

Principles of Environmental Health Administration
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Key Terms

Environmental health and protection
Risk assessment
Public health assessment
Risk communication
Risk management

Objectives

- Understand the scope of environmental health and protection, and name at least 30 problems addressed.
- List at least 10 common program activities..
- List at least 5 important support services.
- Discuss why ecological considerations are important to environmental health and protection.
- Describe the mission of environmental health and protection agencies.
- Understand the importance of basing priorities and decisions on sound risk assessment and public health assessment.
- Explain risk communication and how it differs from public information.
- Identify at least 10 federal agencies that have major environmental health and protection responsibilities.

Introduction

Public and scientific concern regarding the quality of the environment and related public health and ecological considerations continues to be intense.¹ Environmental health and protection services are expected and demanded by the public, the media and political leaders, and are widely considered to be an entitlement. At the state level, environmental health and protection expenditures and numbers of personnel approximate half of the field of public health and is the largest single component of the field of public health.

Environmental health and protection services are integral components of the continuum of health services, and are essential precursors to the efficacy of the other components of the health services continuum. Other health continuum services include personal public health services (population based disease prevention and health promotion), as well as health care (diagnosis, treatment, and/or

rehabilitation of a patient under care on a one-on-one basis).²

Definition

*Environmental health and protection is the art and science of protecting against environmental factors that may adversely impact human health or the ecological balances essential to long term human health and environmental quality. Such factors include, but are not limited to air, food and water contaminants; radiation; toxic chemicals; wastes; disease vectors; safety hazards; and habitat alterations.*³

Organizational Diversity

Environmental health, along with personal public health measures, has always been one of the two basic components of the field of public health. The scope of environmental health and protection administration continues to expand and become more complex. The terminology "environmental health and protection," rather than environmental health or environmental protection should be now be used. The separate terms have been utilized to denote programs based on organizational settings rather than logical or definable differences in programs, missions or goals. Distinctions are largely artificial, and have led to inappropriate organizational confusion, undesirable programmatic gaps and overlaps, and separation of activities which share the common goal of protecting the public's health and enhancing environmental quality. In some cases, the separate terminology has created divisive administrative barriers rather than building administrative bridges between the organizations involved in the common struggle for environmental quality.⁴

At the federal level, most environmental health and protection programs are administered by agencies other than the US Public Health Service. Among states, some 90 to 95% of environmental health and protection activities are administered by agencies other than state health departments. A 1996 study conducted by Public Technology, Inc. indicates that, at the local level, increasing

environmental health and protection responsibilities continue to be assigned to agencies other than local health departments.

Environmental health and protection administration is as complex as the nature and causes of the problems, and involves both the public and private sectors. Program administration impacts the health of the public, the quality of the environment, and the economy. Program administration requires properly qualified personnel; an informed and supportive citizenry; environmental health and protection leadership; a sound scientific basis; the data necessary to measure and understand problems and trends; a number of vital support services; rational public and private sector policies and workable legislation; and budgets prioritized to deal with the more significant problems as determined by sound epidemiology, toxicology, risk assessment, and public health assessment, as well as public demands and expectations.⁵

Values and benefits

The values and benefits of environmental health and protection include:

- enhanced economic status,
- enhanced productivity,
- enhanced educational achievement,
- less social problems,
- a more livable environment,
- better quality of life, as well as
- reduced disease and disability, and
- reduced health care costs.

Scope of Environmental Health and Protection^{6, 7}

Environmental health and protection administration is based on risk assessment, risk communication and risk management applied to one or more of the following problems (A reasonably discrete environmental health and protection issue having an impact on human health, safety, or the

quality of the environment):

Ambient air
Indoor air
Radon
Asbestos
Noise pollution
Radiation
Tanning parlors
Water pollution
Safe drinking water
Liquid wastes
Cross-connections
Eating and drinking establishments
Food wholesalers
Food retailers
Itinerant food establishments
Fish sanitation
Shellfish production and sanitation
Pure food control
Slaughterhouses
Poultry processing
Milk sanitation
Industrial hygiene and safety
Disaster planning and response
Healthful housing
Educational facilities
Health care facilities
Day care facilities
Correctional facilities
Massage clinics
Body art establishments
Unintentional injuries
Amusement parks
Temporary mass gatherings
Migrants workers
Hazardous spills
Brownfields
Leaking storage tanks
Insects and rodents
Nuisances
Animal bites
Bioterrorism
Swimming pools and spas
Beaches

