Appoint a task force, including the public and other stakeholders, to identify and prioritize community hazards and risks.
- See that partnerships and networks are in place with other environmental and health agencies and organizations to assure access to data, epidemiological and laboratory services, and other risk assessment, risk management expertise.
- See that a risk communication system and partnerships are in place to provide:
  - Public access to studies, data, and information on pathogenic chemicals and physical conditions adversely affecting health.
  - Media promotion.
  - Information and public health education strategies that will help the community to become involved in reducing or preventing the adverse impact of environmental hazards and risks on their own health and the health of the community.
- Develop an education paradigm as well as a regulatory paradigm, where possible, to build community capacity to reduce risks independent of compliance monitoring.

Ideally, local governments can move beyond early risk intervention strategies and develop multipurpose management programs. Such programs can include multipurpose resource use, land use management, environmental planning and environmental impact assessment, dispute resolution, and advanced risk assessment/risk management planning (Table 3).

Although initial costs may outweigh the benefits, long-term risk prevention can more than pay for itself both administratively and in terms of the benefits provided to the health of the public and the environment.

**Table 3** Risk assessment, risk management, and risk communication: The radon example.

Risk Assessment	Risk Management	Risk Communication
Fact – Radon increases risk of lung cancer. Fact – USEPA radon Zone 1 (highest risk). Data gap – Inability to measure radon-related lung cancers in community.	Offer coupons for reduced cost kits to monitor radon in homes. Incorporate radon-resistant new construction into building code. Disclose radon levels at time of property transfer.	Billboards and newspaper campaigns. Pamphlets. Workshops and home fair exhibits.



## Questions and Considerations for Local Boards of Health

1. Is your board of health familiar with different risk assessment and management strategies?
2. Has your board of health ensured that the local health department staff are trained in the use of risk assessment and risk management tools?
3. Is your board of health aware of hazards or risks that exist in your community?
4. Has your board of health identified or evaluated ways that conditions or exposures from hazards can be manipulated?
5. Is your board of health aware of the different resources that exist to assist with risk assessment and risk management?
6. Has your board of health participated in a risk assessment or ensured that the health department or local partners have performed a risk assessment?
7. Are partnerships or networks with other environmental and health agencies in place to ensure access to data, epidemiological laboratory services, and other risk assessment tools are available?
8. Has your board of health developed any risk communication strategies?

## Resources for Additional Information

American Conference of Governmental Industrial Hygienists. Available at [www.acgih.org](http://www.acgih.org)

California Environmental Protection Agency. (2001). *A guide to health risk assessment*. Available at <http://oehha.ca.gov/pdf/HRSguide2001.pdf>

Centers for Disease Control and Prevention. Agency for Toxic Substances and Disease Registry. National Toxic Substance Incidents Program. Available at <http://www.atsdr.cdc.gov/ntsip/>

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Robson, M. G., & Toscano, W. A. (Eds.). (2007). *Risk assessment for environmental health*. San Francisco, CA: Jossey-Bass.

United States Consumer Product Safety Commission. Available at [www.cpsc.gov](http://www.cpsc.gov)

United States Department of Labor. Occupational Safety and Health Administration. Available at [www.osha.gov](http://www.osha.gov)

United States Environmental Protection Agency. Available at [www.epa.gov](http://www.epa.gov)



# Epidemiology

## Introduction

Epidemiology is a part of medical science that has made significant improvements to population health. It is an important tool for investigating the causes of individual diseases and disease outbreaks. The principles of epidemiology are often used to organize a disease outbreak investigation and determine disease causation. Epidemiologic investigations usually are conducted by frontline public health workers. Board of health members should be familiar with epidemiology to investigate disease outbreaks and health disparities and ensure its use in their health districts.

Epidemiology is the study of the distribution and determinants of health events in a human population. The *determinants* or factors influencing health can be any interventions/exposures occurring to individuals or communities, such as toxic substance exposure in a neighborhood, food poisoning, indoor air pollution, a health education program, and vaccinations. *Health events* are any health changes to a population, including changes in cancer occurrence, food poisoning, “sick building” symptoms, health behavior changes, and disease prevention and education.

The most common applications of epidemiology in public health are as follows:

1. Collecting and analyzing vital records (births and deaths) and disease records (morbidity).
2. Monitoring diseases or other community health problems.
3. Investigating outbreaks leading to control or prevention of epidemics and other community health problems.
4. Identifying public health problems and measuring the extent of their distribution, frequency, or effect on the public’s health.
5. Evaluating health programs.
6. Providing data necessary for health planning or decision making by health agency administrators or health policy makers.

## *Commonly Used Measurements in Epidemiology*

Table 1 on page 122 provides some of the common terms used in epidemiology.

Although frequently used by health planners, prevalence rates should be interpreted cautiously. A low prevalence rate for a particular disease might reflect the low incidence and good cure rate of the disease. However, it might also be due to the disease’s high fatality, i.e., people who have the disease may tend to die and, therefore, they would not be counted as cases. Moreover, a high prevalence rate might not be a bad thing either; it might be the result of better medication and surviving patients being counted as “existing cases” in the prevalence rate. In either event, the prevalence rate is a good indicator for determining the workload, facilities, and resources needed for community health services.



**Table 1** Common terms and definitions.

Mortality Rate (MR)	An estimation of the proportion of a population that dies during a specific time period. Also called the death rate.
Prevalence Rate (PR)	The proportion of a population that has a specific disease at a specific point in time. For example, if the 2000 prevalence rate for a particular disease is 5 per 1,000, 5 people for every 1,000 people in the population will have the disease.
Incidence Rate (IR)	The proportion of a population that will get a specific disease over a period of time. This is also referred to as the attack rate.
Duration of the disease (D)	The average duration of a disease is calculated by dividing a disease's prevalence by its incidence ( $D = \text{prevalance rate}/\text{incidence rate}$ ).
Case Fatality Rate	The risk among all persons who acquire a disease that they will subsequently die from. It is an indication of the severity of the disease.
Rate Ratio (RR)	The ratio of incidence rates between a group exposed to a disease-causing agent and a nonexposed group. It is used to measure the magnitude of the exposure's impact.
Odds Ratio (OR)	The ratio or odds of getting a disease between a group exposed to a disease-causing agent and a nonexposed group. It is used to measure the magnitude of association between exposure to an agent and a disease outcome.
Rate Difference (RD)	The difference in incident rates between the exposed group and the nonexposed group. It is an indication of the proportional decrease in the incidence of a disease if the entire population were no longer exposed to the suspected etiological agent.

### *Identify an Epidemic Situation*

The number of cases of a disease that occur in a community without a specific exposure or intervention is called the baseline rate. This is also often considered the expected level of the disease. For example, over the past 5 years the average number of new cases (the incidence rate) of Hepatitis A per year in Community A was 10 per every 10,000 people. The accepted or expected levels ranged from 8 to 12 cases per 10,000 people per year. When the incidence rate is greater than the expected level (12 per 10,000 per year), this indicates that a disease epidemic may be occurring.

The patterns of disease occurrences in communities vary. When a particular disease is consistently found in a specific community, and the disease occurs only in that limited geographical region or population, the disease is said to be endemic. In other words, endemic diseases tend to have relatively high rates in a specific location and/or population. For example, Lyme disease is endemic in the Northeast in the United States. When the occurrence of a disease within an area is clearly in excess of the expected level for a given time period, it is referred to as an epidemic or outbreak. When an epidemic spreads over several countries or continents and affects a large number

of people, it is called a pandemic. For example, HIV/AIDS is an epidemic among intravenous drug users in the United States; HIV/AIDS is also considered to be pandemic because of its worldwide infection rates.

