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Recognizing and Preventing Occupational and Environmental Disease and Injury

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A woman complaining of headache and vomiting visited an urgent care center, where she was diagnosed with a viral syndrome and treated symptomatically. She and her husband and three children returned the following night with the same symptoms and were diagnosed with carbon monoxide poisoning. Inspection of their home revealed a faulty furnace.

A woman sought medical attention for a painful right knee. The physician prescribed diet and exercise with no improvement. At a follow-up visit, she announced that her problem had resolved after a co-worker showed her how to pad the knee-operated pedal on her sewing machine at work.

Orders for lead-containing chemical products from a factory increased when its competitor went out of business. As production increased, physicians found an increased number of workers with high blood lead levels (BLLs), removed them from work using the Occupational Safety and Health Administration (OSHA) Lead Standard, and returned them to work only after their BLLs declined. Several workers went through this cycle repeatedly. Some workers' children had elevated BLLs on routine testing by their pediatricians.

In the same factory, in response to an OSHA inspection, an overhead exhaust hood was installed in the room where workers opened bags of inorganic lead to feed into a hopper to be mixed into a final product. The purpose of the hood was to provide local exhaust ventilation to capture and remove lead dust from the workers' breathing zones. The workers had been using a table to hold the bags before opening them and dumping them; with the new hood, there was no room for the table, and bags were instead placed on and lifted from the floor. The number of back injuries resulting in lost work time increased.

In a mining town, occupational health investigations conducted in the 1980s revealed asbestos-related diseases and deaths among workers who mined and processed asbestos-containing vermiculite ore. These workplace deaths were not seen as sentinel health events. Vermiculite waste was not controlled until deaths from mesothelioma were reported in community residents in the 1990s.

Recognizing an occupational or environmental illness and injury requires characterizing a specific health outcome, identifying a hazardous exposure, and determining a relationship between exposure and outcome. Once this relationship has been established, interventions can be developed that will interrupt the causal pathway, thereby preventing illness and injury—the goal of occupational and environmental health and safety. Since illnesses and injuries may be

difficult or impossible to treat or may result in complications, it is best to identify a problem early, when the affected person may be treated effectively and when other people at work and in the community can be protected.

The five examples at the start of this chapter demonstrate how occupational or environmental illnesses may fail to be recognized and opportunities for prevention may be missed. These examples highlight common themes, such as the need for better communication and feedback.

RECOGNIZING OCCUPATIONAL AND ENVIRONMENTAL DISEASES AND INJURIES

Occupational and environmental diseases and injuries can be recognized at the individual level, which depends on obtaining and assessing an occupational and environmental history, as discussed in the following section. In addition, occupational and environmental diseases and injuries can be recognized by surveillance at the population level, as discussed briefly later in this chapter and more thoroughly in Chapter 3.

The Occupational and Environmental History

Obtaining an occupational and environmental history helps a clinician to understand patients in the context of their lives; design anticipatory guidance; provide specific advice about work, community, or home exposures; and diagnose symptomatic individuals.

Consider the following five cases:

1. An emergency medicine physician diagnosed acute alcohol intoxication in a machinist who developed loss of balance at work.
2. A primary care physician diagnosed a garment worker's finger numbness and weakness as an exacerbation of her rheumatoid arthritis.
3. An internist diagnosed the worsening chronic cough of a man working at a bottle-making factory as a side effect of his antihypertensive medication.
4. A physician attributed a young boy's learning difficulties in school to borderline mental retardation.
5. A pediatrician concluded that a young girl's asthma exacerbation was caused by a viral infection.

In each of these cases, the facts fit together and resulted in a coherent story, leading each physician to recommend a specific therapeutic and preventive regimen. But, in each case, the physician made an inadequate or incorrect diagnosis because of a common oversight—failure to take an occupational and environmental history.

The first patient had acute central nervous system (CNS) intoxication caused by exposure to organic solvents at work.

The garment worker had carpal tunnel syndrome, possibly caused by some combination of her rheumatoid arthritis and the strenuous repetitive movements she performed with her hands and wrists hundreds of times an hour.

The man working in the bottle-making factory had worsening of his chronic cough and other respiratory tract symptoms as a result of occupational exposure to hydrochloric acid fumes.

The young boy had lead poisoning due to inhalation of dust from leaded paint in his home.

And the young girl had exacerbation of her asthma caused by allergy to mold growing in the basement of her home as a result of water damage.

The associations noted by the physicians may have contributed to causing the second and fifth cases. But without an occupational and environmental history, appropriate treatment and prevention could not have been performed. Although a physical examination and laboratory tests may raise suspicion or help confirm that a medical problem is related to occupational or environmental factors, identification of occupational and environmental health problems depends most importantly on the occupational and environmental history.

What Questions to Ask

The occupational and environmental history is outlined in Table 2-1. Most clinical situations do not require obtaining complete histories.

Table 2-1. Outline of the Occupational and Environmental History

Components	Specific Questions and Issues
Description of all jobs held	Obtain information on employers, details of jobs, and starting and ending dates of each job. Ask about second jobs, work in the home as a homemaker or parent, military service, and part-time and summer jobs. Ask worker to describe typical work shift. Ask worker to simulate performance of work tasks by demonstrating body movements associated with them. (Visiting the workplace may be necessary.) Obtain information on routine tasks as well as unusual and overtime tasks, such as cleaning out tanks or cleaning up spills.
Exposures	Ask about chemical, physical, biomechanical, biological, and psychosocial exposures at workplaces. Start with open-ended questions, such as "What have you worked with?" Follow with specific questions, such as "Were you ever exposed to lead or other heavy metals? To solvents? To asbestos?" Obtain material safety data sheets (MSDSs) for workplace chemicals. Ask about tasks performed in adjacent areas of the workplace that may contribute to a worker's exposure. Ask about unusual incidents, such as spills of hazardous materials, work in confined spaces (Fig. 2-1), use of new substances, and changed processes at work. Quantify exposures to the extent feasible, usually by estimating concentration and determining duration of exposure and route of entry. Check for the presence of protective engineering systems and devices, such as ventilation systems, and whether they seem to function adequately. Check for the use of personal protective equipment, such as gloves, work clothes, masks, respirators, and hearing protectors. Ask about eating, drinking, and smoking in the workplace (Fig. 2-2). Ask about hand washing and showering at work, changing of work clothes, and who cleans the work clothes.
Timing of symptoms	What is the time course of symptoms in relation to exposures? When do symptoms begin and end in relation to work shifts? Are symptoms present during weekends and vacation periods? Are symptoms related to certain processes, work tasks, or work exposures?
Symptoms among co-workers	Are there other workers at the same workplace or in similar jobs elsewhere who have the same symptoms or illnesses? If there are people similarly affected, find out what they may share in common.
Present and prior residences	List all the places where you have lived and the periods when you lived at each place. Have you ever lived near any of the following: *(a)* an industrial facility that may be polluting the air, surface or ground water, or the soil; *(b)* a hazardous waste site; and *(c)* a farm where pesticides or herbicides may have been applied.
Jobs of household members	Ask if workplace contaminants, such as lead, may have been brought into the home. Ask if children have been brought to the worksite, such as occurs frequently for farm work.
Environmental tobacco smoke	Do you share your home, car, or other environment with a smoker?
Lead exposure history	Have you ever lived in a home built before 1978? Have you known anyone who has had lead poisoning? (If yes, please provide additional information.) Is lead present in pipes in your home or supplying water to your home? Is there imported pottery in your home? Do you use folk remedies that may contain lead?
Home insulating, heating, and cooking	What type of fuel do you use for heating or cooking in your home? What type of insulation do you have in your home? Is your stove properly ventilated?
Household building materials	What type of materials is your home made of?
Home cleaning agents and other household products	What type of cleaning agents and other household products do you use in your home?