Park and recreational areas
Solid wastes
Hazardous wastes
Toxic chemicals
Lead poisoning
Pesticides and herbicides
Fertilizers
Weeds
Global warming
Stratospheric ozone depletion
Global toxification

Program activities to prevent or ameliorate the foregoing problems include:

Surveillance, sampling, monitoring

Regulation, including:

- Warnings
- Administrative hearings
- Permits
- Grading
- Compliance schedules
- Variances
- Injunctions
- Administrative and judicial penalties
- Embargoes
- Environmental impact requirements
- Court preparation/testifying

Inspection

Complaint response

Consultation

Networking and community involvement

Pollution prevention

Plan and design review

Economic and social incentives

Public information and education

Problem prioritization

Public policy development and implementation

Program marketing

Strategic planning, and

Planning for prevention of environmental health problems through effective involvement during the planning, design and implementation stages of:

- Energy production and utilization
- Land use
- Transportation systems
- Resource development and consumption
- Product and facility design

Support services for the foregoing include:

Epidemiology

Laboratory

Legal

Geographic information systems

Personnel training

Information technology

Research

Ecological Considerations

Public health personnel have traditionally justified, designed, and administered environmental programs based narrowly on public health issues. But as environmental problems, priorities, public perception and involvement, goals, and public policy have evolved, ecological considerations have become increasingly important. Whatever long-term health threats exist, the public and public policy leaders also know that pollution kills fish, limits visibility, creates foul stench, ruins lakes and rivers, degrades recreational areas, and endangers plant and animal life.^{8,9}

The report of the U.S. Environmental Protection Agency's Science Advisory Board, *Reducing Risk: Setting Priorities and Strategies for Environmental Protection*, states:

... there is no doubt that over time the quality of human life declines as the quality of natural ecosystems declines ... over the past 20 years and especially over the past decade, EPA has paid too little attention to natural ecosystems. The Agency has considered the protection of public health to be its primary mission, and it has been less concerned about risks posed to ecosystems... EPA's response to human health risks as compared to ecological risks is inappropriate, because, in the real world, there is little distinction between the two. Over the long term, ecological degradation either directly or indirectly degrades human health and the economy... human health and welfare ultimately rely upon the life support systems and natural resources provided by healthy ecosystems.¹⁰

Mission

Environmental health and protection agencies should have missions of administering services in such a manner as to protect the health of the public and the quality of the environment.

Additionally, environmental health and protection administrators should stimulate interest in related areas in which they may not have primary responsibility. For example, it may be desirable to support and promote such environmental health and protection-related activities as long range community planning, recycling programs, zoning ordinances, plumbing codes, building codes, solid waste systems, economic development, energy conservation, land-use, and transportation systems.

Agencies such as agriculture departments have obvious and appropriate missions of promoting and protecting specific industries or segments of public interest. Conflicts of interest occur when missions are mixed, thereby resulting in the familiar "fox in the hen house" syndrome. Such conflicts of interest result in the public being defrauded rather than receiving the protection they deserve. If environmental health and protection administrators do not articulate and adhere to a mission of protecting the health of the public and the quality of the environment, they may end up inadvertently protecting or promoting the interests of those they are charged with regulating.

Goal

The goal of environmental health and protection is to ensure an environment that will provide optimal public health and safety, ecological well-being, and quality of life for this and future generations.

We do not live in a risk-free society or environment. Therefore, the goal for many environmental health and protection program administration is not always be "zero-risk." The pursuit of zero-risk as a standard or goal is frequently unnecessary, economically impractical, frequently unattainable, and may create unfounded public concern when zero-risk is not attained. The pursuit of zero-risk as a goal for one issue may also preclude resource availability to deal with other priorities.

The public is barraged with "catastrophe-of-the-week" information regarding environmental risk coupled with a paucity of critical scientific inquiry. Administrators should recognize that there would be many times the actual morbidity and mortality if all the predicted catastrophes were factual. And finally,

administrators should be scientifically critical, routinely questioning existing policies, standards, and regulations as well as proposals to insure that all measures reflect scientifically valid priorities and needs.