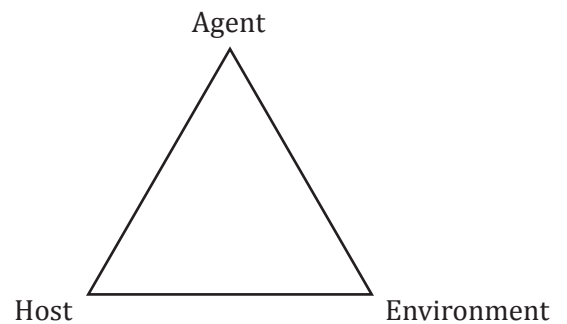
*Epidemiology Triangle*

There are three primary factors that influence if, when, where, and how disease occurs. These three factors are the disease agent and its characteristics; the human, plant, or animal “host” and its vulnerability to the disease; and the environment containing the agent and the host (Figure 1). These three factors are often described as the “epidemiology triangle” and all are important to examine when searching for a disease’s cause(s). Table 2 offers examples or descriptions of each of these factors.

The Centers for Disease Control and Prevention (CDC) is currently applying a “systems-based” approach to environmental health practice. Utilization of the systems approach will influence how environmental health services are delivered and how environmental health problems are solved. CDC has successfully integrated the systems approach into several recent investigations of environmentally-related diseases.

“Systems theory” is the science of wholeness. Rather than dissecting a complex process and studying the individual parts, systems theory focuses on understanding the complete system and the underlying interactions of all the forces that make up the system.

**Figure 1** Epidemiology Triangle.



**Table 2** Examples of three epidemiology triangle factors.

<b>Types of Agents</b>
Disease agents can be classified into three primary categories: biological, chemical, and physical. Examples of each are:  <b>Biological:</b> bacteria, virus, parasite, or other microbes <b>Chemical:</b> pesticide, herbicides, metals, organic solvents, etc. <b>Physical:</b> ionizing radiation, nonionizing radiation, noise, heat, vibration, etc.
<b>Host Characteristics</b>
Factors that affect an individual’s susceptibility and response to causive agents include: age, gender, race, socioeconomic status, lifestyle (smoking, diet, exercise, sexual preference, drug abuse), and the status of an individual’s immune system.
<b>Environmental Factors</b>
External factors that affect the spread of agents and the opportunity of agents to contact and/or enter hosts include: local geology, climate, sanitation of living conditions, presence of vectors (flies, mosquitoes, ticks, mice, etc.) that can carry disease, and the availability of health services.

A food service establishment is an example of a system. The outcome of the system (food served to customers) is influenced by numerous factors that make up the system, such as ingredients, food workers, equipment, preparation/cooking processes, and the economics of the establishment. The investigation of a foodborne illness in a food service establishment using the systems approach would not only look at the source of contamination and the pathogen involved, but would also determine the underlying factors in the system that allowed the outbreak to occur. An example would be a restaurant owner who would not allow a sick employee to go home due to a shortage of persons working in the kitchen. A standard investigation may reveal the source of the pathogen, but would not look at the underlying factors or “environmental antecedents” that allowed the pathogen to enter the system. Using the systems approach, the investigation would review underlying factors to reveal that a sick employee was not allowed to leave work because of a staffing shortage in the kitchen. The corrective action might involve working with the owner to change his policy regarding sick leave to ensure that sick employees are not involved in the food preparation process in the future.

Boards of health should encourage environmental health personnel to become familiar with the systems concept and to identify opportunities to study environmental health problems using a systems approach.

Systems education and training would provide environmental health program managers the information they need to incorporate systems thinking into the practice of environmental health.

### *Epidemiologic Observational Studies*

The goal of epidemiology is to discover the relationship between agents, hosts, and the environment and their impact on the occurrence of disease. To understand these relationships, local boards of health and health departments primarily rely on observational studies. There are two main types of observational studies: descriptive studies and analytical studies.

*Descriptive studies* frequently consist of case reports of illness or death and cross-sectional surveys. Information is gathered on community or individual health characteristics (e.g., cancer incidence or mortality rates, incidence of lead poisoning, etc.) with respect to person, place, and time to estimate disease frequency, geographical clustering of illness, and time trends. The results from descriptive studies are often used by boards of health to develop disease prevention policies and to allocate resources.

One example of a descriptive study is an investigation that was conducted on the rate of childhood cancer in the United States. Because of increasing public concern, data on 14,540 children under the age 15 who had been diagnosed with cancers between 1975 and 1995 were investigated. In particular, these data were examined to determine whether there was a change in the number of cancer cases that occurred in specific states and regions over time. The results showed that there was no substantial change in major childhood cancers, and the rates have remained relatively stable since the mid-1980s. The modest increases that were observed from brain/central nervous system cancers, leukemia, and infant neuroblastoma were confined to the mid-1980s (Linnet, Ries, Smith, Tarone, & Devesa, 1999). These results were used to help answer concerns about cancer risks.

*Analytical studies* include ecologic, case-control, and cohort studies. Such studies are designed to test hypotheses regarding the factors that cause a disease. The types of data used in ecologic epidemiology studies include exposure data (e.g., ozone levels in the outside air, the amount of arsenic in drinking water, soil lead levels), the per capita income of the community, smoking prevalence of a community, and disease data (e.g., the number of new disease cases or disease death rates).

*Rate Comparisons in Epidemiologic Studies*

To allocate local health resources, board of health members often need to compare disease distribution among communities. It is critical that boards choose correct and comparable rates when discussing different communities. Three types of information regarding illness that can be used to compare regions are presented in Table 3.

**Table 3** Regional illness information.

Crude Rate	<ul style="list-style-type: none"> <li>Calculates the rate for an entire population.</li> <li>Provides the overall picture of a community.</li> </ul>
Specific Rate	<ul style="list-style-type: none"> <li>Calculates the rates for subgroups in a population.</li> <li>Commonly see specific rates: age, sex, socioeconomic class, residential area, or occupation.</li> </ul>
Adjusted Rates	<ul style="list-style-type: none"> <li>Summary measures of morbidity and mortality rates in a population in which statistical procedures have been applied to remove the effect of differences in composition of the various populations. Uses a third party’s population distribution or disease rates to remove misleading results due to uneven distribution of certain demographic factors in the populations.</li> <li>Age and/or sex distribution factors are commonly adjusted when doing rate comparisons.</li> </ul>

An example of using direct adjusted rates for comparison: Table 4 shows the 1995 total cancer death rates of Florida and Indiana, using the 1970 U.S. population as a standard population for adjustment.

**Table 4** Using direct adjusted rates for comparison.

State	Crude Cancer Rate per 100,000	Age-Adjusted Cancer Rate per 100,000
Florida	266.5	169.1
Indiana	219.9	182.1

If crude cancer death rates are compared directly, Florida’s rate has 266.5 deaths per 100,000 individuals—21% more than Indiana. However, when the cancer mortality rates are adjusted by age, Florida’s cancer death rate is 169.1 or 7% lower than Indiana’s 182.1. The age-adjustment helps account for the differences in age distributions between the states, i.e., the large number of older adults who live in Florida. Thus, boards of health may be misled if they rely only on crude disease rates when comparing communities.