(*Continued*)

Table 2-1. Outline of the Occupational and Environmental History (Continued)

Components	Specific Questions and Issues
Presence of pests, mold, pets, dust in the home	Do you have dust mites or cockroaches in your home? Do you have growth of mold in your home? Is there evidence of water damage in your home? What type of carpeting do you have in your home? What pets do you have in your home?
Pesticide usage	What types of insecticides, herbicides, or other pesticides have you used in or near your home?
Water supply	What is the source of water for your home?
	If you have a private well, when was it last tested and what were the results?
Foodborne illness	What food was eaten in the time period just before onset of illness?
Renovation/remodeling	Has your home recently been renovated or remodeled?
Air contamination	Are you concerned about contamination or pollution of the air in or near your home? (If yes, please describe.)
Hobbies	What hobbies do you or other household members have?
	Do any of these hobbies cause contamination of the air or other hazards?
Recreational history	Have you been exposed to any hazards in recreational activities, such as swimming in polluted bodies of water?
Travel	Please describe any recent travel.



Figure 2-1. Many jobs require work in confined spaces, which requires specialized training and procedures, which are specified in the OSHA standard on Permit-required Confined Spaces (1910.146) (Photograph by Earl Dotter.)



Figure 2-2. Workers eating in the workplace may ingest toxic substances. (Photograph by Earl Dotter.)

But patients should always be asked what work they do. Health professionals need to exercise judgment in choosing which questions to ask. For a comprehensive medical examination, however, a question or two in the psychosocial section of the medical history is not enough; the clinician should obtain information, as deemed appropriate, on current and major past occupations of patients as well as information on residential and other environmental exposures. The extent of detail depends largely on the clinician's level of suspicion that occupational or environmental factors may have caused or contributed to the patient's illness. The occupational history should always contain sufficient detail to understand how patients spend their workdays and to determine safety and health hazards, including any potentially hazardous chemical, physical, biomechanical, biological, or psychological exposures.

Some hospitals and clinics have standardized forms for occupational and environmental histories, which can facilitate obtaining and recording this information. Ideally, such forms should include *(a)* a grid with column headings for employer, job title, primary job tasks, dates of starting and stopping the job, and major work exposures (Fig. 2-3); and *(b)* a series of questions on environmental exposures. It may be helpful to ask questions, from a list prepared in advance, about whether the patient has had any exposures to specific hazardous substances or physical factors, such as noise or ionizing radiation.

Further elaboration on each of the key parts of the occupational and environmental history may be helpful, especially when *(a)* the patient raises concerns about potential exposures, *(b)* the clinician needs to further evaluate exposures of concern, *(c)* organ systems that are commonly associated with exposure are adversely affected, or *(d)* the diagnosis remains unclear.

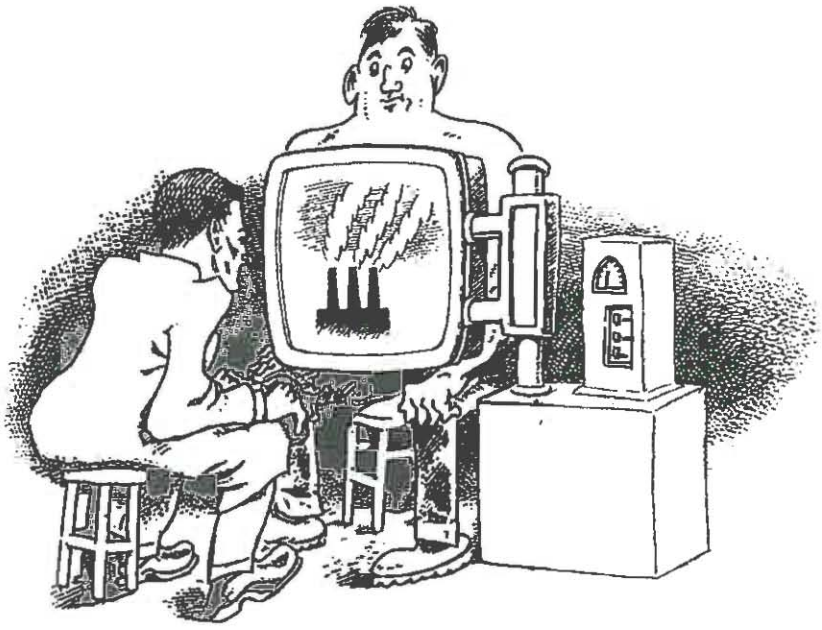
Sometimes there is an additive or synergistic relationship between occupational and/or environmental factors in causing disease. The clinician should ask whether the patient smokes cigarettes—or is exposed to environmental tobacco smoke, or drinks alcohol; if so, amount and duration should be quantified. For skin problems, questions should be asked regarding recent exposure to new soaps, new cosmetics, or new clothes.

One should determine whether the worker has had preplacement or periodic physical and laboratory examinations at work. For example, preplacement audiograms or pulmonary function tests may suggest the presence of occupational risk and may be helpful in determining whether hearing impairment or respiratory symptoms are work-related. Because OSHA regulations mandate periodic screening of workers with certain exposures, such as loud noise and asbestos, and because many employers voluntarily provide screening tests at work, such information may be available to a clinician, if the worker approves its release.

Finally, one should ask the worker if there is some reason to suspect that symptoms may be related to identified exposures, if the person

Employer	Job title	Primary job tasks	Start	End	Work exposures
ELECTRICIANS UNION	STEWARD	REPRESENT WORKERS	6/07	→	JOB STRESS
BRIGHT EXTERIORS	PAINTER	SPRAY PAINT, SCRAPE OFF OLD PAINT	12/99	9/07	PAINT, THINNERS, LEAD
XYZ FOUNDRY	LABORER	CAST METAL	11/98	10/99	LEAD, SILICA DUST, NOISE
TOWN OF FRANKIN	FIREFIGHTER	RESPOND TO FIRES, OTHER EMERG.	3/95	10/98	SMOKE, FUMES, HEAT, FALLING OBJECTS
COUNTY MED. CENTER	HOSP. ORDERLY	MOVE + LIFT PATIENTS, EQUIP.	5/92	1/95	HEAVY LIFTING, SHARPS, BLOOD
ROADSIDE NURSERY	HELPER	SPRAY CHEMICALS, MOVE PLANTS	9/89	4/92	PESTICIDES, FERTILIZERS
U.S. ARMY	VEHICLE MECHANIC	SERVICE + REPAIR TRUCKS	7/87	6/89	MOTOR OIL, GASOLINE, SOLVENTS
GARMIN GROCERY	STOCK CLERK	STOCK SHELVES	6/81	8/82	LIFTING HEAVY BOXES

Figure 2-3. Part of a sample occupational and environmental history, which also includes questions on environmental exposures, smoking history, timing of symptoms in relation to exposures, and symptoms or illness among co-workers and household contacts.



Physicians and other health professionals have a vital role in recognizing occupational and environmental disease. Contrary to the drawing above, there is no simple test. The suspicion and the determination of work-relatedness depend primarily on a carefully obtained occupational and environmental history. (Drawing by Nick Thorkelson.)

works with or encounters any known hazards, and if preventive measures are taken at work—and, if so, for what purpose.

When to Take Complete a Occupational and Environmental History

In the following situations, the clinician should have a strong suspicion of occupational and environmental factors or influences on the development of the problem and take a more detailed or complete occupational and environmental history. Many nonspecific symptoms arise from occupational and environmental exposures.

