Solid Waste

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Key Concepts

- Solid wastes are a possible cause of groundwater contamination, air pollution, and odor.
- Solid wastes may be displeasing to the public either visually or through odors.
- Solid wastes may be a breeding ground for disease-causing vectors (e.g., mosquitoes, rodents, insects).
- Boards of health have varying degrees of authority to handle solid waste issues, ranging from acting as an advisory body to carrying out and enforcing policies.
- Boards of health may be responsible for regulation, licensure, and oversight of solid waste.
- Boards of health that share responsibility for solid waste with other agencies should build partnerships with those agencies
- Partnering with community leaders, agencies, and the public forms the bedrock of successful board of health initiatives.

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 community, 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 present 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, 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. Figure 1 provides an approximate breakdown of the estimated 220 million tons of municipal solid wastes generated in 1998 before recycling.

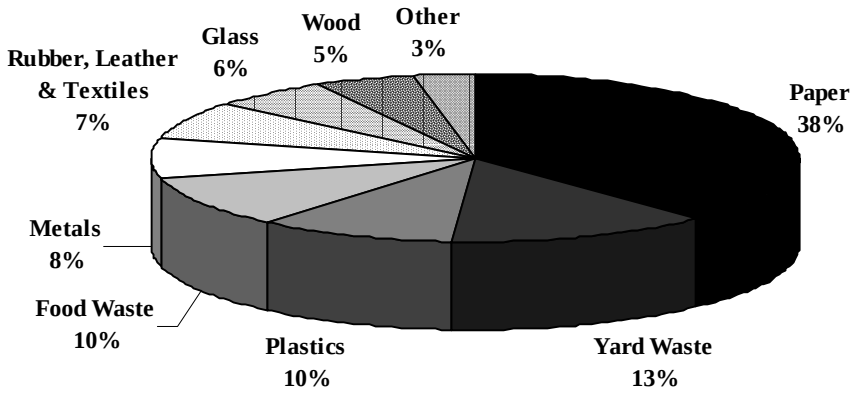

FIGURE 1. Types of Solid Waste, in Percentages

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 seven pounds of solid waste per day, of which 4.5 pounds is municipal solid waste. Nationwide, this amounts to approximately more than 220 million tons per year, an amount that, if placed in one location uncompacted, would cover an area of 400 square miles, six feet deep.

Two important pieces of legislation apply to municipal solid waste. Both the Solid Waste Disposal Act (1965) and the Resource Conservation and Recovery Act (RCRA, 1976) 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

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, and
- 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 considering building a landfill should consult with the 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 2).

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

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, <www.epa.gov>.

FIGURE 2. Sixteen Phases of Landfill Operation Recommended by the USEPA

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 to 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 Assisting–MSW-Reducing Alternative

When communities consider extending landfill sites, reducing the cost of managing solid waste, and obtaining maximum benefits from a product, recycling may enter the discussion. It sounds good, has merit, and is a familiar term to most people. However, the process is difficult to initiate and sustain without a clear understanding of what is required from the public and what monetary commitments are needed to achieve success. Successful marketing of recyclables requires an understanding of recyclable market trends (what is hot and what is not), accurate market knowledge (identifying, contacting, selecting, and contracting with buyers), developing a program design that involves the public, and obtaining a shared decision-making policy. Issues to consider include space needs, safety, accessibility, short-term 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.

Some of the more popular recyclable items that usually have a reasonably accessible market are listed below and as one can observe from the graph in Figure 1 these products are a significant percentage (50%+) of the MSW package:

- Newsprint, computer paper, cardboard;
- Glass (designate clear or colored and any divisions of colored);
- Plastics (determine what forms of plastics will be accepted or post the stamped standard recycle number(s) displayed on the plastic items that will be taken by the facility); and
- Metals (once again a decision needs to be made addressing the types received, such as tin, aluminum, etc.).

Some recycling programs may declare a profit, but many program managers find that such programs generate only a small amount of funds. Most would report that the project may be a "break even" effort with the gain being a savings on the MSW landfill's lifetime. Additional considerations that communities must address are zoning and land use, including siting, permits, ordinances, general business regulations, and contacts.

All new recycling programs involve major changes in the way citizens handle waste; therefore, a start-up plan is a must. Boards of health must take an active role in implementing short- and long-term programs that incorporate public understanding, participation, and acceptance or support. In addition, citizens and local officials must be constantly reminded of the environmental, economic, and social reasons for reducing landfill waste. 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?

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.

Other Options to Consider?

There are additional options for MSW disposal that decision makers may examine. For example, MSW can be incinerated to produce electricity. Incineration, however, contributes to air pollution, and it is being phased out in many parts of the country. A second alternative for some types of MSW is composting. Yard wastes and leaves can be converted into compost. The drawback to this method is that it requires a large amount of land and time to create compost. Thus, each of these alternatives has distinct positive outcomes, but each may also have negative consequences or require considerable time and planning to develop. Each also has a niche that must be balanced against the abilities, practicalities, and situations of the individual community. Further information regarding MSW disposal options can be obtained from the references listed at the end of this chapter, particularly the Internet website for the USEPA <www.epa.gov>.

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; and
- Realize the 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 (Figure 3). 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.

- 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

FIGURE 3. The Objectives of a Public Involvement Plan
(*Source:* USEPA, *Sites for Our Solid Wastes: A Guidebook for Effective Public Involvement*, 1990.)

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. This 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. Although board of health members may have varying responsibilities regarding solid waste policy development, implementation, and enforcement, to assure the safe management of garbage 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.

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Hazardous Waste

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Key Concepts

- Hazardous waste can have harmful effects on people and the environment.
- Hazardous waste can be found almost anywhere in a community.
- There are numerous implications for the public's health in how we manage currently generated hazardous waste and how we remediate sites contaminated in the past.
- Although much of the regulatory responsibility for hazardous waste resides with the federal and state governments, there are opportunities for boards of health and their health departments to help protect their communities from adverse effects resulting from improper management.
- Boards of health have a national commitment to pollution prevention and waste minimization.
- The issue of environmental justice involves past, present, and future disposal policies for 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 ºC (140 ºF) 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.

Hollywood Makes a Fuss Over Hazardous Leaks and Spills

A striking example of how hazardous waste leaks affect the environment can be seen in the film *A Civil Action* starring John Travolta. This movie received critical acclaim for its portrayal of a leukemia cluster that developed in a small town whose drinking water wells had become contaminated with hazardous materials and wastes. The contamination originated from mismanagement of on-site hazardous materials and wastes at local industries. The contamination then seeped down through the soil to the groundwater serving the town's wells.