Risk Assessment, Communication, Management and Prioritization

Risk Assessment

Considering the serious differences in perceived priorities between scientists and those of the public and political leaders, risk assessment must be considered an administrative issue to be understood and practiced by all interests involved in protecting the health of the public and the quality of the environment.

The U.S Environmental Protection Agency's Science Advisory Board has defined risk assessment as the process by which the form, dimension, and characteristics of risk are estimated.¹¹ Utilizing sound scientific principles to assess risk is vital to communicating risk, recommending priorities, designing and administering risk management programs, requesting funds, and evaluating control efforts. However, the results of risk assessment models may vary considerably depending on the assumptions, data and models utilized. Serious debate continues over the validity of risk assessment models and methods. Such differences may be confusing to public policy makers, and may create a credibility gap concerning risk assessment as a useful process.

Many agencies have developed models which utilize the following risk assessment components:

- Hazard identification to determine the health, ecological, economic, or quality of life effects of a substance, activity, or problem.
- Exposure assessment to evaluate the routes, media, magnitudes, time and duration of actual or anticipated exposure, and of anticipated exposures, as well as the number of people, species, and/or areas exposed.

- Amount or dose-response assessment to estimate the relationship between the amount of the substance and the incidence of adverse effects.
- Risk characterization to estimate the probable incidence of an adverse effect under various conditions of exposure, including a description of the uncertainties involved.

Risk assessment has always been utilized informally and even intuitively by public policy makers and environmental health and protection administrators. Utilizing risk assessment mathematical models has been a comparatively recent development. Whenever a decision or recommendation has been made to develop a policy or manage an environmental problem based on available information, a risk assessment has been performed. Frequently, environmental health and protection administrators must make major emergency decisions based on incomplete but compelling information without having the luxury of waiting until incontrovertible evidence is available.¹² This practice is performed daily by environmental health and protection personnel charged with managing such risks as food, water, air, radiation, toxics, noise, and unintentional injuries.

Most mathematical health risk assessment models have been developed to determine carcinogenic outcomes. Current models reflect single-agent exposure assessment. New models must be developed to assess effects of multiple incidents of exposures and multiple agents. Increasingly, researchers and practitioners are finding it necessary to develop knowledge and models to determine other types of health and ecological outcomes of various environmental exposures. Besides carcinogenicity, the health outcomes might include mutations, teratogenicity, altered reproductive function, mental health, neuro-behavioral toxicity and other specific organ systems.

Risk assessments generally follow the most conservative estimates which can be defended. The uncertainties in the degree of risk are frequently significant, and many issues in risk assessment can only be determined judgmentally. It has been shown that by taking nearly all relevant information about the

test chemicals into consideration, a group of scientists correctly predicted the outcome at a higher success rate than computer-assisted models.¹³ Risk assessment remains as much an art as a science, and risk assessment models need significant improvement.

Personnel involved in risk assessment procedures rely on knowledge and skills gleaned from such fields as chemistry, epidemiology, toxicology, biology, engineering, geology, hydrology, statistics, meteorology and physics. The practice of risk assessment is, therefore, multidisciplinary and interdisciplinary in nature. Risk assessment procedures are commonly practiced by a team of individuals representing a spectrum of required competencies.

Many individuals and agencies have recommended developing a uniform model for risk assessment. Others feel this would prevent needed improvements in the available models and would retard progress in risk assessment procedures and public acceptance.

While risk assessment modeling is practiced to some degree by all environmental health and protection agencies, many feel that formal risk assessment should be separate from environmental risk management programs in order to reduce possible politicization of the process.

Interesting case studies iterating the politicization of several EPA standards and policies are detailed in the book The Environmental Protection Agency: Asking the Wrong Questions.¹⁴

The U.S. Office of Management and Budget has noted that "The need to keep risk assessment and risk management separate has long been the objective of responsible officials."¹⁵ The National Institute of Medicine (IOM) in its report The Future of Public Health recommends "there should be an institutional home in each state and at the federal level for development and dissemination of knowledge, including research and the provision of technical assistance to lower levels of government and to academic institutions and voluntary organizations." The U.S. Public Health Service Bureau of Health Professions publication Educating Environmental Health Science and Protection Professionals

recommends that the foregoing "IOM and OMB recommendations could best be accomplished by providing start-up financial incentives for each state to organize and staff an Environmental Health Science and Protection Research and Service Institute within a university. By insuring good environmental epidemiology and risk assessment studies specific to each state, environmental health science and protection issues would be better defined and prioritized. In such a system, program funding could address science based recommendations rather than public hysteria. By basing such institutions in academic settings and separating them from operating agencies, emotionalism would be alleviated." The Report of The Committee on the Future of Environmental Health¹⁶ recommends that "Environmental health and protection research institutes should be established in each state to ensure timely research that addresses local and regional issues."