Respiratory Disease

Virtually any respiratory symptom can be related to occupational and environmental factors. It is easy to misdiagnose acute respiratory symptoms as acute tracheobronchitis or viral infection when the actual diagnosis is occupational asthma, or to attribute chronic respiratory symptoms to chronic obstructive pulmonary disease when the actual diagnosis is asbestosis. Viruses and cigarettes are often mistakenly assumed to be the sole agents responsible for respiratory disease. Environmental factors, including ambient and indoor air contaminants, account for a substantial portion of childhood asthma (Box 18-1). Adult-onset asthma is frequently work-related, but it is often not recognized as such. In addition, patients with preexisting asthma may have exacerbations of their otherwise quiescent condition when exposed to workplace sensitizers. Less commonly, pulmonary edema can be caused by workplace chemicals, such as phosgene or oxides of nitrogen. A detailed occupational and environmental history should be obtained for anyone with acute respiratory illness when no likely nonoccupational or nonenvironmental cause can be identified. (See Chapter 18.)

Skin Disorders

Many skin disorders are self-limited, but they can impact a person's daily activities, including work. The occupational and environmental history may identify the offending irritant, sensitizer, or other factor. Contact dermatitis, which accounts for about 90% of cases of work-related skin disorders, may be challenging to treat. Determining work-relatedness and the causative agent depends on a carefully obtained history. (See Chapter 22.)

Hearing Impairment

Many cases of hearing impairment are falsely attributed only to aging (presbycusis). Millions of U.S. workers have been exposed to hazardous noise at work, home, rock concerts, or elsewhere. A detailed occupational and environmental history should be obtained from anyone with hearing impairment. Recommendations for the prevention of future hearing loss should also be made. (See Chapter 21.)

Back and Joint Symptoms

Most back pain is at least partially work-related. But there are no tests or other procedures that can differentiate work-related from non–work-related back problems. Determination of work-relatedness depends on the occupational and environmental history. Many cases of arthritis and tenosynovitis are caused by awkward, forceful, or repetitive movements at work. Ergonomics—the study of the complex interactions among workers, their workplace environments, job demands, and work methods—can help prevent some of these problems. (See Chapters 16 and 27.)

Cancer

A number of occupational and environmental exposures are established causes of cancer. As new chemicals are introduced into commercial use and as epidemiologic and other studies increase our understanding of their potential hazards, more chemicals are being identified as carcinogens and probable carcinogens. Sometimes the initial suspicion that a substance may be carcinogenic comes from clinicians' reports, especially when a cluster of cases of a rare cancer occurs. Identification of occupational and environmental cancer would be facilitated if an occupational and environmental history was obtained from all patients with cancer. Exposure to a carcinogen may have begun many years before diagnosis of cancer and exposure need not have been continuous between onset of exposure and diagnosis. (See Chapter 17.)

Exacerbation of Coronary Artery Disease Symptoms

The frequency or severity of symptoms of coronary artery disease may increase due to chemicals in the workplace, workplace psychological stress, unemployment and underemployment, and environmental exposures, such as to lead, carbon monoxide, and fine airborne particulates. (See Chapters 3, 6, 11, 14, and 23.)

Liver Disease

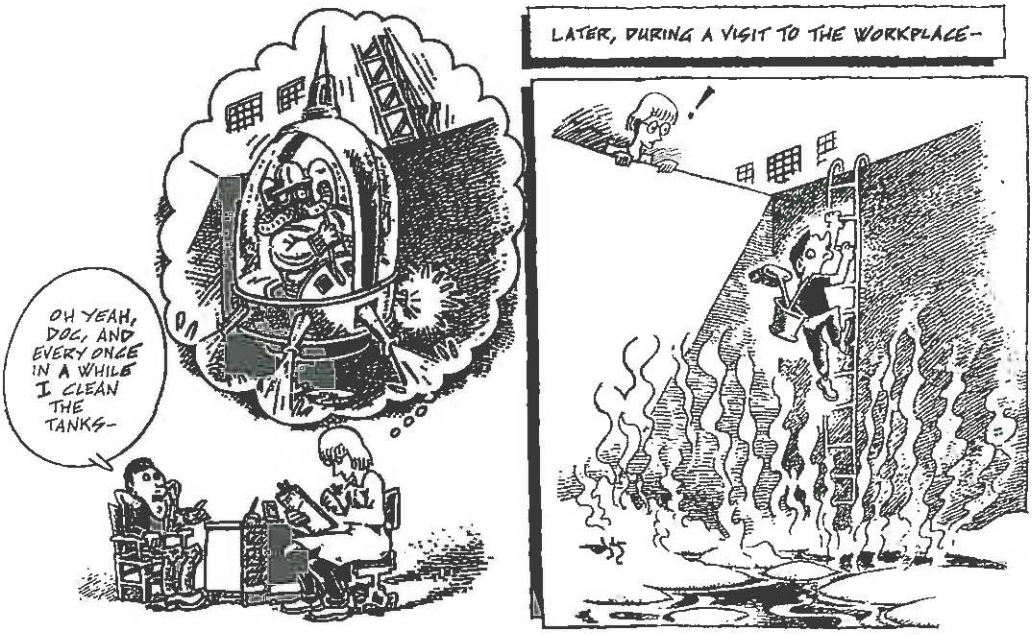
The liver is the major site for metabolizing chemicals in the body. The association between alcohol and liver disease may lead a clinician to overlook occupational or environmental causes of liver disease, such as hepatotoxins and hepatitis B virus. The occupational and environmental history should include questions on use of over-the-counter medications and traditional remedies that may adversely affect the liver. (See Chapters 11 and 13.)

Neuropsychiatric Problems

The possible association of neuropsychiatric problems to occupational and environmental factors is also often overlooked. Peripheral neuropathy is often attributed to diabetes, alcohol abuse, or "unknown etiology." Central nervous system depression is often attributed to substance abuse or a psychiatric disorder. And behavioral abnormalities—which may be the first sign of work-related stress or, in a child, lead poisoning—are often attributed to a psychosis, a personality disorder, or attention deficit hyperactivity disorder. More than 100 chemicals, including virtually all organic solvents, can cause CNS depression, and several neurotoxins—including arsenic, lead, mercury, and methyl n-butyl ketone—can produce peripheral neuropathy. Carbon disulfide exposure can cause symptoms that mimic a psychosis. And manganese can cause symptoms of parkinsonism. (See Chapters 14 and 19.)

Illnesses of Unknown Cause

A detailed, complete occupational and environmental history should be obtained in cases where the cause is unknown or uncertain or the diagnosis has not been established. The need to search carefully for an occupational and environmental source in such illnesses results from many factors, including the increases in informal work and self-employment and the use of alternative medicines and food supplements. Illnesses of unknown origin may also be due to exposure to hazardous wastes (Chapter 10) or



It is crucial to clearly understand working conditions and exposures. (Drawing by Nick Thorkelson.)

contamination of indoor air or water (Chapters 7 and 8).

Certain types of conditions and circumstances require the clinician to take a more in-depth approach. For example, a worker's back strain might require the clinician to play a role in designing or modifying work tasks to prevent a recurrence in the worker or prevent cases affecting other workers. (See Chapter 16 and 27.)

Proper diagnosis of illness or injury requires information from a variety of sources. Successful identification of an association with an occupational or environmental factor rarely results from a single laboratory test or diagnostic procedure, but rather depends on a comprehensive patient history that explores the relation of illness to occupational and environmental exposures and conditions. Health professionals play vital roles in recognizing occupational and environmental illness and injury. Contrary to the cartoon on page 28, there is no simple test.