Another film, *Erin Brockovich*, starring Julia Roberts, tells the story of the small town of Hinkley, California, where a cluster of illnesses and cancer cases resulted from hexavalent chromium that had leaked into the area's groundwater and soil. The chromium was used by the local Pacific Electric & Gas plant, but improper handling and disposal led to the poisoning of the town's people.

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 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**). 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.

TABLE 1
Federal Agencies and Laws Regulating Hazardous Waste

Agency	Legislation	Provisions
U.S. Environmental Protection Agency	Resource Conservation and Recovery Act (RCRA)	Sets standards and issues permits for generators, transporters, and TSDFs
	Comprehensive Environment Response, Compensation, and Liability Act (**CERCLA**)	Provides for Superfund activities such as emergency cleanup and long-term containment of hazardous waste dump sites
	Clean Air Act	Sets emission standards for hazardous air pollutants
	Clean Water Act	Sets standards for toxic discharges to water
		Prepares national contingency plan for spills, coordinates spill response, levies penalties, and recovers costs
	Safe Drinking Water Act	Regulates the underground injection of wastes that could contaminate drinking water
	Toxic Substances Control Act	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
Department of the Interior Fish and Wildlife Service	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

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 Superfund (CERCLA) 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>.

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, **SARA Title III** (**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, in fact it 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 cleanup 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 decade. 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 six years earlier. The percentage of recycled hazardous waste continues to increase, while the percentage that goes to land disposal is decreasing.

By 1999, the amount of regulated hazardous waste produced by large quantity generators in the U.S. fell to 53 million tons. The five states that generated the largest amount

of hazardous waste that year were Texas (15 million tons), Louisiana (4 million tons), Illinois (3 million tons), Tennessee (2 million tons), and Ohio (2 million tons). Together, the large quantity generators in these states accounted for 65% 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. Between 1980 and 1993, the number of household hazardous waste collection programs in the United States grew from virtually none to more than 1,200 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 **National Priorities List (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 January 2002, there were 1,222 sites on the National Priorities List. An additional 72 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 257 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 lists spill totals for the previous eight years.

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	1991	1992	1993	1994	1995	1996	1997	1998
Oil/chemical spills	24,794	25,929	28,263	31,378	30,794	27,499	25,693	26,774
Continuous releases	333	323	476	215	184	177	170	305
Railroad hotline	627	933	1,109	1,109	1,134	1,197	1,451	2,053
Generic incidents	0	0	0	236	971	565	113	53
Pre-release/terrorism	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; and

- 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, and 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, and
   - 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, and
   - 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 an emerging concept of awareness and sensitivity to the disproportional impact of chemical pollution and waste treatment facilities on low-income and minority neighborhoods. In 1992, the USEPA organized a workgroup to investigate the problem and develop recommendations for improvement. The recommendations that were issued by the workgroup included:

- Increasing the priority given by the USEPA to environmental justice,
- Identifying and targeting opportunities to reduce high concentrations of risk to different population groups,
- Assessing the impact and distribution of chemical pollution in USEPA rule-makings and agency initiatives, and
- Reviewing and revising, when possible, permit granting, monitoring, and enforcement procedures to address the high concentration of risk in racial minority and low-income communities (Kindschy, Kraft, and Carpenter 1997).

Environmental justice is an area ripe for change. At the federal level, increased attention and subsequent grant monies are being given to investigate the problem of disproportionate risk of chemical pollution in selected neighborhoods. Local boards of health could have a large impact on bringing the issue of environmental justice to the forefront of local policy.

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Vector Control

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Key Concepts

- There is increased incidence of vector-borne diseases in the United States.
- The increased incidence of vector-borne disease is caused by the following:
  - Changes in human settlement patterns,
  - Loss of organized vector-control programs, and
  - Local and global climate change.
- Local health agencies must be aware of and act on the following:
  - Removal of breeding sites,
  - Promotion of vegetation management,
  - Support of integrated pest management, and
  - Animal control.
- Responsibilities of local boards of health include
  - Gathering environmental and health surveillance data,
  - Providing education for the public, and
  - Developing and enacting an emergency response plan.

Public Health Significance

As we enter the 21st century, 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. As of February 2003, there have been 4008 confirmed cases of human illness with 263 deaths in 40 states. The significant increase in virus activity in 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 these 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 and 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), 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.

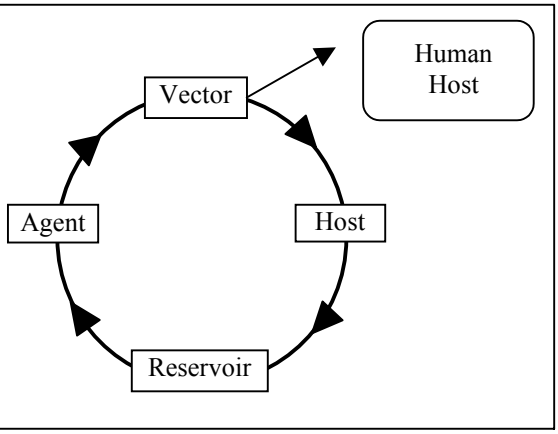


FIGURE 1. Generalized Vector-borne Disease Transmission Cycle

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 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; and
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, and
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	Bunyavirus	Birds (?)
	Dengue fever	Flavivirus	Humans, etc.
	Eastern equine encephalitis	Alphavirus	Birds (?)
	La Crosse encephalitis	Bunyavirus	Birds (?)
	St. Louis encephalitis	Flavivirus	Birds (?)
	Western equine encephalitis	Alphavirus	Birds (?)
	West Nile fever	Bunyavirus	Birds (?)
	Yellow fever	Flavivirus	Humans, etc.
Ticks	Colorado tick fever	Bunyavirus	Small mammals
	Lyme disease	Sphirocete	Deer, mice
	Powassan encephalitis	Flavivirus	Ticks, mammals
	Relapsing fever	Spiorochete	Humans, ticks
	Rocky Mountain spotted fever	Rickettsia	Ticks
Lice	Relapsing fever	Spirochete	Humans
	Trench fever	Bacteria	Humans
	Typhus (epidemic)	Rickettsia	Humans
Fleas	Bubonic plague	*Yersinia pestis*	Rodents, etc.
	Typhus (endemic)	Rickettsia	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. Figure 2 shows the recuperative ability of the yellow fever mosquito (*Aedes aegypti)* to expand its habitat even after extensive reduction efforts. 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.