There are many different databases and resources that can assist boards of health and local health department staff in doing epidemiologic investigations several of which are available from the Centers for Disease Control and Prevention. The CDC WONDER database can provide boards of health with adjusted death rates by county.

Such information can allow boards of health to examine their county's death rates for specific diseases and compare their rates to the state or the nation. The CDC's Environmental Public Health Tracking Network includes information from a nationwide network of integrated health and environmental data. The network provides information on the links between key environmental health indicators (air, carbon monoxide, lead, water) and the development of disease. The CDC's *Morbidity and Mortality Weekly* provides reports and surveillance summaries based on data reported by state health departments to the CDC. The Agency for Toxic Substances and Disease Registry (ATSDR) at CDC provides information on a variety of toxic substances and exposures. Another promising tool is the County Health Rankings. These rankings are the result of collaboration between the Robert Wood Johnson Foundation and the University of Wisconsin's Population Health Institute. They list each county within the 50 states according to its health outcomes and the multiple health factors that determine a county's health. The project includes rankings on environmental quality and the built environment. Boards of health can utilize these various investigative tools to further assess and evaluate the health status in their communities.

### *Application of Statistics in Epidemiology*

One of the best examples of how health investigators use statistics is a 1996 outbreak of *Plesiomonas shigelloides* and *Salmonella serotype Hartford* infections. Health authorities were alerted to a problem when 30 of 189 party attendees developed diarrhea. The county health department conducted a study to find out whether consumption of particular food items was associated with diarrhea.

The statistical results of the study showed that several food items were associated with the diarrhea; however, only three food items—macaroni salad, potato salad, and baked ziti—had a statistically significant association with the disease. These findings led the investigation team to examine the water that was used for food preparation. Investigators determined that the untreated surface water was contaminated by *Salmonella serotype Hartford* and *P. shigelloides*, and this was the cause of the diarrheal illness outbreak. Immediately after the cause was recognized, public health measures were taken to stop further disease cases. These steps included prohibiting stores from preparing food and instructing people not to drink the water until an adequate water-treatment system that met drinking water standards could be provided.

### *Steps in Outbreak Investigations: A Case Study*

As the example above indicates, local health department staff plays a very important role in disease outbreak investigations. The results of their investigations are critical for determining the appropriate control measures that will prevent further disease spread. Such investigations frequently are a legal responsibility of health departments and are an important component of health department health communications. The CDC has developed recommended standard procedures for outbreak investigations. These steps are shown in the flowchart in Figure 2.

An example of how this flowchart is implemented can be found in a 1999 *Escherichia coli* outbreak. In September 1999, a state department of health received reports of at least 10 children who were hospitalized in neighboring counties with bloody diarrhea or *Escherichia coli* O157:H7 infections. All of the children had attended the same county fair, which was held August 23–29, 1999. By September 15, 921 persons reported diarrhea after attending this county fair. The state department of health began an investigation that included an attempt to locate all disease cases, epidemiologic and laboratory studies, and an environmental investigation of the county fairgrounds.

As diagnoses of the cases and the causal agents (*E. coli*) were verified, local board of health and health department administrators issued press releases and contacted hospital emergency departments to identify additional fair attendees with diarrhea. A descriptive epidemiologic report was compiled to characterize the persons who contracted the disease after attending the fair.

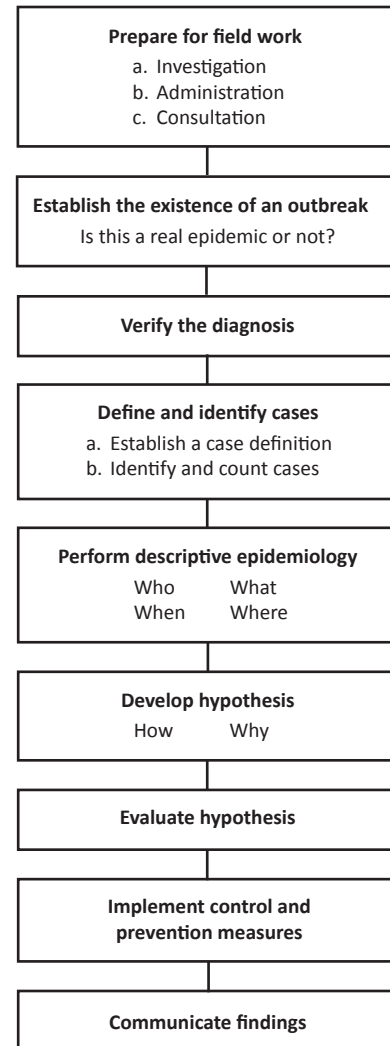
Subsequently, a case-control study was conducted to determine the risk factors for the infection. Through this study, investigators were able to develop and evaluate hypotheses on the source of the *E. coli* contamination. Researchers found that consumption of water or beverages made with water from a particular well were associated with illness. Fair attendees who drank water from the suspect well were 23.3 times more likely to develop the disease compared with people who did not drink water from that well. To prevent future outbreaks several public health measures were enacted:

1. Letters were sent to schools and day care centers emphasizing the need to exclude symptomatic children and practice careful handwashing to prevent the further transmission of infections.
2. Letters were sent to nursing homes and hospitals with recommendations regarding employees and residents with diarrhea.
3. Information to the public focused on how to prevent secondary infections from the outbreak.
4. The state health commissioner issued an order requiring county fairgrounds to use disinfected water when hosting public events; the health commissioner began a review of all laws and regulations applicable to fairs.

## Conclusion

Epidemiology provides local boards of health and health department staff with important tools for determining the causes of diseases and the programs and policies that are needed to prevent and control disease. Although studies of disease outbreaks are usually conducted by trained professionals, boards of health have a responsibility to ensure that the health department has determined baseline disease rates in the community, is watchful for changes in disease patterns, and has the resources to investigate disease outbreaks when needed. The CDC has many tools, including the CDC WONDER database and the Environmental Public Health Tracking Network, to allow boards of health to understand how the disease burden in their community compares with rates in other communities nationwide. Depending on the situation, boards of health may also have a responsibility to inform the public of changes in disease patterns or disease outbreaks, along with communicating the steps being taken to protect the public.

**Figure 2** Outbreak investigation flowchart.



## **Questions and Considerations for Local Boards of Health**

1. Does your local health department have an epidemiology program? Does your local health department participate in epidemiological investigations?
2. Has your board of health used the results of epidemiological studies for strategic planning or decision making?
3. Is your board of health familiar with basic epidemiology terms and concepts?
4. Has your health department determined baseline disease rates in your community?
5. Is your board of health familiar with various data sources and tools available for analysis?
6. Is your health department using a systems-based approach to environmental health practice?





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United States Environmental Protection Agency. Toxic Release Inventory. Available at [www.epa.gov/tri/](http://www.epa.gov/tri/)

# Management Tools: Environmental Policy, Law, and Administration

## Introduction

Environmental health professionals emphasize prevention as the primary tool in protecting public health. Prevention includes the implementation of programs and policies that are based on evidence and found to be effective through rigorous evaluation.