Preventing Occupational and Environmental Illnesses and Injuries

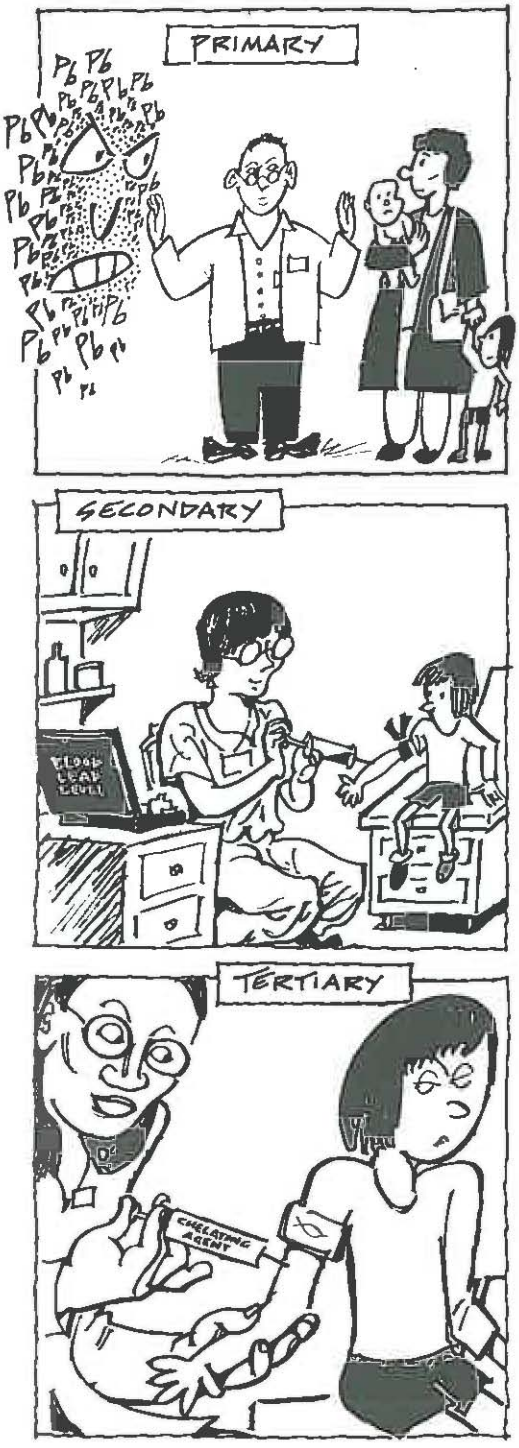
Prevention generally involves a sequence of measures, including the following:

1. Obtaining information about the causal relationship between exposures and outcomes by performing research, and disseminating this information
2. Identifying or diagnosing health problems in individuals and groups
3. Developing, communicating, and implementing preventive measures
4. Evaluating the process and outcome of implementing these measures

Information sharing can enable and empower individuals to recognize hazards and prevent illnesses and injuries. Examples include measures taken by *(a)* individuals, such as using seat belts and stopping smoking; *(b)* communities, such as constructing safe bicycle paths and speed bumps; and *(c)* workplace safety and health teams. Successful programs produce results, such as preventing dermatitis among printing workers and back injuries and needlesticks among health care workers.[1-3]

Health and safety professionals need to anticipate and recognize hazards in a systematic manner, and to design and implement preventive measures at all three levels of prevention:

1. *Primary prevention* to deter or avoid illnesses and injuries



Examples of primary, secondary, and tertiary prevention. (Drawing by Nick Thorkelson.)

2. *Secondary prevention* to identify and treat health problems as early as possible, often before symptoms have developed
3. *Tertiary prevention* to avoid complications of and disability from illnesses and injuries or to provide rehabilitative and palliative care

When properly planned and integrated, these approaches help to *(a)* control risks at the source, *(b)* identify new health problems as early as possible, *(c)* provide high-quality treatment and rehabilitation for those who are ill or injured, *(d)* prevent recurrent and new illnesses and injuries, *(e)* ensure appropriate economic compensation, and *(f)* discover new associations between occupational and environmental exposures and adverse health effects.

Identifying and Preventing Hazards

Hazard identification is performed by safety engineers, industrial hygienists, environmental and civil engineers, and others (see Chapters 26 and 27). By interacting with clinicians, these individuals can better identify lapses or gaps in prevention and clinicians can better understand and facilitate implementation of preventive measures.

Implementing Primary Prevention at an Organizational Level

The following paragraphs describe implementing primary prevention measures with substitution, engineering, and development of changes in job design, work practices, and work organization. Ideally, a public health approach to prevention aims to "move upstream" to address the primary sources of a health problem (Fig. 2-4).

Substitution of a Hazardous Process or Broad Approach with a Safer One

There are many ways in which substitution of a process or broad approach can be accomplished, as illustrated by the following four examples:

- Giving medications orally or, if possible, with transdermal patches can reduce needlestick injuries among health care workers.

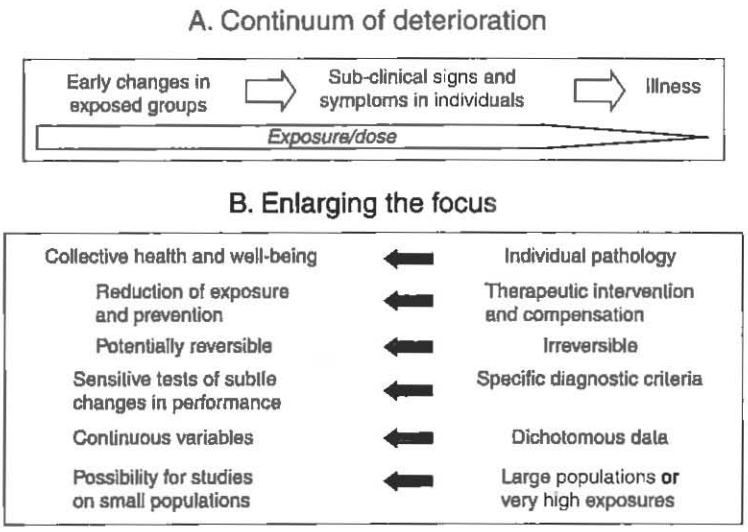


Figure 2-4. Moving upstream: Understanding the relationships of exposure to clinical illness offers the opportunity, in many different ways, to seek the earliest possible evidence of effects to prevent the chain of events and identify reversible changes.

- Implementing policies that promote mass transit—rather than automobile travel—can decrease air pollution and vehicle crashes, thereby reducing illnesses and injuries.
- Using wind power or solar energy can reduce air pollution from fossil fuels and safety risks from nuclear-power plants.
- Mixing chemicals in enclosed structures or bags can reduce dermal or inhalational exposures to hazardous substances.

Substitution of a Hazardous Substance with a Safer One

For example, synthetic vitreous fibers, such as fibrous glass, have been substituted for asbestos. Substitution carries certain risks because substitute materials may not have been adequately tested for adverse health effects and may be hazardous. Long ago, fire protection was enhanced by replacing flammable cleaning solvents with carbon tetrachloride, which was found to be hepatotoxic and, in turn, was replaced by chlorinated hydrocarbons. Now there is concern that use of chlorinated hydrocarbons should be reduced to protect health and the ambient environment. Therefore, substitution with a seemingly safer substance should be considered only a first step. The impact of substitution needs to be monitored on an ongoing basis to determine whether problems are recognized with increased use of the new material. Substitution is embodied in the broader concept of pollution prevention (see Box 2-1).