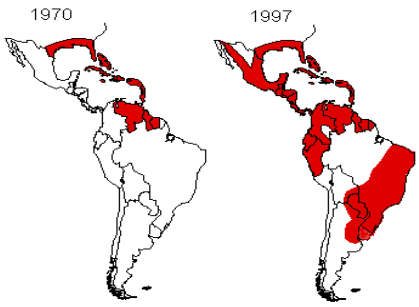


Figure 2. Resurgence of the *Aedes aegypti* Mosquito in Central and South America (courtesy of CDC).

Responsibilities and Options

One of the most important but least visible components of a health department's programs is vector control. Vector-control programs involve surveillance, public education, activities to prevent vector growth and development, actions to reduce adult populations, and where appropriate immunization of susceptible hosts. The role for the board of health in vector activities is

1. To assure that the local health department has proper and adequate resources to accomplish its mission and goals;
2. To communicate with the public when abnormal vector-borne disease risks are present;
3. To assure that the public is provided the necessary information and education to assist in reducing the risk of vector-borne diseases and in controlling the vectors; and
4. To provide a leadership role in the support and development of organizations designed to control specific vectors such as mosquitoes.

The goal of a vector-control program should be to control, reduce, and/or eliminate to the greatest extent possible vector-borne diseases in a community. An efficient and effective approach for a health department's vector control program should include

1. appraisal of the public health risk of zoonotic disease to the general public by vector, pathogen, and disease surveillance;
2. development and utilization of cooperative programs with other government and non-government entities in addressing surveillance, control, and education;
3. oversight or provision of control programs for the vector(s) of concern that considers environmental issues, is responsive to community concerns, and is cost effective in diminishing the risks of vector-borne diseases; and,
4. development and implementation of public education programs for citizens to aid in the elimination of vector habitats and in controlling the target vectors.

Surveillance

A universally applicable surveillance system does not exist. Therefore, a system for a jurisdiction must be tailored according to the probability of vector activity and available resources. Both active and passive surveillance are needed, and the local health department plays an important role in both of these methods. (See the suggested decision tree at the end of the chapter.)

Passive surveillance activities include the following:

1. Mandatory and prompt participation in reporting of notifiable diseases that are vector related: The board of health should encourage this reporting responsibility by its own clinics, local hospitals, and local private clinicians. In addition, the local health department should assure that it participates in and is part of the state and national disease reporting network (e.g. CDC's *Morbidity Mortality Weekly Report*, etc.).
2. Reliance on trappers, fish and wildlife department personnel, and others who routinely come into contact with wild mammals and birds to collect and submit arthropod samples to the local, state, or federal public health laboratories for analysis: Where mosquito control districts are present, these contacts can form a valuable source or information and a natural partnership with the local health jurisdiction.
3. The use of meteorological data for both local and regional patterns to predict vector population trends: The monitoring of rainfall and temperature patterns that promote the development and survival of vector populations can be used to prepare for potential problems such as greatly enhanced populations or an increase in the pathogen in the sentinels.

Active surveillance encompasses functions related to pathogens, diseases, and reservoirs linked to vectors and that are endemic in the jurisdiction or in nearby jurisdictions. These activities are founded on the fact that conditions can be altered quickly due to a shift in wildlife and the rapid transportation of persons and animals. Active surveillance activities to be undertaken by the local health department with board of health support must include

1. Public health follow-up of new cases of specific diseases that have been endemic or epidemic to deny reestablishment (including priority follow-up for emergent cases such as animal bites and positive rabies in animals); and
2. Use of programs to give early warning of the presence of pathogens in the vector or wildlife reservoirs. These include field identification and monitoring of rodents, mosquitoes, ticks, and other vectors of disease. Some of the methods used include the following:
    a. For mosquitoes — monitoring sensitive bird populations, trapping of wild birds with subsequent blood sampling for the pathogen of interest, use of mosquito traps for adult population counts, species identification and pathogen identification and monitoring, and surveillance of mosquito breeding areas for population counts and identification of larvae and pupae.
    b. For rats and mice — trapping of target rodents to determine infections and flea populations for plague and surveillance for hantavirus-infected rodents.
    c. For ticks — field collection and identification of tick species and pathogen surveillance.

It is imperative that staff be well trained in species identification for an effective vector-control program.

Cooperative Partnerships

The development of cooperative efforts between governmental units and between governmental units and nongovernmental units is of the utmost importance. It serves to expand the vector program, to avoid duplication, and to spend the taxpayers' dollars prudently.

Control Efforts

The control of the vector is often the most critical element in protecting the public from vector-borne diseases. The board of health's responsibility is to assure that the public

supports and understands the rationale for control measures performed or required by the local health department. Control can be divided into individual and public responsibilities.

Individual control measures are focused on the removal of the vector habitat or reduction of the risk of exposure. Individual measures may be accomplished by public education or by the enforcement of control regulations. They include the following:

1. Removal of breeding sites,
2. Vegetation management in and around homes,
3. Use of biological controls (e.g., mosquito fish [*Gabusia affinis*] and the microbial insecticide [*Bacillus thuringiensis israeliensis* or *Bti*]), and
4. Use of rodenticides for rodent infestations.

Public control measures consist of efforts either mandated by code for the public to follow or direct measures performed by the local health department with the support of the board of health. These include

1. Enforcement of building and nuisance codes: In conjunction with building codes, require and promote proper installation and maintenance of fine mesh screening for the exclusion of flying vectors. Housing codes banning vacant dilapidated housing, weed growth, the collection of trash and debris, and proper housing construction will reduce rat and mice habitats. These will also diminish the potential for other vectors such as fleas and ticks, plus will eliminate breeding areas for filth-carrying vectors.
2. Rabies control: Vigorously require pet vaccinations coupled with a rabies immunization certificate and rabies tag program, animal leash laws, and veterinarian supervised observation of quarantined animals for rabies.
3. Habitat reduction: Use cooperative efforts with parks and wildlife areas to remove habitats conducive to vector breeding and development. Develop programs to drain mosquito breeding areas and eliminate slow moving streams and ditches. Incorporate vector habitat awareness into the on-site sewage treatment programs to enforce regulations. This will eliminate standing water due to cisterns, cesspools, and septic tank systems, which promote mosquito breeding.
4. Provide cooperative efforts with the water/sewer divisions for the proper repair and maintenance of sewers and manholes to discourage rodent populations.

5. Pest control: Provide for the application of larvacides to standing water to eliminate mosquito larva. This is recognized as the most effective and economical way to control mosquitoes. However, inappropriate larvaciding of nonvector mosquitoes can be eliminated by proper identification of larva species. As needed, provide for the chemical application of pesticides to kill adult mosquitoes. Where rodent populations are high, the provision of maintenance baiting programs should be implemented.