Boards of health are responsible for making important decisions regarding the health department and the health of their community. There are a variety of decision-making and management tools that can be used to assure the public's health and help boards of health make collective decisions. These tools can assist board members in their communication with each other, the local health department and other agencies, and the communities they serve. Proper use of these tools improves both the effectiveness of a board and, by extension, the health of the community.

Decision-making tools useful for boards of health include community health assessments, health impact assessments, strategic planning, and evidence-based programs.

- *Community health assessments* involve a process of the collection and analysis of information about the health needs of a community. Community health assessments are often mandated requirements for local health departments by the state. They seek to assess and prioritize needs, determine the capacity to meet those needs, and develop an action plan.
- *Health impact assessments (HIAs)* determine the effects that a policy, program, or project may have on the health of a community and the distribution of those effects within the community. Health impact assessments promote health in all policies and encourage policies that protect health and health equity.
- Community health assessments and health impact assessments can help boards of health develop *strategic plans* for their communities. Strategic plans involve a set of goals or visions for the future of an organization and activities to fulfill those goals, and they provide a roadmap for an organization to move forward.
- Finally, *evidence-based programs* offer activities and projects that have been proven effective and include knowledge about the cost of a program and the return on investment. For example, the CDC's Community Guide to Preventative Services is a free resource of evidence-based strategies to help choose programs and policies to improve health and prevent disease in a community. The majority of boards of health are responsible for creating or advising about environmental health policy, and these tools will provide data, information, and resources to develop comprehensive environmental health policies.

## Decision Making, Management, and Process

Boards of health can fall under three different types of authority: advisory, governing, and/or policy-making. According to the 2008 National Profile of Local Boards of Health, 33% of boards are advisory. Advisory boards report to their health officer or county, city, or township commissions, who then act on that information to establish policies, programs, and budgets for public health operations. Seventy-four percent of boards of health have governing authority, and may establish local ordinances and regulations; approve health department budgets and expenditures, and fees for services, permits, and licenses; and hire and fire the chief executive or health officer. Forty-seven percent of boards of health have policy-making authority given by local governing units to set policies, goals, and priorities that guide a public health agency.

The challenges that face board of health members are complex because they require not only an understanding of the field of public health, but they also carry the responsibility of decision making, policy analysis, and communication. If done properly, the board will gain respect and support of other agencies and the public.

The hardest part of any project is actually getting started. Whether in an advisory role or one of authority, the first task in problem solving is deciding how to proceed. A decision made by the board will always be the outcome of numerous combined choices made by individuals interacting at various levels, a process known as “group dynamics.” It is sometimes frustrating working with a group that is trying to accommodate multiple opinions, ideas, and perceptions. However, the time-consuming process of a board meeting is a form of “brain-storming” and can result in some of the best ideas from the combined efforts of individuals.

Before choosing a decision-making process by which a board can proceed, here are some rules of working in a group setting:

- *Check emotions at the door!* Strong emotions may cause people to say or do things they do not really mean and may make them lose credibility with others in the group. While emotions may provide incentive to act and improve points or arguments, it is always better not to resort to raising voices or talking out of turn. Be patient and keep your cool while others are losing theirs.
- *Listen to the ideas of others!* Another member may just say something that provides a completely new perspective.
- *Beware of the paralysis of analysis!* One of the best stall tactics is to send a plan back for more study. Sometimes further study is necessary, but often it is a way of delaying the inevitable.
- *It is irrational to attempt to be rational with the irrational!* If a rare moment develops and an individual becomes highly charged and irrational, remember: “Never argue with a fool or the fool will be arguing with one too!”

### *The Decision Process*

Board of health members are asked to share their perspectives, opinions, knowledge, and judgments in making critical public health decisions that may have widespread consequences. They are actually involved in the process of creating new or revising existing public policy. The degree of involvement will depend on whether the member’s role is advisory or authoritative, but the results will be the same: impacting the health and well-being of the community. This is the basis of *policy analysis* and *policy advocacy*.

- Policy analysis – Investigates how and why policies are proposed or implemented.
- Policy advocacy – Makes recommendations for the best course of action.

Most public health problems can be managed by following a simple process for policy development. This process must begin with a thorough investigation of existing laws and regulations, combined with existing policy. If these are found to be inadequate, or inappropriate, new policies must be developed.

*Step 1: Problem definition.* Somewhere an existing problem needs a solution based on a board of health’s expertise, perceptions, and judgment. Worried about their daily lives, the public does not perceive most problems as a concern. Citizens are not usually called to arms unless an event occurs that mobilizes them to demand action. Called “trigger events,” these mobilizing events require an immediate response from the board.



Trigger events are reported frequently on newscasts: A plane crash leads to a new policy on plane inspections, an oil spill leads to a new policy on tanker safety, a shooting leads to demand for gun control. Issues without public support or recognition are often harder to deal with than issues surrounding a trigger event. When defining the problem, remember that problems are perceived differently by different people. After defining the problem, the focus becomes finding the solution.

Suppose that a power plant on the edge of town is creating pollutants that could cause long-term health effects. If that plant is running problem free, it will be difficult to rally public support for improving conditions. If, however, an unfortunate event occurs, such as an explosion that immediately releases toxins into the air or some other trigger event, the public will now rally and support the board's decision to correct the problem.

It is important to know whether the public views the issue being decided as a major priority or not. If it is not a major priority, the board should determine what the best action is and try to convince the public and other officials to take that action or the board can decide to table it. The mistake that often occurs following a trigger event is a rush to policy adoption, without spending time on a thorough policy analysis.

*Step 2: Issue formation.* Keeping in mind that there are always two sides to an argument; there are at least two sides to every issue. For example, if an electrical power plant is polluting the air on the outskirts of a city, two or more opposing issues could result. One view could be that the emissions are dangerous to health, and the plant needs to be shut down. In addition, no new plants should open in the future. Another view could be that the plant is a valuable source of electrical power, and more plants should open to keep electrical costs low. Obviously, each view has valid arguments, and a personal decision should be based on ethical and ideological perspectives. These, however, are just the opposing views. There must be more options from which to choose.

*Step 3: Alternative proposals.* The advantage of working with a group is the exchange of ideas, compromise, and the gradual, even social, give and take. There is an opportunity to develop alternative proposals that may be more acceptable to the board and the public. In the power plant example, here are some alternatives:

1. Open no new plants; retrofit existing plants with air pollution controls.
2. Open some new plants with controls; retrofit existing plants.
3. Close existing plant; open new plants with air pollution controls.
4. Close all existing plants when alternative energy plants are opened.
5. Keep existing plant working, and replace equipment as it breaks down.

*Step 4: Adopt a policy.* Next, decision makers select from their policy agenda. A policy statement is then issued that cites laws, regulations, or ordinances that support the policy. Incorporated into the decision-making process are the impacts on the community (such as power outages, increased utility costs, or health concerns) and a list of all possible outcomes.

*Step 5: Policy implementation.* When deciding about implementing a policy, boards of health must ask questions such as: Do we have the money to spend on the policy? Do we have the people to enforce the policy? They also need a plan of action to establish how to implement the policy. Here is where the policy lives or dies. Policy not backed by sanction (enforcement) is useless.

*Step 6: Policy evaluation.* The most important step for the board to take in the decision-making process is to evaluate the impact the policy has had on the community and society. Only implemented policies can be evaluated. Skipping this step may result in more of the policies and procedures and laws and regulations that are of no value to society. Evaluation affords the opportunity to revise policy, delete policy, or celebrate success stories.