Installation of Engineering Controls and Devices

Often more feasible than substitution, this approach includes a wide range of options to reduce hazards, such as:

- Installing airbags in automobiles
- Installing ventilation exhaust systems to remove hazardous dusts (Fig. 2-5)
- Using jigs or fixtures that support pieces during machining or other work to reduce static muscle contractions while holding parts or tools
- Applying appropriately designed soundproofing materials to reduce loud noises that cannot be engineered out of a work process or an ambient environment
- Installing tools on overhead balancers to eliminate torque and vibration transmitted to the hand
- Constructing enclosures to isolate hazardous processes
- Installing hoists to eliminate manual lifting of containers or parts

Box 2-1. Avoiding the Transfer of Risk: Cleaner Production and Pollution Prevention

Rafael Moure-Eraso

Environmental sustainability describes the modern concern for social equity between generations by meeting the environmental and occupational needs of the present without compromising the ability of future generations to meet their needs. The European Union and the Environmental Protection Agency (EPA) have embraced cleaner production as a policy framework to achieve environmental sustainability.

Cleaner production (CP) is the continuous application of an integrated, preventive strategy applied to processes, products, and services in pursuit of economic, social, health, safety, and environmental benefits. It has been considered by the United Nations Environmental Programme as the basic strategy for sustainability.

Integral to a cleaner production strategy is pollution prevention (PP)—"the use of materials, processes or practices that reduce or eliminate the creation of pollutants or wastes at the source."[1] Only to the extent that pollution prevention cannot be achieved is it appropriate to implement pollution-control activities, such as treatment, disposal, and remediation. Waste management and control alone will not resolve environmental problems in the long run. A paradigm shift from *pollution control* to *pollution prevention* is necessary. Source reduction has been the tactic of choice to achieve pollution prevention. Since 1990, pollution prevention has evolved to become part of a more comprehensive policy framework of cleaner production. CP/PP provides a coordinated approach to primary prevention, eliminating the possibility of pollution-related health effects and superseding "end-of-pipe" interventions.

Since 1990, CP/PP has evolved in the United States through the voluntary activities of industry, while in the European Union it has evolved through more systematic approaches, going beyond voluntarism and involving specific regulatory regimes. In 1996, the EPA reported that more than 7,200 companies in the United States had established PP programs and predicted that the number would exceed 18,000 by 2000. Results were more modest between 2001 and 2009 due to the George W. Bush administration's opposition to environmental regulation and research. However, the American Chemistry Council (ACC), which formerly was the Manufacturers Chemical Association (MCA), reported in 2009 that 87% of its 142 affiliated companies had verifiable sustainability programs that included environmental management systems (including pollution prevention and cleaner production programs). Both environmental and occupational health are integrated in its sustainability efforts under its Responsible Care program. This program has been expanded to 53 countries, representing 80% of manufactured chemicals, but only 20% of chemical production sites. (See http://www.americanchemistry.com/s_responsiblecare/.) The Responsible Care program is voluntary – companies might choose at any time to start or stop participation. Historically, chemical companies have reduced costs during economic recessions. Programs that are voluntary and not required by regulations are early casualties of difficult economic times.

CP/PP has critical implications for environmental and occupational health. The important conceptual change from control of environmental exposures to their prevention through source reduction and changes in process methods allows the workplace to be seen as a separate source of pollution when undertaking a comprehensive and systematic evaluation of pollution sources. When industries that use chemicals as raw materials begin to use CP/PP to change materials and processes, there are opportunities to consider workplace exposures in choosing substitute materials.

In the past, control of workplace exposures has consisted of end-of-pipe interventions that did not systematically examine root causes. Therefore, it was not recognized that a preferred engineering control, such as local exhaust ventilation, shifted the hazard burden from the workplace to the ambient environment in the form of air pollution or, as a result of filters and other pollution collection media, solid hazardous waste. In a comprehensive CP/PP approach, environmental health and occupational health scientists need to work together to avoid shifting hazards from one medium to another, such as from workplace to community air, or from industrial waste to community water.

The six general PP (source-reduction) tactics that most directly affect environmental and occupational health are as follows: raw material substitution or reduced use, closed-loop recycling, process or equipment modification, improvement of maintenance, reformulation of products, and improvement of housekeeping and training. Some examples of pollution prevention interventions that incorporate concern for reduction or elimination of work exposures are the following:

1. Eliminating use of elemental mercury for switches in new car manufacturing, and substituting with traditional electrical switches, as the EPA has recommended.
2. Substituting water-based solvents for perchloroethylene in industrial textile dry-cleaning operations. This change eliminates exposures to a potential human carcinogen but also leads to improvement in dry-cleaning job organization and reduction in ergonomic risk factors.
3. Substituting the solvent with the lowest concentration of aliphatic organic chemicals for organic solvents in cleaning printing ink from metal surfaces in the offset lithographic industry.
4. Introducing an electrostatically delivered coating to replace a paint with resin-based epoxies in painting of small metal parts. Respiratory and skin hazards from epoxy are eliminated, and paint dispensers are made substantially lighter, avoiding an ergonomic hazard.

Occupational and environmental hygiene should strive to change its focus from secondary to primary prevention

(*Continued*)

Box 2-1. Avoiding the Transfer of Risk: Cleaner Production and Pollution Prevention (Continued)

by addressing workplace problems as comprehensive production problems that have impact inside and outside of the point of production. Workplace problems should not be compartmentalized from environmental problems. CP/PP approaches need to be integrated into occupational and environmental health.

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Cleaner Production: Pollution Prevention and Occupational Health

Occupational Hygiene Approaches	Primary Prevention	Secondary Prevention
Anticipation	*Hazard surveillance*	
Identification	*Hazard identification*	*Medical surveillance*
Evaluation	*Exposure assessment*	
Control	*Exposure prevention*	*Control of generated exposures*
	1. Comprehensive approach	1. End-of-pipe interventions
	2. Source reduction	2. Engineering controls
	a) Materials changes:	a) Enclosure
	• Toxic use reduction	b) Local exhaust
	• Substitution	c) Wet methods
	b) Process changes:	d) General ventilation
	• Physical conditions	3. Administrative controls
	• Machinery	4. Personal protective equipment
	• Operations	
	Work organization	*Early therapeutic intervention*



Figure 2-5. Local exhaust ventilation used to protect a worker from asbestos dust generated in working with clutch plates. (Photograph by Earl Dotter.)

- Carefully maintaining process equipment to reduce or eliminate *(a)* fugitive emissions from processes designed as closed systems, or *(b)* the development of unwanted vibrations as equipment ages
- Using scrubbers or other mechanisms to reduce airborne pollutant emissions
- Maximizing fuel use through co-generation of hot water from the heat exhaust produced as a by-product of generating electricity
- Treating wastewater effluent before discharge

Although installation of engineering controls and devices can involve substantial initial capital expenditure, it often saves money by reducing use of materials, toxic and other material wastes, and costs of disease, injury, and lost productivity. Often, such approaches are not considered or implemented because of lack of awareness that such solutions are available.

Changes in Job Design, Work Practices, and Work Organization

Some changes can be introduced to reduce or eliminate risks in work processes, including job redesign, alternative work practices, and changes in work organization. Job redesign, which often combines engineering and administrative measures, aims to increase job content, make physical work less redundant or repetitive, and improve workers' individual or collective autonomy in decision making. (See Chapters 16 and 27.)

Work practices refer to the ways in which jobs are performed. Work practice alternatives can, through relatively limited changes, lead to important improvements in the workplace. For example, dust exposures can be significantly reduced by using vacuum cleaners to clean dusty surfaces in place of compressed air, and wet mops to clean floors in place of dry sweeping.

These preventive measures are generally more effective than those that rely primarily on behavior change.

Changes in work organization, often closely integrated with individual job redesign, are directed at elimination of undesirable features in the structure of work processes. For example, a change from piece-rate work with incentive wages to hourly-rate work reduces inappropriate physical and mental pressure on workers and musculoskeletal disorders.

The measures described in the next section potentially reduce the adverse effects of workplace and community hazards, without removing the source of the problem.