Public Education

Public health education is the cornerstone of good vector-control programs. Each board of health should recognize that while public health has a mandated enforcement function, the focus of the local health department should be prevention and education. 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:

1. Each local health department vector professional should be an educator to the public. Thus, employee speaking skills should be honed to enhance public delivery of information. A speaker's bureau should be developed within the department regarding vector-borne disease issues.
2. Department members 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.
3. The local health department should provide definitive literature about the vector-borne diseases.
4. 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.
5. The local health department 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).

6. The local health department 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.

Policy Issues

Integrated Pest Management

When faced with a vector problem, one of the most thorny issues with which a local health department and its board of health must deal is whether or not to use active control measures—and if so which ones. The use of what is termed *integrated pest management* has become accepted practice. The important concepts here are that the goal is pest management rather than elimination, and the use of a balanced approach—physical, biological, and chemical control measures—to reduce or keep the pest population at or below a level at which disease or nuisance is likely to result.

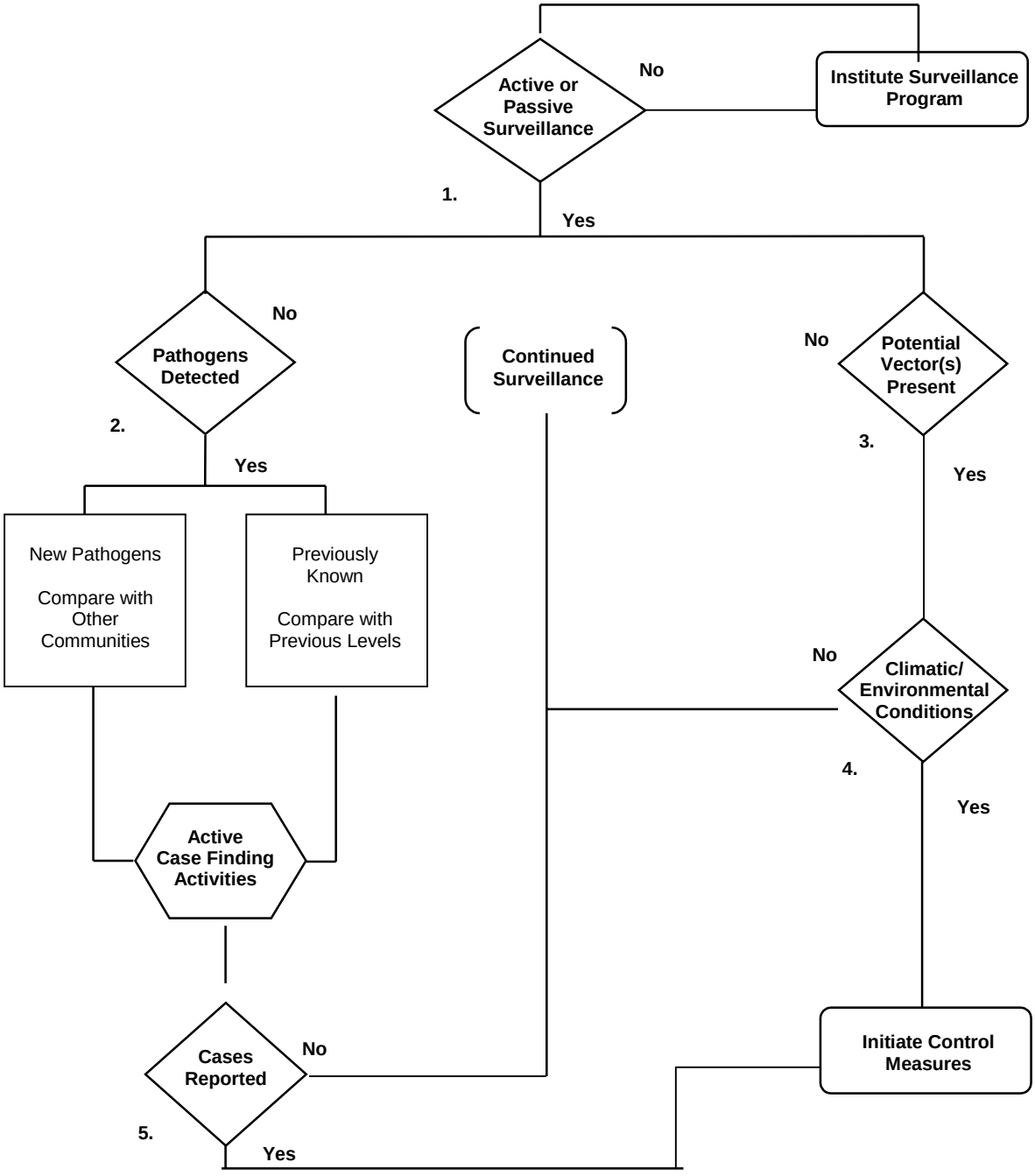
The use of chemical control methods (pesticides) is a step that may be welcomed or feared by the general population, depending upon the prescription of risk. The order of choice for control is habitat management, larvaciding chemicals, and adulticiding chemicals. All of these are based on proper surveillance, and an integrated program will use all at some time. Informing the public of the chemical usage can be a positive effort if it is understood what the ultimate purpose is. Larvaciding is often not seen by the public but should be advertised to obtain continued public support. Adulticiding is a very visible operation and should be advertised before usage and should be founded on information obtained from surveillance and linked to nuisance situations or an increased risk of disease transmission. The latter decision is based on the presence of the proper vector, the presence of the pathogen, the existence of cases, or the risk of the importation of the pathogen from surrounding jurisdictions.

Public Perception

The perception of control can be either positive or negative, and is normally based on the public's perception of risk of exposure to the pathogen. It is imperative that this perception be properly formed by the use of surveillance data (active and passive) that document identified cases, source of vectors, the presence of the pathogen, and the presence of an identifiable host. Public education efforts should include forewarning regarding times and locations of adulticiding and the types of chemicals to be used. The use of malathion in the West Nile virus outbreak in New York City resulted in some public concerns about the long-term effects of exposure and complaints regarding short-term effects. Technical expertise should be obtained regarding the specifics of pesticide preferences. If the public is

educated regarding the purpose and the rationale is based on sound surveillance measures, acceptance is much easier to obtain. If the proper nonchemical controls are applied and good surveillance is performed, the widespread use of chemicals can often be avoided. An effective forum for educating the public is through an "open house," i.e., choosing a public area to arrange training or discussion tables that describe the public health agency's vector control (or other) activities. For example, one table might provide maps of areas scheduled for larviciding, one table could describe the insecticides being used or the vector(s) being targeted, while another could explain the concept of ultra-low volume (ULV) application. These types of educational meetings tend to be less confrontational and provide the public with excellent learning opportunities.