Risk assessment is only one of the factors to be used to determine priorities. Other vital considerations include public health assessments, social factors, economic factors, political factors, technical feasibility, and community expectations.

Few jurisdictions have adequate multidisciplinary capacity to conduct and implement risk based decision-making and risk management¹⁷. Increasingly, educational programs for environmental health and protection personnel are requiring formal risk assessment and risk communication course content. Programs accredited by the National Environmental Health Science and Protection Accreditation Council are now required to include risk assessment and risk communication as educational competencies.

Training in risk assessment and risk communication procedures is available through various short courses and institutes sponsored by various universities, professional groups, EPA and the U.S. Public Health Service.

Public Health Assessment

The Agency for Toxic Substances and Disease Registry has developed and emphasized the use of public health assessments in an effort to better measure public health problems and develop realistic solutions. Such public health assessments are increasingly being used to evaluate human health risk. They provide compelling alternatives to risk assessments, as they provide direct measures of human exposures rather than the hypothetical and statistical findings of risk assessments. Public health assessments are based on the data from representative biologic samples and personal monitoring and, therefore, are targeted at actions directly related to the exposure. Public health assessments have enhanced interactions with individuals and communities, and have improved public health decisions and actions.¹⁸

Risk Communication

Risk communication is the process of communicating risk with the public, including community groups, the private sector, the media and public policy leaders. In the absence of timely and effective risk communication, risk assessment is merely academic. The utilization of risk assessment inherently requires effective risk communication if findings are to be utilized. Administrators must not confuse official pronouncements and the distribution of public information materials with the art of risk communication.

Environmental health and protection administrators must develop and demonstrate effective risk communication skills. Lack of such communication results in priorities and policies that differ considerably from those based on good environmental health and protection science. Effective risk communication requires complete openness throughout the planning and decision process, as well as embracing, including and involving appropriate groups. Failures in risk communication are frequently linked to the failure to involve the public early and openly discuss the needs, assumptions, alternatives, and data on which problems have been assessed and public health assessments conducted¹⁹. Risk

communication, like risk assessment, is multidisciplinary and interdisciplinary involving the such disciplines as sociologists, political scientists, educators, and marketing professionals.

Effective risk communication requires a continuing relationship with the public even in the absence of risk communication crises. Risk communication on a single-issue crisis basis is doomed to be less than optimal.

Risk Management

Risk management constitutes those measures designed to deal with risk which has been assessed. Most environmental managers and agencies routinely operate to manage risk, but may not use that terminology. Risk management is the process of integrating the results of risk assessment with economic, social, political and legal concerns to develop a course of action to prevent a problem, or solve an existing problem. Risk management methodologies include such measures as those listed on page 5 ? of this chapter.

The issue of how risk is assessed, communicated and managed is among the most critical environmental problems faced by society. Public perception drives the actions of elected officials. However, public perception of environmental priorities and problems frequently differs from that of environmental scientists. We do not live in a zero-risk society, and it is essential that limited resources be utilized to address the higher priority problems. The environment and the health of the public will be best served by prioritizing problems based on the best of risk assessment measures and experienced professional judgment, coupled with effective risk communication and risk management.

Prioritization

Globally, priority environmental health and protection issues include species extinction; wastes; desertification; deforestation; global warming and stratospheric ozone depletion; planetary toxification; and, most importantly, over-population.²⁰

Congress, as well as state and local legislative bodies, has authorized and funded our nation's various environmental health and protection programs with little regard for risk, relative risk or priority. A December 1991 survey entitled "The Health Scientist Survey: Identifying Consensus on Assessing Human Health Risk", conducted by the Institute for Regulatory Policy of nearly 1,300 professionals in the fields of epidemiology, toxicology, medicine and other health sciences, indicated that over eighty-one percent (81%) of the professionals surveyed believed that public health dollars for reduction of environmental health risk were improperly targeted²¹. For many years, the U.S Environmental Protection Agency (EPA) and many other federal, state and local agencies have been attempting to request and allocate resources on the basis of relative risk, and EPA is now placing increased emphasis on ecological risk²².