Primary Prevention at an Individual Level

The following paragraphs address opportunities for individuals for primary prevention of occupational and environmental health problems. (See Chapter 38 on Implementing Programs and Policies for a Healthy Workforce.)

Education and Training

Education and training concerning specific occupational and environmental hazards is an essential aspect of health and safety programs. Providing information about adverse effects of potential exposures conveyed in a user-friendly

manner has several benefits, including empowering workers and raising awareness of people outside the workplace, including children and their parents (Fig. 2-6). Health educators describe the various steps individuals use to understand a specific hazard, assess how they can reduce the hazard, and then choose to take action. Much scientific evidence supports specific approaches to encouraging healthy behaviors, such as using seat belts and bicycle helmets, checking home smoke detectors, and quitting smoking. Different approaches are needed for different activities.

Effective education often requires an understanding of basic principles of risk communication (Chapter 29). The Environmental Protection Agency (EPA) and other agencies and organizations have developed materials on risk communication that are useful for health and safety professionals who communicate with workers or community members about occupational and environmental hazards.[4] Its "seven cardinal rules" for effective risk communication are as follows:

1. Accept and involve members of the general public or workers as legitimate partners.
2. Listen.
3. Be honest, frank, and open.
4. Coordinate and collaborate with other credible sources.
5. Coordinate with the media.
6. Speak clearly and with compassion.
7. Plan carefully and evaluate performance.



Figure 2-6. Bee Safe is a community-based program that aims to raise awareness of parents and children about lead hazards in the home environment. (Photograph by Earl Dotter.)

Understanding how people perceive risk is important. People often dread some outcomes, such as cancer, more than others, such as heart disease. People distinguish between risks they perceive they control and risks controlled by others. Providing to people information that restores some control to them—such as information to follow up on a complaint—is often an important component of education and training.

Workers and community members should always be given full information about hazards to which they may be exposed and means of reducing their risk (Fig. 2-7). Many safety measures are based on changed behavior, which requires education or training. Those who are not aware of hazards will not take health and safety precautions necessary to protect themselves and others. Providing hazard and safety training should not replace other forms of hazard control, such as installing necessary workplace equipment or implementing pollution prevention measures. Effective training that builds on life experiences and empowers people to address and solve problems is a cornerstone for health and safety programs (see Box 2-2).

Personal Protective Equipment

Use of personal protective equipment (PPE), such as respirators, earplugs, gloves, and protective clothing (Figs. 2-8 and 2-9), or safety devices, such as helmets, seat belts, and child restraint systems, will continue to be necessary for *(a)* some workplaces, where PPE is the only available protective measure, and *(b)* most transportation safety.



Figure 2-7. Warning signs, as illustrated in this photograph, should be in multiple languages, if appropriate. (Photograph by Earl Dotter.)



Figure 2-8. A National Institute for Occupational Safety and Health (NIOSH) industrial hygienist prepares to sample a worker's lead exposure during a residential lead-based paint abatement project. (Photograph by Aaron Sussell.)

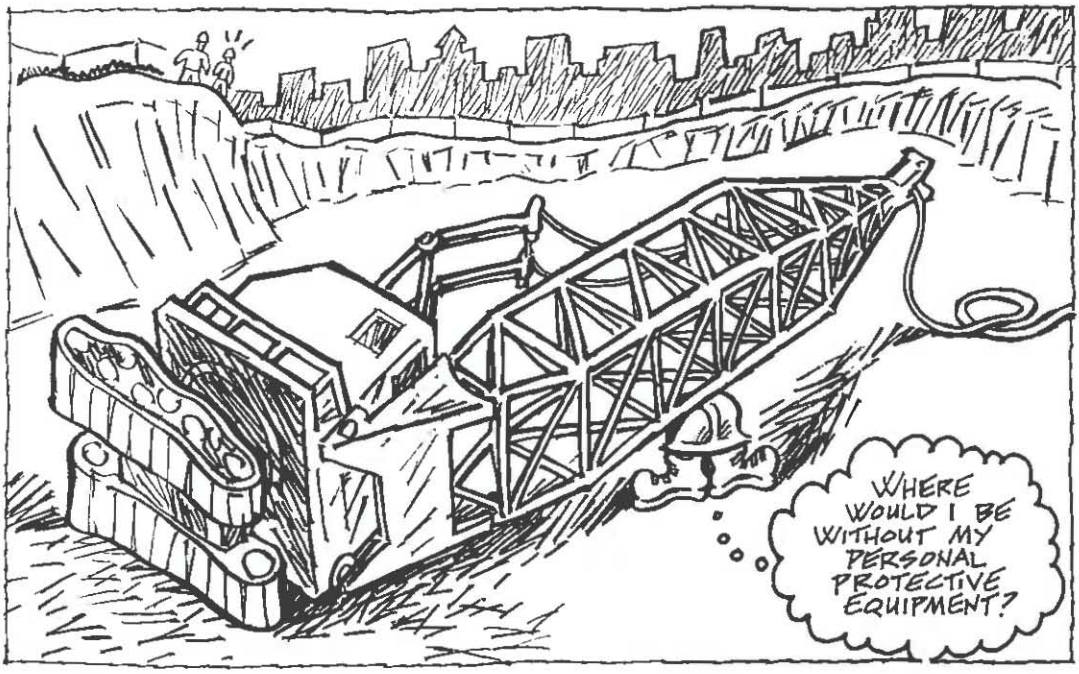
However, using PPE to control a hazard has important limitations; for example, workers have difficulty wearing PPE because it is cumbersome or may limit visibility or communication with other workers. Since the experimentally determined effectiveness of PPE claimed by its manufacturer may not always be as effective in actual use, its effectiveness should be evaluated in "real-life" situations. OSHA has developed lists of acceptable PPE that can be helpful in proper selection and use of this equipment. OSHA and other agencies have emphasized the need and importance of developing a complete program for PPE—not merely a requirement for using it. Adequate programs include requirements for proper fitting of the equipment (especially respirators), education about proper use, and planning for maintenance, cleaning, and replacement of equipment or parts. The costs of an effective PPE program are significant, making it especially important to recognize that PPE should be used only when there is no alternative method to control a hazard.

Administrative Measures

Organizational measures taken by employers or community planners may offer some protection.



Figure 2-9. Workers with personal protective equipment. (Photograph by Earl Dotter.)



Personal protective equipment is generally not the best approach to prevention. (Drawing by Nick Thorkelson.)

For example, in communities, zoning ordinances that restrict certain types of industry in residential areas or set hours for noise restriction offer important protections. As another example, occupational exposure can be reduced somewhat by implementing work schedules so that workers spend carefully limited amounts of time in areas with potential hazardous exposure. Such measures require accurate environmental monitoring data to design appropriate schedules.

Box 2-2. Effectively Educating Workers and Communities

Margaret M. Quinn and Nancy Lessin

A prerequisite to effective health and safety programs is education. The most effective approach to teaching health and safety acknowledges that workers and community members are the ones most familiar with their jobs, homes, and communities. Workers can identify hazards—both apparent and hidden—that may be associated with their work. These include *(a)* physical hazards, such as noise, musculoskeletal strain, or the use of toxic chemicals; *(b)* psychosocial hazards, such as lack of social support, harassment, or discrimination; *(c)* work-organization hazards, such as understaffing, extended hours of work, and production pressures; and *(d)* social hazards, such as living in unsafe neighborhoods or near hazardous waste sites. Community members understand the specific cultural and political characteristics that will affect the success of a program.