Suggested Decision Tree



Decision Points

1. Do active or passive surveillance methods indicate the presence of vector-borne disease pathogens, vectors of concern, climatic condition promoting vector development, or vector-borne disease cases in the jurisdiction?

   If no to all, then no action is needed; continue surveillance methods.

   If yes, then address the following questions.

2. Were the identified pathogens new or previously known to be present?

   If new, compare to levels noted in surrounding communities.

   If existing, compare to previously measured levels in the jurisdiction.

3. Are the vectors of concern capable of transmitting the pathogens noted?

   If no, then no action is needed and continue surveillance

   If yes, are the vector numbers less than/equal to/more than past surveillance data?
   Consider the active approaches to vector reduction by use of integrated pest management (biological/chemical/environmental). Enhance vaccination programs and public education.

4. Do environmental and meteorological data indicate the potential for increases in the numbers?

   If no, continue surveillance of numbers and monitoring of meteorological data.

   If yes, utilize integrated pest management methods to reduce potential future growth.
   Enhance vaccination programs and public education.

5. Are there documented cases of the disease in the community?

   If no, then continue surveillance.

   If yes, how do these numbers compare with previous data? Were the cases indigenous or imported?

Note: There is no easy formula for determining what action to take and when to take it. All of the above information must be considered and integrated.

Resources for Additional Information

Centers for Disease Control and Prevention. National Center for Infectious Disease. Division of Vector-Borne Infectious Diseases. <www.cdc.gov/ncidod/dvbid/index.htm>.

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Injury Prevention, Housing, Occupational Health, Recreational Water and Radiation Programs

Timothy J. Ryan, Ohio University

Key Concepts

- Boards of health must ensure that efforts are directed toward preventing illness, injury, and death on the playground, in the home, and in the workplace through the creation of proactive safety measures, educational programs, and inspections.
- Boards of health have a responsibility to protect the health of all members of their community, but especially those who are at increased risk of experiencing injury or illness, such as children and the elderly.
- Examples of areas of concern that may not be frequently discussed but that boards of health nonetheless have a responsibility to address include injury prevention, housing, occupational safety and health, recreational waters, and radiation.
- The range of health issues that boards of health must address is expanding in many communities. Boards must ensure that they understand their role and duty to act in protecting the public's health as new areas of concern emerge.

Introduction

One balmy spring day, a four-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, housing, 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 relatively recently established 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

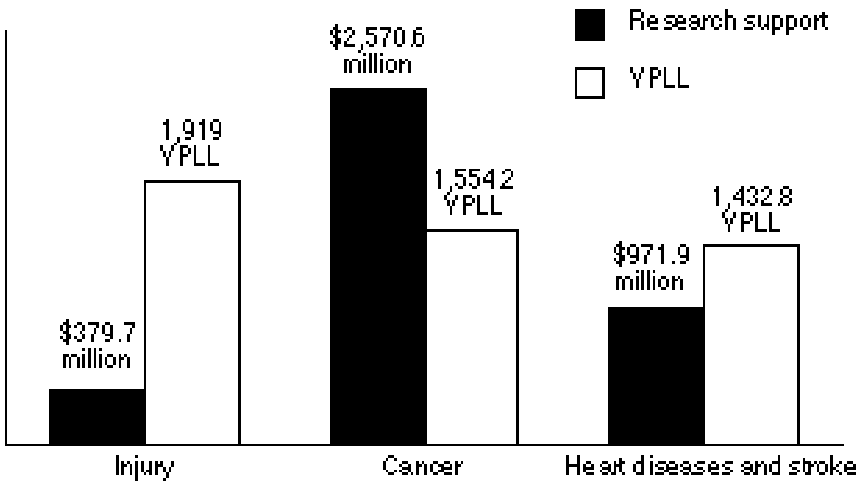

FIGURE 1. Years of potential life lost versus the federal research investment. Note: Age-adjusted years of potential life lost (YPLL) before age 75 in 1996 was calculated per 100,000 population. Injury includes unintentional injury, homicide, and suicide. The research support for injury is for FY 1995; research support for cancer, heart diseases, and stroke is NIH support for FY 1996. Sources: NCIPC (1997); IOM (1998); NCHS (1998). (Reprinted with permission from Reducing the Burden of Injury—Advancing Prevention and Treatment. © 1997 National Academy of Sciences, Washington, D.C.)

homes or in public places, unintentional injury and violence accounts 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 (see Figure 1).

Boards of health can reduce injuries and do have legitimate responsibilities in this area. Where injury reduction programs have been implemented, they often have 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.

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.

TABLE 1
Examples of Effective Injury Prevention Interventions

Injury problem	Intervention
Bicycle injuries	Bicycle helmet use, mandatory helmet laws
Choking and suffocation	Legislation and product design changes (e.g., refrigerator disposal, warnings on plastic bags)
Falls among the elderly	Weight-bearing exercises, multimodal programs (visiting nurses, exercise programs, hazard elimination), protective pads
Fires 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

Source: Adapted from *Reducing the Burden of Injury—Advancing Prevention and Treatment*. Washington, D.C.: National Academy of Sciences (1999).

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 the

- 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), and
- 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.

Housing

Primacy of the community over an individual's dwelling has existed on this continent since the prohibition of thatched roofs by the Plymouth Colony in 1626. In 1850, the *Report of the Sanitary Commission of Massachusetts* recommended that public health issues of overcrowding and sanitation be addressed by the local boards of health. The importance of suitable, safe, and healthy housing for Americans was probably best articulated in the passage by the U.S. Congress of the Housing Act of 1949. It stated, "the general welfare and the security of the Nation and the health and living standards of its people—require a decent home and a suitable living environment."

The term *housing* refers to not only the dwelling but the environment around and in the immediate vicinity of housing. Building codes dictate how a dwelling is constructed. Housing codes mandate how the inhabitant is to occupy the dwelling. It often falls to the local health department and board of health to deal with the inspection of dwellings, necessary enforcement actions, and complaints. Possible issues in such cases include the code itself, fire safety, occupancy, and the use or storage of **toxic** materials. Commonly required code minimums are shown in Table 2.

TABLE 2
Typical Minimum Housing Code Requirements

Kitchen or food preparation area	Stove
Sink	Refrigerator
Flushing toilet	Potable water
Lavatory (hand sink)	Wash tub or shower
Ventilation, heating and cooling	150 square feet space per occupant

Fire

Home fires kill thousands of Americans each year and pose a major threat of injury. Community fire protection and early warning through smoke detectors are two mechanisms for reducing individuals' risk of injury. Boards of health can encourage community groups to participate in Fire Prevention Week (sponsored each fall in the United States) to increase community awareness of the need to install and/or test smoke detectors. Many communities

have found local sponsors who are willing to provide inexpensive yet functional smoke detectors at minimal cost to lower income citizens. The same may be true for small kitchen fire extinguishers, which can be purchased in quantity for less than $10 each.