## **Understanding the Law**

Board of health members often face the difficult task of advising and creating policy that has widespread interest and impact throughout the community. Therefore, it is important that board members understand the workings, nature, and substance of the law.

### *Types of Law*

The United States uses a system of justice derived from *English Common Law*. English Common Law was developed in 13th-century England when kings appointed royal judges to settle disputes; clerks recorded the judges' decisions. Using his own perceptions, prejudices, and moral values, a judge made rulings that ultimately resulted in different penalties for the same crime. Stealing an orange could have resulted in a prison sentence for one person and a slap on the wrist for another. Alerted to the discrepancies in rulings, the king decided to make them more "common" (or equal) and required judges who deviated from the norm or "precedent" to justify their position in writing. This soon led to a system of law that was common to the entire country.

In the American legal system, when a ruling is made by a judge it becomes precedent and can be used in another case to demonstrate how one judge ruled. Researching precedents relative to a case and the ability to cite them in the courtroom is why past cases relative to environmental law are important to cite as case studies. Along with precedent as a tool of law, we have other sources of American law: the Constitution, statutes, ordinances, and agency rules.

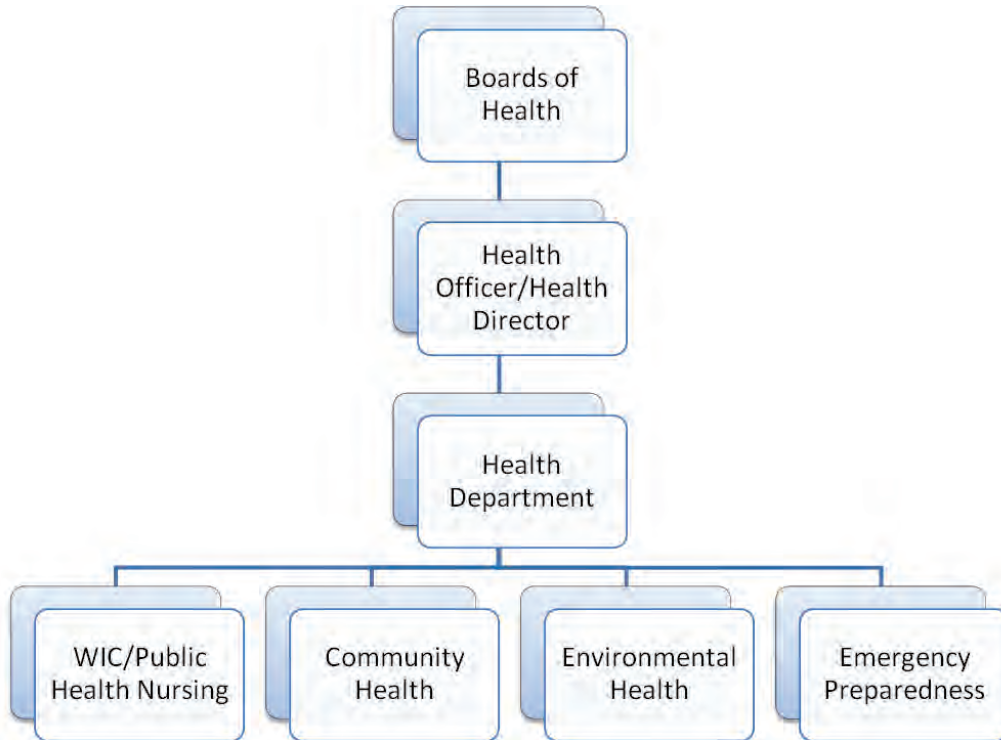
The U.S. Constitution is the legal foundation of the nation in which the powers, duties, and limits of the federal government are created. The Constitution includes the Bill of Rights to protect people from the abuse of power. The word "health" does not appear anywhere in the U.S. Constitution; governing health instead is relegated to the states or people. The Constitution allows the federal government to provide for the general welfare of citizens and to regulate commerce, both of which slowly evolved into provisions for health.

States each have their own constitutions that provide the framework for states to determine how they will be funded and organized and which activities they will undertake. State constitutions are generally more explicit and require less interpretation than the U.S. Constitution. State statutes, or laws passed by a state legislature, enable states to take actions and are the basis of public health law.

State statutes establish governmental subunits of the state and give local governing units authority. State statutes are responsible for establishing state and local boards of health and detailing their authorities. As stated previously, local boards of health typically serve three different functions and are advisory, governing, or policy making (or some combination of those three).

Regardless of their function, all boards of health are responsible for assuring legal authority for public health, establishing a policy base, providing adequate resources to protect health, and maintaining accountability for public health at the local level. Boards of health have responsibility for passing or enforcing policy or assuring policy exists on many environmental health issues, including private water wells, food safety, septic systems and private wastewater collection, nuisance regulations, air quality, and more. For a list of sample local environmental health policies currently in use in communities, visit [www.nalboh.org/EH\\_local\\_policies.htm](http://www.nalboh.org/EH_local_policies.htm).

**Figure 1** Organizational structure of governing boards of health and health departments.



*Administrative Law*

Another type of legal authority is administrative law, or law overseen by administrative agencies within the executive branch of government, such as the Environmental Protection Agency (USEPA). Although technically only elected officials can make federal laws, an agency’s rules and regulations are legitimate and have the same status as any legislation passed by the legislature as long as they follow due process. There are two types of due process: Procedural due process requires the agency to follow the correct procedures in making a law. Substantive due process means the agency is operating within its jurisdiction. The USEPA, for example, cannot create rules and regulations on local speed limits. Its boundary is limited to environmental law. The Administrative Procedures Act (APA) passed in 1946 governs the actual legislative function of an agency. Agencies must follow the APA when issuing new rules and regulations.

The APA was proposed as a way of providing checks and balances for any agency. In 1935, the American Bar Association first pressed for a method to monitor the executive branch of government by aiding in the passage of the Federal Register Act. This provides for a daily record of all the administrative activities of the executive branch and all proposed rules and regulations. Before becoming effective, a new rule must be published in the *Federal Register*. The Administrative Procedures Act, divided into six major areas, extends the reach of the Federal Register Act (see Table 1 on page 136).

The following are some of the more important concepts relative to the APA that may affect the decision-making process of board of health members.

*Fair information practices.* This section of the APA led to the passing of the Freedom of Information Act of 1966 (FOIA). The FOIA provides a useful means for gaining access to public material that the government does not



**Table 1** The Administrative Procedures Act.

Section of APA	Provides For:	Importance
Definition of terms	Common language	Universal understanding of law
Fair information practices	Freedom of information	Allows public access to government information
Rule making	Guidelines for the agency to make rules and regulations	Following due process makes the rules and regulations legitimate
Administrative adjudication	Hearing to resolve conflicts	Allows public to challenge rulings
Liability of public officials	Protection from lawsuits	Protects individuals acting in good faith
Judicial review	Power of court to determine legality	Checks and balances

make available to the public. For example, information can be obtained about the extent of involvement that environmental groups or industry have had in the formation of new regulations. Documents may be requested from an agency with the FOIA. Agency personnel cannot ignore FOIA requests, and must respond within 10 days. Most agencies have an FOIA officer to whom requests should be sent. Documents that relate to national security do not have to be released. (See Case Study.)