A Roper poll determined that, in terms of public perception, at least 20 percent of the U.S. public considered hazardous waste sites to be the most significant environmental issue. At the same time, the report of EPA's Science Advisory Board, *Reducing Risk: Setting Priorities and Strategies for Environmental Protection*, listed ambient air pollution, worker exposure to chemicals, indoor pollution and drinking water pollutants as the major risks to human health. While not EPA programs, food protection, unintentional injuries, and childhood lead poisoning (in specified areas) should be added to this list by any reasonable public health priority.

As risks to the natural ecology and human welfare, *Reducing Risk* listed habitat alteration and destruction; species extinction and overall loss of biological diversity; stratospheric ozone depletion; global climate change; herbicides/pesticides; toxics, nutrients, biochemical oxygen demand and turbidity in surface waters; acid deposition; and airborne toxics. Among relatively low risks to the natural ecology and human welfare, the list also included oil spills, groundwater pollution, radionuclides, acid runoff to surface waters, and thermal pollution.

Priorities at the local levels may vary considerably, but should be based on public health assessments, epidemiology, community risk assessment, cost-benefit analysis, and public demands, as well as legislative delegation of responsibilities.

Organizations

Federal Agencies

In addition to the U.S. Environmental Protection Agency, other significant federal environmental health and protection agencies include the Occupational Safety and Health Administration of the U.S. Department of Labor, the U.S. Public Health Service (including the National Institute of Environmental Health Sciences, the Centers for Disease Control and Prevention, the Indian Health Service, the Food and Drug Administration, the Agency for Toxic Substances and Disease Registry, and the National Institute for Environmental Health and Safety), the U.S. Coast Guard, the Geological Survey, the National Oceanographic and Atmospheric Administration, the Nuclear Regulatory Commission, the Corps of Engineers; and the Departments of Transportation, Agriculture, and Housing and Urban Development.

State Agencies

A study conducted by the Johns Hopkins School of Public Health under contract with the USPHS Bureau of Health Professions, revealed that at least 85% of state level environmental health and protection activities were being administered by environmental health and protection agencies other than state health departments.²³ Every state indicated that multiple agencies were involved in environmental health and protection activities. Data from the Hopkins study, coupled with data published by the Public Health Foundation²⁴, also suggest that states spend approximately as much on environmental health and protection as they do on all other public health activities combined. Another study conducted by the University of Texas School of Public Health leads to similar conclusions.²⁵ It is clear that environmental

health and protection is the largest single component of the field of public health. Regardless of titles, environmental health and protection agencies are components of the broad field of public health as their programs fall within any common definition (see pg.4) of environmental health and protection and are based on achieving public health goals. Such agencies have various titles such as environment, environmental protection, ecology, labor, agriculture, environmental quality, natural resources, and pollution control.

In general, state environmental health and protection agencies are apt to have responsibility for administering water pollution control, air pollution control, solid waste management, public water supplies, meat inspection, occupational health and safety, pesticide regulation, and radiation protection.²⁶

Local Agencies

The majority of local environmental health and protection administration remains the responsibility of local health departments, but there is a trend to assign various responsibilities to local agencies other than health departments. Local activities tend to differ from those assigned state agencies, and focus on such programs as food protection, swimming pool inspection, lead in the environment, on-site liquid waste disposal, groundwater contamination, asbestos surveillance, water supplies, animal/vector control, radon testing, illegal dumping, hazardous materials spills, emergency response planning, health impact statements, and nuisance abatement. A few local jurisdictions administer comprehensive indoor and ambient air pollution control programs. Some local health departments indicate activities in water pollution control, solid waste management, radiation control, and hazardous waste management.^{27, 28}

Most local governments have assigned certain environmental health and protection administration to agencies such as public works, housing, planning, councils of government, solid waste

management, special purpose districts, and regional authorities.²⁹

Federal, State, or Local?