Toxins

In addition to fire safety in homes, boards of health should ensure that issues surrounding common housing-related toxins and toxic materials are addressed. Examples of toxic substances or materials that can pose a public health hazard in homes include carbon monoxide, lead-based paint, radon, and molds. The risk factors associated with each of these substances and remedial actions are described below.

Carbon monoxide (CO)

- CO is a colorless, odorless gas that kills over 200 persons per year in the United States.
- It is a product of poorly vented or operating nonelectric heaters and furnaces.
- Boards of health should ensure that community members are properly informed of the risks posed by malfunctioning and poorly vented burners.
- Boards of health can also establish programs for distributing CO detectors to high risk community members at low cost.

Lead-based paints (LBP)

- Lead-based paint is found on both the interiors and exteriors of pre-'70s houses.
- Flaking, sanding, or improper removal of lead paint creates hazards.
- Children are at high risk of brain damage (diminished IQs) from breathing LBP dust or by eating the paint chips.
- Boards of health must ensure that the community receives the necessary education regarding the risk posed by LBP.
- Boards of health may also consider regulating building owners.

Radon

- Radon can enter houses via foundations and water sources.
- Radon exposure poses a serious and ongoing threat of lung cancer.

- Boards of health must ensure that builders and homeowners are aware of the risk associated with radon and that health department staff have sufficient funds and training to conduct inspections.
- Boards of health should advocate for building codes that ensure new houses contain proper exhaust systems to the appropriate local agency(ies).

Molds

- Molds grow under imbalanced temperature or excessive moisture conditions.
- Certain exterior foam insulated homes are especially prone to mold problems.
- Molds are **allergens** and can cause allergic reactions or make occupancy impossible.
- Boards of health can ensure that the public is informed of the risks associated with molds and the methods for preventing and eliminating mold growth.

Special Issues in Duplexes, Apartments, and Other Multiple Dwellings

Special problems can exist in multiple unit dwellings, in addition to those describe above. General issues at such facilities can include:

- Overall living-space hygiene
- Sanitation of waste accumulation areas
- Security
- Gang/violence matters
- Parking lot traffic
- Noise from neighbors and car alarms
- On-site recreational rooms
- Asbestos regulations

Many times, the first means of addressing these and other multiple unit dwelling issues is through licensing by a municipal authority. Depending on the conditions set forth in the license, it will then fall to the owner and his agents to ensure safe and healthy environs are provided. Some states and localities have taken regulatory steps on these issues (e.g., installing speed humps or passing new environmental noise ordinances).

Recreational facilities such as swimming pools, spas, and exercise rooms are increasingly provided at many larger apartment or condominium complexes. Not only do injury issues exist from such establishments, but hygiene matters may arise. Water quality in pools and spas is largely determined by maintenance staff adherence to prescribed water testing and treatment regimens. Licensing alone cannot adequately ensure the prevention of problems from poorly maintained facilities. The environmental health division of the local

health department must play an active and visible role in the management of such waters to prevent disease transmission and injury.

Under model federal legislation, multiple dwellings with four or more units are subject to strict asbestos management regulations when they have cancer-causing asbestos-containing material (ACM). Management of asbestos includes not only visible materials, such as ceilings and floor tiles, but also ACM in out of the way locations of buildings, such as around pipes and above suspended ceilings. Of greatest importance to those living in the immediate vicinity of units with asbestos is how ACM is handled when it must be removed. Typically, owners of public buildings with ACM must register with the state health department before performing any such work. In some cases, the local board of health may wish to examine how aggressively ACM issues in their community are being pursued, since it is initially up to building owners or their agents in many jurisdictions to declare the presence of ACM.

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; and
- 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 3).

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 3
Steps in Implementation of Workplace Safety Controls

Rank-ordered step		Comments
1.	Engineering controls	• Physical changes are not always the most expensive approach. • If engineering fixes are properly maintained, they hold the greatest promise of long-term effectiveness.
2.	Administrative controls	• Use in addition to engineering changes. • Directed at reducing the time persons spend in hazardous locations. • Education and training qualify.
3.	Personal protective equipment	• Use as a last resort. • Must include training • Use with efforts at engineering and administrative control.

Recreational Waters

Drowning historically has been the most visible cause of morbidity or mortality with respect to recreational waters. Yet the most recent widespread public interest in recreational waters probably occurred in the mid-1980s. At that time medical waste, including used exam

gloves, plastic hypodermic syringes with needles, and IV solution bags, washed up on several swimming beaches along the U.S. Eastern seaboard. Against a backdrop of intense phobia of the then-emerging Acquired Immune Deficiency Syndrome (AIDS) epidemic and a growing awareness of the agent responsible—Human Immunodeficiency Virus (HIV)—demands for governmental action were immediate and uncompromising. Although no cases of disease transmission were ever documented, as a result of these scares the waste disposal practices of many healthcare institutions were not only reexamined, but the expectation of board of health oversight of recreational waters was fortified.

Traditionally focused only on water quality in pools and swimming areas, health departments have had to become vigilant to chemical and unnatural biological contamination of recreational waters. In addition, with Americans spending anywhere from 5% to 25% of their available incomes on recreational activities, and with more than half of all such spending directed at water-centered activities, the workload of health officials in this area is high. Spurred on by new concepts in recreational water use, such as water slides, wave pools, and theme parks, this potential workload is growing.

Swimming

The actions of the board of health with respect to public swimming waters must of necessity focus on two areas. These are education and rules for safe water use to prevent drowning, and the control of all manner of contamination hazards that could result in disease transmission. Safe water use rules include

- Prohibition of pollution sources in or near beaches;
- Education on how to swim;
- Life-saving training;
- Effective use of the 9-1-1 emergency notification system;
- Use of the “buddy system” when swimming;
- Warning signs prohibiting swimming in the vicinity of dams, plant intakes, or canals; and
- Education about the hazards of shallow water diving.

Contamination Monitoring

Only by the vigilance of the local health department, with support and resource allocation from the governing or advising board of health, can water contamination issues stand a chance of detection prior to outbreaks of disease or **morbidity** among users. Routine

sampling and public notification are necessary for public health protection. Monitoring of certain bacteria (i.e., *E. coli*) known to be associated with the transmission or spread of human diseases is readily accomplished and should be performed on a routine basis for all public swimming pools, tidal pools, inland lake beaches, hot tubs, and spas. Environmental health professionals and trained maintenance workers at such facilities are the first line of defense with respect to blooms of disease-causing **biohazards**. If necessary, state health personnel may be relied on for the identification of more unusual or serious contaminants.