**CASE STUDY: He should have known about fair information practices!**

A local television station received a complaint about restaurant sanitation in a major city in California. The reporter called the local health department and asked to see data on restaurant inspections. The environmental health specialist explained to the reporter that the information is confidential and could not be released. **WRONG!!!** The reporter knew better and it raised his suspicions that the local health department was trying to hide something. This led to a hidden camera exposé on restaurant sanitation and an embarrassment for the local health department. The reporter then got the information he had originally requested through the FOIA.

*Rule making.* New rules and regulations must be published in the Federal Register before they can go into effect. The rule-making procedure normally allows for comment from individuals, boards of health, and others before a rule's final enactment. Often agencies will issue statements to help the public understand the rules. Called interpretive rules, these statements often have the same status in a courtroom as the original law.

*Liability of public officials.* What is a board of health member's liability relative to his or her role on a board of health? The issue is very complex. Under ancient common law doctrine, there is the process of sovereign immunity, which stated that government employees were immune from prosecution for actions related to government functions.

Today, most individual liability cases against government advisors and employees come down to "acting in good faith." If officials are conscientious about doing their jobs and carry them out without malice, then they generally have some protection. However, under section 1983 of the Federal Civil Rights Act, individuals may sue state officials if they feel that officials operating under state law have violated their federal civil rights.

The biggest mistake that a board of health official can make is giving advice in an area that is outside of his or her expertise. For example, assume that a home's water supply system is in need of repair, and the board of health official requests an "abatement," which means the homeowner has the responsibility for making the repairs. The board member recommends re-piping with galvanized pipe. Legal action could result if the homeowner follows the recommendation and then discovers that copper pipe would have been better suited for the repairs. The law is dynamic and open to interpretation by judges. Even though the official acted in good faith, he acted outside of his area of expertise (unless, of course, he was a licensed plumber). The better advice would be to recommend the repair and advise the homeowner to seek professional assistance in meeting all codes and regulations.

The legal aspect of dealing with conflicts that arise regarding agencies is the practice known as administrative law. An estimated 80-90% of all disputes concerning the federal environmental laws and regulations are administrative law issues. Familiarity with administrative procedures will help in improving effectiveness in dealing with the law. See Table 2 for important aspects of administrative law.

**Table 2** Important aspects of administrative law.

Agencies have no real authority unless it is "delegated" to them by statutes enacted by Congress. An agency cannot act beyond the scope of its delegated authority.

Agencies' opinions and interpretations of their actions are often accepted as legal (interpretive rules).

Agencies must follow their own rules.

Agency actions may not be "arbitrary," that is based on opinion or prejudice.

Agency decisions can be appealed in court if you have "standing."

*Property Law*

Property law has the longest history of any environmental law and dates back to 450 B.C. when governments set laws, known as "set-back laws," on where houses could be built relative to public streets. Some of the bitterest battles in the courtroom have been over the use of property. Public health advisors need to understand a few of the basic concepts of property law.

Eminent domain is the right of the government to take land for public purposes. If the government wants to build a county road or federal highway where a home is located, the government can take the property as long as the

homeowner is provided with due process. Due process includes a hearing and the payment of “just compensation,” or what a willing buyer would pay a willing seller of the property.

Easement is a legal right to use or traverse someone else’s land. For example, power lines often traverse a homeowner’s property through an easement.

Covenants are restrictions on property that “run with the land.” Legal covenants include prohibiting children in a retirement community or attempting to restrict the type of exterior decor in a condominium. Some have attempted to restrict the parking of boats or recreational vehicles on the streets, as is the case in some Las Vegas communities. Illegal covenants are restrictions on selling a home based on race or religion.

Zoning is a government activity that affects property use. It is a legitimate power usually governed by statutes. The government has the right to restrict the use of certain property. For example, no one wants a department store in a residential area. Denying construction of the store is a legal activity and is valid as long as it is not unreasonable or arbitrary (based on one’s own opinions or prejudice).

Anytime the government seizes private property, or if zoning restrictions prevent adequate use of the property, it is called a “taking.” A taking is decided at a hearing that is part of normal due process. Anytime the government takes property, a hearing is required. The judge will decide if the action is a “taking” and if just compensation is required.

### *Legal Concepts in Environmental Law*

Board of health members often face controversial decisions that may eventually lead to conflict resolution by means of the courtroom. Members need to be aware of some of the concepts by which people sue.

The first concept is “standing.” This is the right to have a case heard and to stand before a judge. For an individual to go to court, there must be a violation of some law before standing is granted. Courts seem to be very liberal in their granting of standing for environmental cases.

A “nuisance” is using personal property to impair the right of another. A private nuisance is when an individual is prevented from the use or enjoyment of one’s land. An example of a nuisance is when people in the house next door are playing loud music and it interferes with normal activities.

A “public nuisance” is any activity that adversely affects the public’s health, morals, safety, welfare, or comforts. Nuisance law is normally under the jurisdiction of local, state, or federal government agencies. An industry’s pollution of homes in an area would be treated as a violation of nuisance laws. The advantage is that the homeowner would rely on the government to fix the problem, and individual citizens would not have to bear the expense or time in fighting the large corporation or industry.

What if someone moves to the end of an existing racetrack and complains that the noise is too much to handle? There is a part of nuisance law called “coming to the nuisance.” If an individual was aware of problems and moved there anyway, he or she would have to bear some or all of the responsibility.

### **Communicating With the Public**

Essential Public Health Service number three from the U.S. Public Health Service’s publication, *The Public Health Workforce: An Agenda for the 21st Century*, requires the board of health to “inform, educate, and empower people



about health issues.” However, there are no set criteria for selecting communication tools that can be applied to all segments of the general population. Each community has its own level of interest and concern, social structure, demographic make-up, and culture.

With cases of controversial environmental issues (for example, a hazardous waste site), board members could conduct phone interviews or in-person interviews with members of the effected community to identify its concerns and devise a communication strategy.

Two communication tools are *one-way communication* and *two-way communication*. One-way communication tools are a way of getting information out to the public so that community members may contribute to the decision-making process. These include public outreach programs, factsheets, newsletters, information brochures, press releases, and public service announcements that inform the public regarding current or upcoming issues or decisions. Videotapes have also proven very successful as a method of getting information to the public.

Two-way communication promotes an interactive environment. It includes face-to-face open discussions, public information telephone lines, visitor centers, focus groups, and citizen advisory groups. Whereas one-way communication communicates the process, two-way communication gets the public involved. Advisory boards are a good example of two-way communication. Public opinion can greatly affect the decision-making process. It is important to check the pulse of the community using adequate two-way communication.

## Questions and Considerations for Local Boards of Health

1. Has your board of health conducted any policy analysis or relied on policy analysis when making a decision?
2. Is your board of health aware of its functions and the state statutes that detail its authority?
3. Does your board of health understand the workings of environmental law?
4. Does your board of health follow updates to administrative law? Does your board of health provide comments on new or revised legislation during the open comment period?
5. How does your board of health communicate with the public? Does it include both one-way and two-way communication?