Environmental health and protection services should be administered as close to the people as possible. Local agencies can do a better job of protecting the local environment than can a distant bureaucracy.³⁰ There are, however, certain issues that have defined the responsible levels of government. These include:

- Problems of an interstate nature such as interstate protection of food and food products, interstate solid and hazardous wastes transportation, interstate water pollution control, interstate pesticide regulation, interstate air pollution resolution are administered by appropriate federal agencies.
- The federal government has retained partial or sole authority to administer many activities that have been federally mandated or funded including, but not limited to, certain aspects of radioactive waste management, water pollution control and facilities construction, air pollution control, meat inspection, occupational safety and health, and safe drinking water. State and local governments have frequently accepted primacy for administering some of these activities subject to adhering to federal requirements.
- State agencies or special districts may find it easier to administer certain issues on a problem-shed basis rather than on a limited local jurisdiction basis. Examples include water pollution control, air pollution control, solid waste management, and milk sanitation.
- In sparsely populated states as well as rural areas of some other states, the state agency may exercise direct administrative authority in all program areas.
- Many state agencies provide technical and consultative support to local environmental health and protection agencies.

- State agencies, as well as federal agencies, may develop criteria, standards, and model legislation for state and/or local adoption.
- State agencies administer state and federal grant-in-aid funds for local agencies.
- There may be a conflict of interest situation when local environmental health and protection agencies attempt to regulate local government proprietary functions such as public water supplies, solid waste disposal, and sewage treatment.
- Smaller local agencies may not have expertise in certain specialized areas such as epidemiology, toxicology, public health assessment, and risk assessment.

The trend to organizationally diversify environmental health and protection programs will continue in response to the priority of environmental health and protection, the demands of environmental advocates, and the trend for many health departments to become significantly involved in health care to the detriment of environmental health and protection and other public health priorities. It is unrealistic to develop programmatic relationships between water pollution control, for example, and any one of a number of health care (treatment and rehabilitation) programs. Increased health care responsibilities of federal, state, and local health departments may translate into inadequate understanding, leadership and priority for environmental health and protection within health departments.³¹ Additionally, health departments find it difficult to deal with the ecological aspects of environmental health and protection.

Such organizational diversification does not mean that environmental health and protection programs are no longer basic components of the field of public health. While each community or state has only one health department, every community and state has several other public health agencies including numerous environmental health and protection agencies.

Academic institutions preparing students for environmental health and protection careers should

orient students striving for leadership roles in the multitude of agencies involved. Public health leaders should help assure that the programs administered by such agencies are comprehensive in scope; based on sound epidemiology, toxicology, public health assessment, and risk assessment data; and help ensure that they have adequate legal, fiscal, laboratory, epidemiological and other support resources to be effective.

Program Design

An environmental health and protection program is a rational grouping of activities designed to solve one or more problems. See Page 6?

Problems must be accurately defined as to cause, time of day or season, geographic area, nature, intensity, and public health and environmental effects prior to designing the program. Program design must stand the scrutiny of critical evaluation to ensure that the design will prevent or solve the problem(s) in an economical and societally acceptable manner.

The net health, environmental, social, and economic impacts of proposed requirements must be thoroughly evaluated prior to implementation. One seemingly desirable measure may result in undesirable problems of a more serious nature than the problem for which the program was intended.

Most environmental health and protection programs have been developed to address a single problem. This has led to unnecessary inefficiencies and ineffectiveness along with poor utilization of personnel and other resources. Properly designed, a program can address components of several environmental problems. This design practice is common in such programs as food protection, institutional environmental control, environmental control of recreational areas, and industrial hygiene and safety.

Program Support

All organizations require such administrative support elements as fiscal, audit, purchasing,

budget, and personnel. A number of additional support functions are essential to the administration of environmental health and protection services.

Laboratory

Comprehensive laboratory support must be available in quantity and quality for epidemiological investigations, public health assessment, risk assessment, determining environmental trends and needs, developing standards and regulations, enforcement, public information, and program design. Such services are available through public health laboratories, environmental laboratories, pollution control laboratories, agriculture laboratories or, in a few jurisdictions, comprehensive laboratories serving various governmental agencies. At the federal level, more specialized services may be requested from the Centers for Disease Control and Prevention, the Environmental Protection Agency, and the Food and Drug Administration.

Epidemiology

Environmental epidemiology is a specialized epidemiological function which deals with extrapolations and correlations as well as direct cause-and-effect investigations. Early day environmental health practice was geared primarily to communicable disease problems. Now, it also embraces the impacts of increasing amounts, types, and combinations of non-living contaminants and other stresses. Such impacts are more subtle and long range in their effects. There is greater difficulty in measuring effects as well as in precisely isolating and understanding the cause(s).