Boating

The Institute of Medicine of the National Academy of Sciences has called for stronger liaisons and more cooperation between governmental agencies to effect a reduction in recreational water-related fatalities and injuries of the U.S. populace. Two obvious opportunities for such successful interaction are in the areas of life safety and watercraft regulation.

Life safety. Long the purview of either the sheriff's department or a department of natural resources, it would seem that only education and intervention work led by the local board of health holds the promise of achieving the recommendations of the Institute of Medicine's report. While enforcement should continue to be encouraged for infractions of existing rules, board of health efforts might include

- Classroom programs focused on the hazards of drugs and alcohol use;
- Age-related driver qualifications or legislation supported by the board;
- Awareness training concerning personal flotation devices;
- Support of, or establishment of, speed limits; and
- Safeguards directed at use zones (e.g., swimming areas separate from power craft).

Regulation. Many states have in place or have considered additional regulations aimed at the harmonious use of the public's waters. Problems caused by irresponsible public behavior where mixed use historically occurred have prompted action by governing entities, including local boards of health. Issues to address may include:

- Noise,
- Annoyance from high-powered motor boats or jet skis,
- Illegal behavior,

- Operation of polluting equipment,
- Operation of equipment at unreasonable hours,
- Operation of watercraft in large groups, and
- Improperly maintained on-board sanitary facilities in some watercraft.

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
- Nuclear fuel rods
- X-rays
- Cancer treatments
- Iodinated salts
- Exit signs
- Compass dials
- Electronics leak testing
- Glass

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 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). For example, body piercing was until recently only of minor concern, but its increasing popularity has led many boards of health to review or recommend local regulations to ensure that safe piercing techniques are practiced. 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 4).

TABLE 4
Public Trends of Potential Importance to Boards of Health

Trend	Hazard	Control
Tattooing parlors	Infectious disease spread	Regulation
Roller boarding parks	Injury	Education
Massage providers	Infectious disease spread	Regulation
Drug paraphernalia shops	Intoxication	Regulation, education
Health food stores	Potent unregulated substances	Regulation, awareness
Body piercing parlors	Infectious disease spread	Regulation

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.

Resources for Additional Information

American Industrial Hygiene Association. Indoor air quality information. <www.aiha.org/>.

Automobile Safety from Safe Kids Website. <www.safekids.org>.

Boating Safety topics from the U.S. Coast Guard. <www.USCGBoating.org/>.

Bonnie, Richard J., Carolyn E. Fulco, and Catharyn T. Liverman (ed.). 1999. *Reducing the Burden of Injury—Advancing Prevention and Treatment.* Washington, D.C.: Institute of Medicine, National Academy of Sciences, National Academy Press. 319 pp.

Centers for Disease Control and Prevention. National Center for Environmental Health. <www.cdc.gov/nceh/>.

---. National Center for Injury Prevention and Control. Injury Prevention and Control. <www.cdc.gov/ncipc/>.

Healthy Homes Partnership. <http://www.uwex.edu/healthyhome>.

Lead-based paint site. <www.hud.gov/offices/lead/index.cfm>.

Mood, Eric W. 1986. *Housing and Health. APHA-CDC Recommended Minimum Housing Standards.* Hollywood, Md.: St. Mary's Press. 84 pp.

Morgan, Monroe T. 1997. *Environmental Health*. 2nd ed. Englewood, Colo.: Morton Publishing Co. 317 pp.

National Center for Playground Safety. <www.uni.edu/playground/home.html>.

Nuclear Regulatory Commission. <www.nrc.gov/>.

United States. Consumer Product Safety Commission. <www.cpsc.gov/>.

---. Environmental Protection Agency. Radon. <www.epa.gov/docs/iedweb00/radon/index.html>.

Risk Assessment, Management, and Communication

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Key Concepts

- **Risk** has its own terminology.
- **Risk assessment** and **risk management** are different functions.
- Analyses of **hazard** and risk are important in the environmental and public health decision-making process and are an integral part of public health activities.
- Risk assessment and risk management must use all available pertinent information.
- The community must be involved in the risk assessment and risk management process through timely and necessary **risk 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 twentieth century (Figure 1). Improved environmental and public health protection services during the twentieth 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.

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

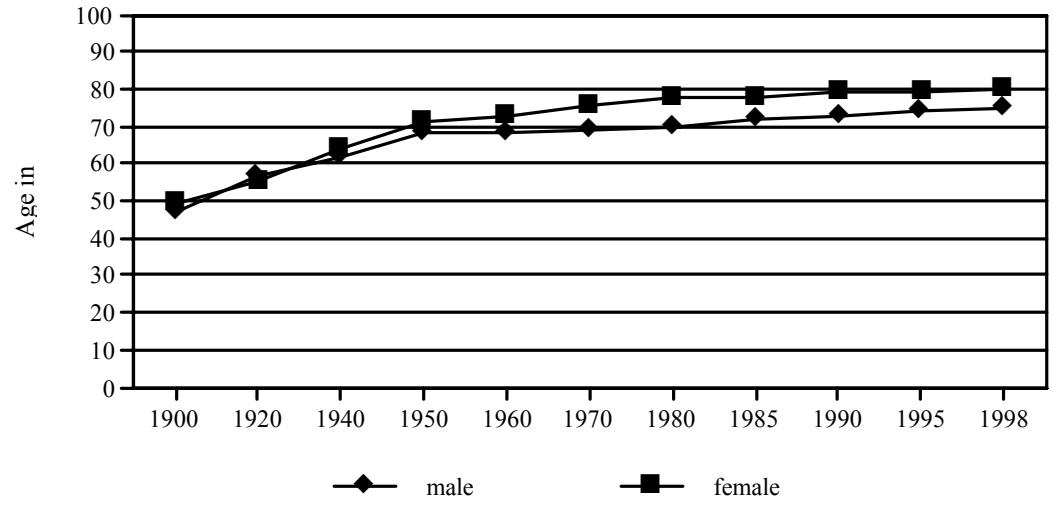

FIGURE 1. Life expectancy at birth in the United States (data based on National Vital Statistics System).

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 1). Both must be understood to manage or reduce the impact of situations or conditions on environmental or public health.