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## Appendix A: Abbreviations and Acronyms

ACGIH	American Conference of Governmental and Industrial Hygienists	FOIA	Freedom of Information Act
ACM	Asbestos containing material	GI	Gastrointestinal
AIDS	Acquired Immune Deficiency Syndrome	GIS	Geographic Information Systems
AIHA	American Industrial Hygiene Association	HACCP	Hazard Analysis Critical Control Points
APA	Administrative Procedures Act	HAP	Hazardous Air Pollutants
APHA	American Public Health Association	Haz-Mat	Hazardous Materials
AQI	Air Quality Index	HHS	U.S. Department of Health and Human Services
ATSDR	Agency for Toxic Substances and Disease Registry	HIV	Human Immunodeficiency Virus
BOD	Biochemical oxygen demand	IAQ	Indoor Air Quality
BRI	Building-related illness	IPM	Integrated Pest Management
CAA	Clean Air Act	IR	Incidence rate
CCP	Critical control points	LBP	Lead-based paints
CDBG	Community Block Development Grant	LEPCs	Local Emergency Planning Committees
CDC	Centers for Disease Control and Prevention	LQG	Large quantity generators
CERCLA	Comprehensive Environment Response, Compensation, and Liability Act	MR	Mortality rate
CO	Carbon monoxide	MSW	Municipal solid waste
CPSC	Consumer Product Safety Commission	NAAQS	National Ambient Air Quality Standards
CSO	Combined sewer overflows	NACCHO	National Association of County and City Health Officials
CWA	Clean Water Act	NALBOH	National Association of Local Boards of Health
DDT	Dichloro-Diphenyl-Trichlorethane	NASA	National Aeronautics and Space Administration
DO	Dissolved oxygen	NCEH	National Center for Environmental Health
EHAC	National Environmental Health Science and Protection Accreditation Council	NEHA	National Environmental Health Association
EMT	Emergency Medical Technicians	NIOSH	National Institute for Occupational Safety and Health
ERS	Economic Research Service, United States Department of Agriculture	NPDES	National Pollution Discharge Elimination System
ESHB	Environmental Health Services Branch	NPL	National Priorities List
FDA	Food and Drug Administration	NRC	Nuclear Regulatory Commission

## Abbreviations and Acronyms (cont.)

NSC	National Safety Commission
NSFC	National Small Flows Clearinghouse
OR	Odds ratio
OSHA	Occupational Safety and Health Administration
PACE-EH	Protocol for Assessing Community Excellence in Environmental Health
POTW	Publicly owned treatment works
PR	Prevalence rate
PSA	Public service announcement
RCRA	Resource Conservation and Recovery Act
RD	Rate difference
RR	Rate ratio
RWI	Recreational Water Illness
SARA Title III	Emergency Planning and Community Right-to-Know Act
SBS	Sick building syndrome
SERC	State Emergency Response Commission
SIP	State implementation plan
SQG	Small quantity generators
THM	Trihalomethanes
TMDL	Total maximum daily load
TSDF	Treatment, storage, and disposal facility
TSS	Total suspended solids
USDA	United States Department of Agriculture
USEPA	Environmental Protection Agency
WNV	West Nile Virus
YPLL	Years of Potential Lost Life



## Appendix B: Internet Resources

Organization	Website
Agency for Toxic Substances and Disease Registry (ATSDR)	<a href="http://www.atsdr.cdc.gov">www.atsdr.cdc.gov</a>
AIRNOW	<a href="http://www.airnow.gov/">www.airnow.gov/</a>
American Conference of Governmental Industrial Hygienists (ACGIH)	<a href="http://www.acgih.org">www.acgih.org</a>
American Hotel & Lodging Associations (AH&LA)	<a href="http://www.ahma.com">www.ahma.com</a>
American Industrial Hygiene Association (AIHA)	<a href="http://www.aiha.org">www.aiha.org</a>
American Lung Association	<a href="http://www.lungusa.org">www.lungusa.org</a>
American Society of Microbiology (ASM)	<a href="http://www.asm.org">www.asm.org</a>
American Water Works Association (AWWA)	<a href="http://www.awwa.org">www.awwa.org</a>
Association of Food and Drug Officials (AFDO)	<a href="http://www.afdo.org">www.afdo.org</a>
CDC Division of Viral and Rickettsial Diseases	<a href="http://www.cdc.gov/ncidod/dvrd/disinfo/disease.htm">www.cdc.gov/ncidod/dvrd/disinfo/disease.htm</a>
CDC Division of Vector-Borne Infectious Diseases	<a href="http://www.cdc.gov/ncidod/dvbid/index.htm">www.cdc.gov/ncidod/dvbid/index.htm</a>
CDC Environmental Health Services Branch	<a href="http://www.cdc.gov/nceh/ehs/">www.cdc.gov/nceh/ehs/</a>
CDC Healthy Swimming	<a href="http://www.cdc.gov/healthyswimming/index.htm">www.cdc.gov/healthyswimming/index.htm</a>
CDC National Center for Environmental Health (NCEH)	<a href="http://www.cdc.gov/nceh">www.cdc.gov/nceh</a>
CDC National Center for Injury Prevention and Control	<a href="http://www.cdc.gov/injury/index.html">www.cdc.gov/injury/index.html</a>
CDC Special Pathogens Branch	<a href="http://www.cdc.gov/ncidod/dvrd/spb/index.htm">www.cdc.gov/ncidod/dvrd/spb/index.htm</a>
CDC WONDER database	<a href="http://wonder.cdc.gov">http://wonder.cdc.gov</a>
Center for Food Safety & Applied Nutrition	<a href="http://www.fda.gov/Food/default.htm">www.fda.gov/Food/default.htm</a>
Center for Law and the Public's Health	<a href="http://www.publichealthlaw.net">www.publichealthlaw.net</a>
Centers for Disease Control and Prevention (CDC)	<a href="http://www.cdc.gov">www.cdc.gov</a>

**Internet Resources (cont.)**

Organization	Website
Communication and Decision Making	<a href="http://www.psychology.nottingham.ac.uk/research/credit/projects/modelling_decision_making">www.psychology.nottingham.ac.uk/research/credit/projects/modelling_decision_making</a>
Consumer Product Safety Commission	<a href="http://www.cpsc.gov">www.cpsc.gov</a>
Enviroflash	<a href="http://www.enviroflash.info/">www.enviroflash.info/</a>
Environmental Law Institute	<a href="http://www.eli.org">www.eli.org</a>
FedWorld	<a href="http://www.fedworld.gov">www.fedworld.gov</a>
Food and Drug Administration (FDA)	<a href="http://www.fda.gov">www.fda.gov</a>
FoodSafety.gov	<a href="http://FoodSafety.gov">FoodSafety.gov</a>
Food Safety Inspection Service	<a href="http://www.fsis.usda.gov/">www.fsis.usda.gov/</a>
Healthy Homes and Lead Hazard Control	<a href="http://portal.hud.gov/hudportal/ HUD?src=/program_offices/healthy_homes">http://portal.hud.gov/hudportal/ HUD?src=/program_offices/healthy_homes</a>
Healthy Homes Partnership	<a href="http://www.uwex.edu/healthyhome">www.uwex.edu/healthyhome</a>
Healthy People 2020	<a href="http://www.healthypeople.gov">www.healthypeople.gov</a>
Housing and Urban Development – Healthy Homes Initiative	<a href="http://portal.hud.gov/hudportal/ HUD?src=/program_offices/healthy_homes/hhi">http://portal.hud.gov/hudportal/ HUD?src=/program_offices/healthy_homes/hhi</a>
Indoor Air Quality Tools for Schools	<a href="http://www.epa.gov/iaq/schools/">www.epa.gov/iaq/schools/</a>
International City/County Management Association (ICMA)	<a href="http://icma.org/go.cfm">http://icma.org/go.cfm</a>
International Food Information Council Foundation	<a href="http://www.foodinsight.org/">http://www.foodinsight.org/</a>
National Association of County and City Health Officials (NACCHO)	<a href="http://www.naccho.org">www.naccho.org</a>
National Association of Local Boards of Health (NALBOH)	<a href="http://www.nalboh.org">www.nalboh.org</a>
National Center for Healthy Housing	<a href="http://www.nchh.org/">http://www.nchh.org/</a>
National Center for Playground Safety	<a href="http://www.uni.edu/playground/home.html">www.uni.edu/playground/home.html</a>