Some state and local environmental health and protection agencies do not have in-house epidemiological support and must receive such services through another agency, usually a health department. Sound environmental surveillance data and epidemiology are essential to determine needs, trends, priorities, and to design effective programs.

Legal

Environmental health and protection programs are authorized by legislative bodies at various levels of government, and provide for legal remedies when other efforts do not provide for compliance with specified requirements. When regulatory remedies are pursued, the advice, support and involvement of legal counsel is desirable.

Many environmental health and protection agencies have specialized environmental law attorneys. Others may request assistance through the office of a city or county attorney, a state attorney general, or the U.S. Department of Justice, depending on the type of requirement(s). The involvement of a skilled legal draft person is also essential when legislation is being drafted.

Public Information and Education

Environmental health and protection is the public's business, and will not be properly understood or supported in the absence of continuing public information and educational activities. While all environmental health and protection administrators should be involved in these activities, it is appropriate that the agency utilize staff specifically skilled in assuring a free flow of information and the attainment of new skills by the public, including the news media, target groups, citizen groups, professional groups, elected officials, and other agencies involved in the field of environmental health and protection.

Research

Environmental health and protection programs cannot be properly justified, prioritized, budgeted, designed, implemented or administered without the benefits of peer reviewed research. Research is essential to the development of new methodologies for preventing and controlling problems, environmental remediation, analyses, and educating target groups.

Most operating agencies and practitioners are not well equipped to conduct research, but should be vital participants in the processes of identifying research needs and routinely communicating these needs to appropriate research institutions. The knowledge and skills of practitioners will be

enhanced through continuing communication and coalitions with academic programs and individuals involved in environmental health and protection education and research.

Data

Environmental health and protection surveillance and status data are currently inadequate. These data should include environmentally related morbidity and mortality, specified environmental contaminant and pollution levels, and other environmental/ecological conditions.

State-of-the art environmental health and protection information systems would enhance the level of informed administration at all levels of government and industry.³²

Fiscal Support

Environmental health and protection administrators are finding it necessary to be creative in funding services. Activities must be evaluated and prioritized to address the more significant priorities within the jurisdiction. Where additional general fund support is not available, administrators must consider reallocating budgets from lower priority activities, or developing new sources of revenue such as fees for service and/or pollution taxes and other market based incentives.

Prioritizing funding requests requires the best skills in administration, epidemiology, public health assessments, toxicology, and risk assessment. Developing creative funding mechanisms will require that administrators have basic knowledge and skills in public financing and environmental economics. Marketing such budget requests requires competencies in marketing, communication, and public policy development.

The Primacy of Prevention

EPA's Science Advisory Board publication *Reducing Risk* states:

...end-of-pipe controls and waste disposal should be the last line of environmental defense, not the front line. Preventing pollution at its source - through the redesign of

production processes, the substitution of less toxic production materials, the screening of new chemicals and technologies before they are introduced into commerce, energy and water conservation, the development of less-polluting transportation systems and farming practices, etc. - is usually a far cheaper, more effective way to reduce environmental risk, especially over the long term...

Pollution prevention also minimizes environmental problems that are caused through a variety of exposures. For example, substituting a non-toxic for a toxic agent reduces exposures to workers producing and using the agent at the same time as it reduces exposures through surface water, groundwater, and the air.

Pollution prevention also is preferable to end-of-pipe controls that often cause environmental problems of their own. Air pollutants captured in industrial smokestacks and deposited in landfills can contribute to groundwater pollution; stripping toxic chemicals out of groundwater, and combusting solid and hazardous wastes, can contribute to air pollution. Pollution prevention techniques are especially promising because they do not move pollutants from one environmental medium to another, as is often the case with end-of-pipe controls. Rather, the pollutants are not generated in the first place.³³

Planning for Environmental Health and Protection

Environmental health and protection planning (as differed from program planning) is a fundamental prevention function. While environmental health and protection should be grounded on prevention, a preponderance of efforts and funds are currently devoted to remediation of contamination and pollution created as a result of earlier actions taken by other interests in the public and private sectors.