Involvement of community members and workers in prioritizing educational needs and in designing and presenting training are major determinants of meaningful and useful programs. They should also be included in developing and implementing solutions to health and safety problems. Education regarding solutions should include a discussion of the traditional hierarchy of hazard controls that emphasizes hazard elimination, and it should not be limited to training on the use of personal protective equipment or actions that individuals can take to minimize the impact of hazards. In addition to worker and community involvement with needs assessment and program design, the following tasks serve as guidelines for successful educational programs:

1. Develop programs in trainees' literal and technical language. Understand the social context and psychosocial factors of a workplace or community that may affect a person's ability to participate in an educational program or to implement personal safety measures in response to potential hazards.
2. Define specific, clearly stated goals for each session based on a needs assessment that has involved representatives of workers or community residents to be trained. Begin each program with a concise overview. Reinforce the key issues that come up during the session.
3. Develop an evaluation mechanism that can easily be adapted to each program. Design the evaluation process to judge the effectiveness of the educational program in attaining the goals that have been set by the trainer and trainees.
4. Use participatory, popular education approaches, which draw on the experience that workers and community members have had, instead of a traditional lecture approach that imparts instructor-defined problems and solutions.

Participatory, popular-education approaches utilize adult learner–centered education methods; are designed to foster maximum participation and interaction; and empower participants to devise effective strategies for improving workplace and environmental health and safety. They constitute an approach to labor and community-based education that is based on the understanding that adults bring an enormous amount of experience to the classroom and that this experience should be used in the training program. In addition, adults learn more effectively by doing rather than listening passively. Learners' experiences are incorporated into the course material and are used to expand their grasp of new concepts and skills. Basing new knowledge on prior practical experience helps the learner solve problems and develop safe solutions to unforeseen hazards. Combining instructors' specialized knowledge and participants' direct experience leads to effective, long-lasting solutions to health and safety problems.

Participatory learning generally requires more trainer–trainee interaction than lecture-style presentations. Groups should be limited to approximately 20 participants, and these may be subdivided into groups of three to six for small-group exercises. Participatory teaching methods include a variety of techniques, including the following:

1. *Speakouts* (large-group discussions): Participants share their experiences in relation to a particular hazard or situation.
2. *Brainstorming sessions*: The instructor provides a particular question or problem; the participants call out their ideas, which are recorded on a flipchart so that patterns are identified and a collective work is created. In this activity, the trainer elicits information from the participants, rather than presenting it in a didactic manner.
3. *Buzz groups* (small-group discussions or exercises): Each group of three to six participants discusses a particular problem, situation, or question, and then records the answers or views of the group.
4. *Case studies* (small-group exercises): Participants apply new knowledge and skills in the exploration of solutions to a particular problem or situation.
5. *Discovery exercises*: Participants go back into the workplace or community to obtain certain items, such as OSHA-300 logs for their workplaces or Toxic Release Inventory records for their communities, or perform activities, such as interviewing co-workers regarding a particular hazard. This information is then brought back into the classroom for discussion.
6. *Hands-on training*: The participants practice skills, such as testing respirator fit, simulating asbestos removal or hazardous waste clean-up, using OSHA-300 logs to identify hazards in need of correction, or handling, and learning the uses and limitations of, industrial-hygiene or air-pollution monitoring equipment.
7. *Report-back sessions*: After buzz groups, the class reconvenes as a larger group, and a spokesperson for each buzz group reports the group's answers or views. Similarities and differences among groups are noted, and patterns may be discovered.
8. *Hazard mapping*: Participants create a map of their workplace or neighborhood, locating hazards and indicating their type, severity, and number of people affected. The hazards include psychosocial

(*Continued*)

Box 2-2. Effectively Educating Workers and Communities (Continued)

and work- organization hazards as well as physical and chemical hazards. If participants need technical assistance, they are referred to information by the course instructor and the participants actively seek it out. The map becomes a way for participants to visually integrate their existing knowledge with new knowledge. Participants then use the map to prioritize actions and resources for change. As improvements are made, the map can be used to show solutions and accomplishments. This technique can be especially useful for labor-management health and safety committees and community-based environmental organizations.

Participatory, popular-education approaches are well-established educational methods practiced in labor education programs, schools of education, national and international community education centers, labor unions, and Committees for Occupational Safety and Health (COSH) groups. These groups have demonstrated that it is possible to use participatory methods, even for educational programs that require conveyance of specific, technical knowledge. For example, the OSHA Hazard Communication Standard has worker training requirements for use of material safety data sheets (MSDSs), forms that contain brief information regarding chemical and physical hazards, health effects, proper handling, storage, and personal protection for a particular substance. Training on MSDSs should cover how to obtain the MSDSs, how to interpret them, and their uses and limitations, and should give the participants practice in each of these areas. Rather than presenting an MSDS in a lecture-style format, the information can be taught more effectively with a participatory exercise, such as the exercise that follows:

In the first part of the exercise, workers go back into their work areas, find a labeled chemical container, and seek an MSDS for that substance. This requires workers to become familiar with where MSDSs are located in their particular workplace and the process required to find one. It also serves to identify problems in the system that can be corrected, such as unlabeled containers, missing MSDSs, or locked offices to which no one on a given work shift has a key. In the second part of the exercise, the class is divided into small groups, which review sample MSDSs and collectively answer questions such as the following: "Is the substance flammable?" "What are the health effects associated with it?" "Does it require wearing of gloves?" and "What ventilation is required?" During the report-back session, the instructor asks for the answers from all of the groups and reviews how to read and interpret MSDSs in general. In the final part of the exercise, participants look up the chemicals covered in the sample MSDSs in other sources, such as the *NIOSH Pocket Guide to Chemical Hazards* (available at: http://www.cdc.gov/niosh/npg/). In some situations, more hazards—especially health hazards—are discovered when other sources are consulted. In this way, students learn about the uses and limitations of MSDSs, and practice using additional sources.

Participatory, popular-education approaches not only make learning active, but they also value workers' and community residents' knowledge and experience. And they broaden the objectives of curricula to give workers and community residents the skills, support, context, framework, and strategic planning practice necessary for them to identify hazards and take action to improve health, safety, and environmental conditions.

Further Reading and Resources

The Labor Safety and Health Training Project at the National Labor College

A joint project of the National Labor College and the AFL-CIO, its goal is to increase involvement of workers and unions in improving workplace safety and health. It has developed extensive training materials and facilitator guides for educating workers and union members about workplace safety and health. It provides workshops on workplace safety and health for unions and labor-related organizations and offers week-long train-the-trainer courses. For more information, visit http://www.nlc.edu/educationalPrograms/laborSafetyHealth.html or contact Sharon Simon at the National Labor College (301-431-5414, or ssimon@nlc.edu).

The Highlander Research and Education Center, New Market, TN

A leader in adult, learner-centered, participatory education and a founding member of the North American Association of Popular and Adult Educators (NAAPAE), it promotes the understanding and practice of popular-education approaches among community groups and universities. Its library has an extensive collection of case studies, oral histories, and model curricula from adult education programs in the United States and elsewhere on worker literacy, community research, radio education, education for immigrants and indigenous peoples, and democratic facilitation. More information is available at: http://www.highlandercenter.org/r-popular-ed.asp.

Massachusetts Coalition for Occupational Safety and Health (MassCOSH)

MassCOSH brings together workers, unions, community groups, and health, safety, and environmental activists for training related to safe, secure jobs and healthy communities. Its Immigrant Worker Center uses community-based participatory methods to train immigrant workers More information is available at: http://tools.niehs.nih.gov/wetp/.