Organization	Website
National Environmental Health Association (NEHA)	<a href="http://www.neha.org">www.neha.org</a>
National Environmental Health Science and Protection Accreditation Council (EHAC)	<a href="http://www.ehacoffice.org">www.ehacoffice.org</a>
National Fire Protection Association	<a href="http://www.nfpa.org">www.nfpa.org</a>
National Institute for Occupational Safety and Health Administration	<a href="http://www.cdc.gov/niosh/homepage.html">www.cdc.gov/niosh/homepage.html</a>
National Institute of Food and Agriculture	<a href="http://www.csrees.usda.gov/">www.csrees.usda.gov/</a>
National Priorities List (NPL)	<a href="http://www.epa.gov/superfund/sites/npl/index.htm">www.epa.gov/superfund/sites/npl/index.htm</a>
National Response Center, United States Coast Guard	<a href="http://www.nrc.uscg.mil">www.nrc.uscg.mil</a>
National Restaurant Association	<a href="http://www.restaurant.org">www.restaurant.org</a>
National Safety Council	<a href="http://www.nsc.org">www.nsc.org</a>
National Small Flows Clearinghouse (NSFC)	<a href="http://www.nesc.wvu.edu/wastewater.cfm">www.nesc.wvu.edu/wastewater.cfm</a>
NSF International	<a href="http://www.nsf.org">www.nsf.org</a>
Nuclear Regulatory Commission (NRC)	<a href="http://www.nrc.gov/">www.nrc.gov/</a>
Occupational Safety and Health Administration (OSHA)	<a href="http://www.osha.gov">www.osha.gov</a>
Office of Resource Conservation and Recovery	<a href="http://www.epa.gov/epawaste/index.htm">www.epa.gov/epawaste/index.htm</a>
Pacific NW Pollution Prevention Resource Center	<a href="http://www.pprc.org">www.pprc.org</a>
Partnership for Food Safety Education	<a href="http://fightbac.org">http://fightbac.org</a>
Public Health Law Network	<a href="http://www.publichealthlawnetwork.org/">www.publichealthlawnetwork.org/</a>
Safe Kids	<a href="http://www.safekids.org">www.safekids.org</a>
Scorecard: The pollution information site	<a href="http://scorecard.goodguide.com/">http://scorecard.goodguide.com/</a>
Seafood Inspection Program, NOAA	<a href="http://www.seafood.nmfs.noaa.gov/">www.seafood.nmfs.noaa.gov/</a>

**Internet Resources (cont.)**

Organization	Website
Team Food Safety	<a href="http://www.teamfoodsafety.org/">http://www.teamfoodsafety.org/</a>
Toxicology Data Network, NLM	<a href="http://toxnet.nlm.nih.gov">http://toxnet.nlm.nih.gov</a>
Underwriters Laboratory, Inc. (UL)	<a href="http://www.ul.com">www.ul.com</a>
United Nations Environment Programme	<a href="http://www.unep.org">www.unep.org</a>
United States Department of Agriculture (USDA)	<a href="http://www.usda.gov">www.usda.gov</a>
United States Government Printing Office	<a href="http://www.gpo.gov">www.gpo.gov</a>
US Coast Guard – Boating Safety	<a href="http://www.USCGBoating.org">www.USCGBoating.org</a>
USDA Food Safety Inspection Service	<a href="http://www.fsis.usda.gov">www.fsis.usda.gov</a>
USEPA AIRNOW	<a href="http://www.epa.gov/airnow">www.epa.gov/airnow</a>
USEPA – Consumer Confidence Reports	<a href="http://water.epa.gov/lawsregs/rulesregs/sdwa/ccr/index.cfm">http://water.epa.gov/lawsregs/rulesregs/sdwa/ccr/index.cfm</a>
USEPA Health Effects Notebook for Hazardous Air Pollutants	<a href="http://www.epa.gov/ttn/atw/hlthef/hapindex.html">http://www.epa.gov/ttn/atw/hlthef/hapindex.html</a>
USEPA – Indoor Air	<a href="http://www.epa.gov/iaq">www.epa.gov/iaq</a>
USEPA Laws & Regulations	<a href="http://www.epa.gov/lawsregs/index.html">www.epa.gov/lawsregs/index.html</a>
USEPA My Environment	<a href="http://www.epa.gov/myenvironment/">http://www.epa.gov/myenvironment/</a>
USEPA National Ambient Air Quality Standards	<a href="http://www.epa.gov/air/criteria.html">www.epa.gov/air/criteria.html</a>
USEPA Office of Air and Radiation	<a href="http://www.epa.gov/aboutepa/oar.html">www.epa.gov/aboutepa/oar.html</a>
USEPA Office of Air Quality Planning and Standards	<a href="http://www.epa.gov/oar/oaqps">www.epa.gov/oar/oaqps</a>
USEPA Office of Ground Water and Drinking Water	<a href="http://water.epa.gov/drink/index.cfm">http://water.epa.gov/drink/index.cfm</a>
USEPA Office of Pollution Prevention and Toxics	<a href="http://www.epa.gov/chemfact">www.epa.gov/chemfact</a>
USEPA Office of Wastewater Management (OWM)	<a href="http://water.epa.gov/polwaste/wastewater/index.cfm">water.epa.gov/polwaste/wastewater/index.cfm</a>



Organization	Website
USEPA Operating Permits Program	<a href="http://www.epa.gov/oar/oaqps/permits/index.html">www.epa.gov/oar/oaqps/permits/index.html</a>
USEPA Radon	<a href="http://www.epa.gov/radon/index.html">www.epa.gov/radon/index.html</a>
USEPA Septic (Onsite) Systems	<a href="http://cfpub.epa.gov/owm/septic/index.cfm">http://cfpub.epa.gov/owm/septic/index.cfm</a>
USEPA State, Local, and Tribal Partnerships	<a href="http://www.epa.gov/ttnatw01/stprogs.html">www.epa.gov/ttnatw01/stprogs.html</a>
USEPA Terminology Reference System	<a href="http://iaspub.epa.gov/sor_internet/registry/termreg/home/overview/home.do">http://iaspub.epa.gov/sor_internet/registry/termreg/home/overview/home.do</a>
USEPA Toxic Release Inventory	<a href="http://www.epa.gov/tri">www.epa.gov/tri</a>
Voluntary National Retail Food Regulatory Program Standard	<a href="http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/ProgramStandards/ucm180269.htm">www.fda.gov/Food/FoodSafety/RetailFoodProtection/ProgramStandards/ucm180269.htm</a>
Water Environment Federation (WEF)	<a href="http://www.wef.org">www.wef.org</a>
Water Quality Association	<a href="http://www.wqa.org">www.wqa.org</a>





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