Environmental health and protection administrators must have the knowledge, skills and authority to become effectively involved in prevention during the planning, design and construction stages of energy development and production, land use, transportation methods and systems, facilities, resource development and utilization, and product design and development. Developing the capacity and authority to function effectively in environmental health and protection planning is necessary for environmental health and protection administrators strive to function in a primary prevention mode, rather than secondary prevention or treatment of the environment after the contamination or pollution has been produced and emitted.

Building and Traveling Bridges

Effective environmental health and protection administration depends on developing and utilizing constantly traveled communication bridges and network processes connecting a wide variety of groups and agencies involved in the struggle for a quality environment and enhanced public health. A few such interests include land use, energy production, transportation, resource development, the medical community, public works officials, agriculture, conservation, engineering, architecture, colleges and universities, economic development, chambers of commerce, environmental groups, trade and industry groups, and elected officials. These relationships should be dictated by organizational policy rather than being left to chance or personalities.

Personnel Requirements

Environmental health and protection, like other components of public health, is not a profession or a discipline. It is a cause and a field engaged in by a wide array of personnel practicing within a broad and diverse spectrum of individuals, groups, and agencies.

The field of environmental health and protection requires the involvement of scores of disciplines as well as interdisciplinarily trained personnel. Personnel function in roles ranging from routine inspection

and surveillance levels through administration, policy, education and research components. Depending on the type of agency and sophistication of programs, effective efforts demands an alliance of physical scientists, life scientists, social scientists, educators, physicians, environmental scientists, engineers, data specialists, planners, administrators, laboratory scientists, veterinarians, attorneys, economists, political scientists, and others in order to fully utilize the variety of environmental health and protection activities.

Environmental health and protection personnel may be grouped as environmental health and protection professionals, and professionals in environmental health and protection.³⁴

Environmental health and protection professionals are those who have been educated in the various environmental health and protection technical areas, as well as in epidemiology, biostatistics, toxicology, administration and public policy, risk assessment, communication, public health assessment, risk management, environmental law, and environmental finance. For the most part, such professionals are graduates of environmental health science and protection programs accredited by the National Environmental Health Science and Protection Accreditation Council^{35, 36}, or of schools or programs accredited by the Council on Education for Public Health.³⁷

Professionals in environmental health and protection include other essential professionals and disciplines such as epidemiologists, biostatiticians, toxicologists, chemists, hydrologists, geologists, biologists, physicians, attorneys, administrators, economists, political scientists, educators, engineers, meteorologists, and social scientists.

The 1990 EPA Science Advisory Board publication, *Reducing Risk*, states that:

The nation is facing a shortage of environmental scientists and engineers needed to cope with environmental problems today and in the future. Moreover, professionals today need continuing education and training to help them understand the complex control technologies and pollution prevention strategies needed to reduce environmental

risks more effectively.

....Most environmental officials have been trained in a subset of environmental problems, such as air pollution, water pollution or waste disposal. But they have not been trained to assist and respond to environmental problems in an integrated and comprehensive way. Moreover, few have been taught to anticipate and prevent pollution from occurring or to utilize risk reduction tools beyond command-and-control regulations. This narrow focus is not very effective in the face of intermedia problems that have emerged over the past two decades and that are projected for the future.

Competencies for environmental health and protection professionals as practitioners should include:^{38, 39}

- relevant environmental health and protection sciences such as biology, chemistry, physics, geology, ecology and toxicology
- environmental health and protection technical issues
- epidemiology and biostatistics
- etiology of environmentally induced diseases
- risk assessment
- public health assessment
- risk communication
- risk management
- marketing
- interest group interactions
- personnel, financial, and program administration
- organizational behavior

- public policy development and implementation
- planning for environmental health and protection
- cultural issues
- strategic planning
- fiscal impacts of environmental health and protection
- environmental health and protection law
- organizational diversity
- political processes

Continuing Education

Continuing education is an essential component of a career, not only to be effective, but personnel learn more readily as they encounter specific needs. Such continuing environmental health and protection education should be budgeted, timely, relevant, economical and convenient, as well as strongly supported by management.

The Future

Environmental health and protection administration will continue to assume a higher priority in our society, and the public will expect and demand greater levels of protection.

Demographic changes, resource development and consumption, product and materials manufacture and utilization, wastes, global environmental deterioration, technological development, changing patterns of land use, transportation methodologies, energy development and utilization, and continuing diversification of environmental health and protection efforts will create additional and unanticipated challenges. The competencies of properly prepared environmental health and protection administrators will be critical.

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