TABLE 1
Definitions of Hazard and Risk

Hazard	Risk
Adverse consequences resulting from exposure at a particular level to a chemical, pathogen, or physical substance or condition. *Example*: 40 micrograms/deciliter blood lead in children results in acute symptoms of lead poisoning, e.g., stomach ache, headache, hearing problems, etc.	Likelihood that in a given situation, the conditions or exposure will be adequate to cause the adverse consequence or effect *Example*: 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.

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; and
- 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 (see Figure 2 for resources).

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, and
- Evaluate whether any contact with the condition or exposure is likely to be extensive enough to result in an adverse outcome.

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 resource list at end of chapter for contact information):

- Agency for Toxic Substances and Disease Registry,
- U.S. Environmental Protection Agency,
- National Institute for Occupational Safety and Health,
- Occupational Safety and Health Administration,
- American Conference of Governmental Industrial Hygienists, and
- Consumer Product Safety Commission

FIGURE 2. Resources for safety guidelines.

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.

Purpose of the Risk Assessment

Understanding the hazard and risk of a condition or situation is the purpose of conducting a risk assessment (Figure 3). 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, and

- Predict the adverse outcome from exposure to the chemical, pathogen, or physical condition (characterize the risk).

The quantitative risk assessment should thoroughly characterize the risks. It should

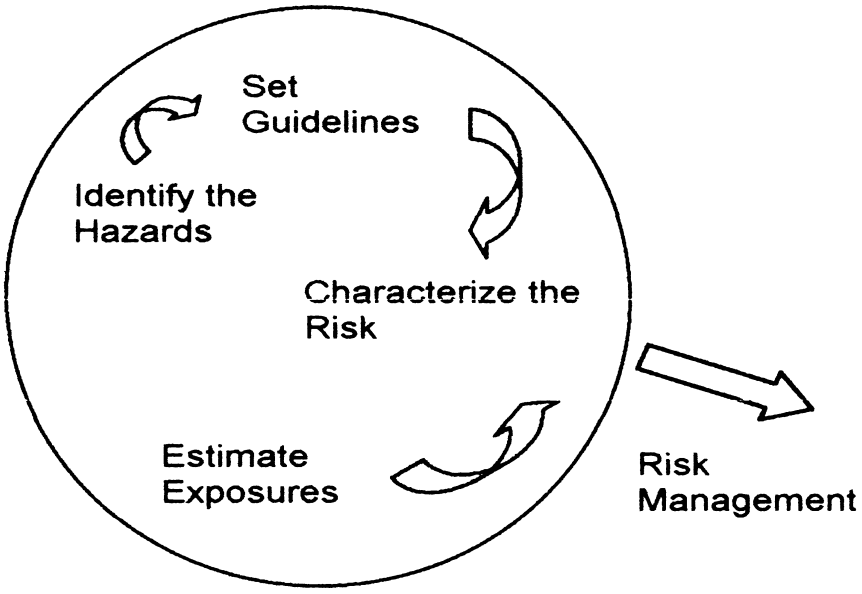

FIGURE 3. Elements of risk assessment

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 4). 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

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

FIGURE 4. Reliability of risk assessment.

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 (Figure 5). 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

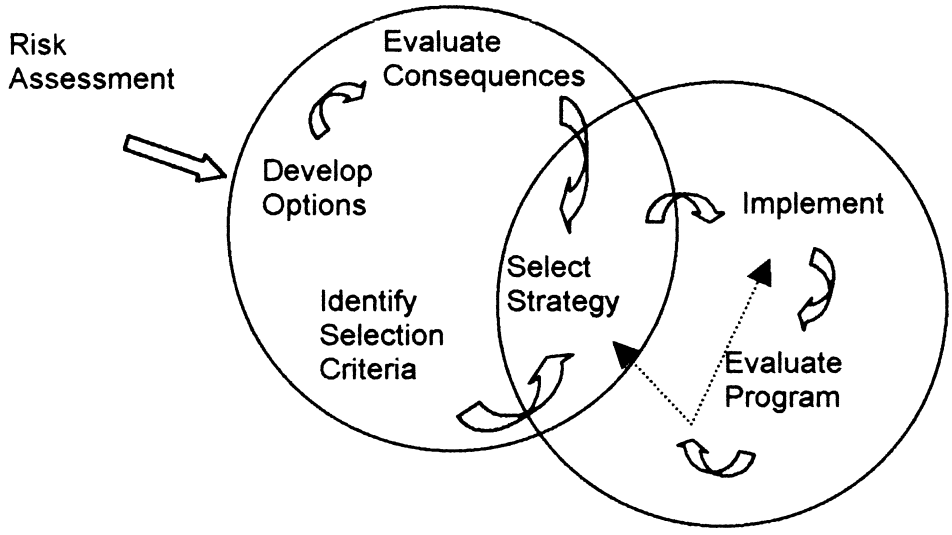

FIGURE 5. Elements of risk management

criteria. Buying into the decisions requires total commitment of all stakeholders.

Risk management includes establishing goals for all populations of a community (Figure 6).

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.

- Community, environmental, and public health goals;
- Social and political factors;
- Available control technology;
- Costs and benefits;
- Results of risk assessment; and
- Acceptable risk.

FIGURE 6. Criteria for risk management decisions.

- 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 must determine how much money should be spent to reduce risks.
- 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.

- 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.

FIGURE 7. Seven elements of effective risk communication (adapted from U.S. Environmental Protection Agency).

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 7) 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 8) on a community and the economics of complying with these

- Food, Drug, and Cosmetic Act (1938)
- Federal Insecticide, Fungicide, and Rodenticide Act (1947)
- Clean Air Act (1970)
- Occupational Safety and Health Act (1970)
- 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)

FIGURE 8. Legislation requiring risk assessment/risk management.

mandates. Existing environmental programs require 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, 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, and
    - 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; and
- 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 2).

TABLE 2
The Radon Example

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

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.

Resources for Additional Information

Agency for Toxic Substances and Disease Registry: <www.atsdr.cdc.gov>.

American Conference of Governmental Industrial Hygienists: <www.acgih.org>.

Consumer Product Safety Commission: <www.cpsc.gov>.

National Institute for Occupational Safety and Health Administration: <www.cdc.gov/niosh/homepage.html>.

National Research Council. 1989. Improving Risk Communication. Washington, D.C.: Committee on Risk Perception and Communication. National Academy Press.

Occupational Safety and Health Administration: <www.osha.gov>.

Presidential/Congressional Commission on Risk Assessment and Risk Management. 1997. Framework for Environmental Health Risk Management. Final Report. Volume 1.

Presidential/Congressional Commission on Risk Assessment and Risk Management. 1997. Risk Assessment and Risk Management in Regulatory Decision-Making. Volume 2.

United States. Environmental Protection Agency: <www.epa.gov>.