National Institute for Environmental Health Sciences maintains the National Clearinghouse for Worker Safety and Health Training at http://tools.niehs.nih.gov/wetp/

Its curricula catalog contains direct access to training curricula produced by awardees funded by the NIEHS Worker Education and Training Program (WETP) to help employers meet OSHA requirements under 29 CFR 1910.120, Hazardous Waste Operations & Emergency Response (HAZWOPER). It supports the development of model worker safety and health training development and delivery in hazardous waste worker training, minority worker training, brownfields worker training, Department of Energy nuclear weapons cleanup training, and hazmat disaster preparedness training. These model programs use innovative methods for training difficult-to-reach populations by addressing issues such as literacy, appropriate adult education techniques, training quality improvement, and other topics not addressed directly by the private sector.

Tools of the Trade—A Health and Safety Handbook for Action, Labor Occupational Health Program, University of California Berkeley.

Training for unions and community groups to assist them in integrating health and safety into every aspect of their work. More information is available at: http://www.lohp.org/Publications/publications.html

(*Continued*)

Box 2-2. Effectively Educating Workers and Communities (Continued)

Risk Mapping—A Group Method for Improving Workplace Health and Safety, Labor Occupational Safety and Health Program, University of California Los Angeles.
Describes how workers can develop risk maps of their worksite and then how these can be used to make health and safety improvements. Included are examples where risk mapping has been used, lesson plans, and other resources. More information is available at: http://www.losh.ucla.edu/resources-publications/index.htm.

Arnold R, Burke B, James C, et al. Educating for a change. Toronto, Ontario: Doris Marshall Institute for Education and Action/Between the Lines, 1991.
This classic text, which covers the theory, principles, and practice of popular education, is written for educators who are seeking to enhance their skills as facilitators of this type of educational philosophy and methods. It is not specific to any topic area or subject matter; rather, it relates to all types of education that support social change.

National Institute for Occupational Safety and Health. A model for research on training effectiveness. DHHS (NIOSH) Publication No. 99-142, October 1999.
Describes a systematic approach to evaluating all types of training. Available as 99-142.pdf at http://www.cdc.gov/niosh/99-142.html.

Since this approach may distribute hazardous exposure to more workers, it should not replace other preventive measures, such as engineering approaches, that may be safer and more effective. Another administrative measure is use of preplacement examinations to avoid assigning new workers to jobs in which their personal risk factors place them at higher risk for specific diseases or injuries. In the United States, the requirements of the Americans with Disabilities Act place a special responsibility on clinicians performing preplacement examinations.

Secondary Prevention

Screening and Surveillance

Screening and surveillance can identify the need for control measures to prevent further hazardous exposures. Both screening and surveillance are directed toward identification of health events or documentation of early evidence for adverse health effects that have already occurred. Screening is a clinical activity that seeks to identify disorders in an asymptomatic individual at a time when intervention can reduce the probability the individual will develop an adverse health outcome. Specific guidelines for appropriate screening include considerations of risks and benefits to the individual. Screening may identify individuals who need treatment or preventive intervention.

Surveillance is designed to obtain, analyze, and disseminate information on disorders that have already occurred (Chapter 3). Surveillance implies watching out or watching over, and it may consist of *(a)* watching out for single events (sentinel health events) that signal a breakdown in prevention; *(b)* reviewing grouped or aggregate data for subtle trends that may be significant for an entire population, but not necessarily meaningful for a specific individual—such as increases in liver enzymes that do not exceed population norms; or *(c)* reviewing grouped or aggregate data to discern trends in the occurrence of illnesses, injuries, or deaths. Surveillance can lead to primary prevention measures by identifying inadequate control measures and allowing them to be corrected so that others can be protected.

By recognizing potential or existing disease or injury, health professionals can initiate activities leading to one or more of these methods of prevention. They can play an active role in education by informing people about potentially hazardous exposures and ways of minimizing them. For example, they can help identify important residential exposures, such as radon and lead in the home environment, and they can facilitate appropriate measures to address these problems. They can advise workers on how to better protect themselves at work, such as by advocating for improved ventilation systems and, if necessary, using respirators or other PPE. They can also screen individuals and facilitate the screening of others who may be at high risk for specific diseases. Consultation with specialists in various disciplines may be necessary to facilitate these activities.

Prevention at the Systems Level

Preventive approaches to occupational and environmental health problems can occur at the level of the individual, workplace or local

environment, broader community, or entire society—all of which can potentially interact with one another. In the workplace, these approaches rely on management commitment, employee participation, hazard identification and control, training, medical surveillance, and program evaluation. Similar approaches have been developed to reduce environmental hazards. Community-based environmental organizations play important roles in advocating for better regulation and improved urban planning. The EPA's Pollution Prevention Initiative identifies alternatives that reduce the production of pollutants. The International Organization for Standardization management standard (ISO 14000) helps to reduce environmental pollution from industry. In order to be effective, these programs require external verification and constant engagement of vigilant civic groups and non-governmental organizations that empower community members. In workplace settings, labor-management safety committees can help implement the steps required to ensure that programs effectively promote safety and health (Fig. 2-10 and Box 2-3). It often takes a team effort of professionals in occupational and environmental health and safety, and others in medical care and public health, working together with workers, employers, community members, government officials, and others to prevent or control complex problems. Each member must accept responsibility to fully participate, communicate effectively, and engage others.

The following two examples of major improvements show how communication, focus, and persistence among individuals and policy makers can reduce exposure and improve lives—although in both of these examples much work remains to be done.

Lead Exposure

Lead has been widely used for thousands of years. Yet it continues to cause adverse health effects in some workers, young children exposed to lead-based paint, and others. From the 1920s to the 1970s, organic lead was used as an antiknock agent in gasoline, causing widespread population exposure. By the mid-1970s, the geometric mean BLL for the U.S. population was about 16 μg/dL. The removal of lead from

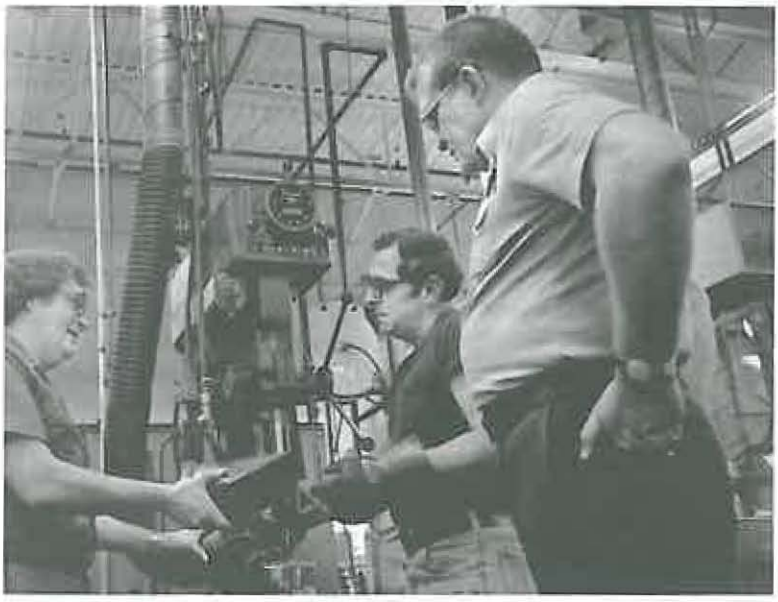


Figure 2-10. Joint labor-management health and safety committees help prevent occupational injuries and illnesses. This photograph depicts a worker, a safety specialist, and a management representative discussing a workplace problem. (Photograph by Earl Dotter.)

Box 2-3. Labor-Management Safety Committees

The benefits that accrue from seeking the participation of labor unions and workers in the development and implementation of occupational health and safety programs and research can be substantial. As a consequence of their experience and intimate knowledge of the actual work processes, workers and their unions often can add significantly to the understanding of a health or safety problem and determine the best approach to prevention of risks. Their participation also aids in understanding and explaining the nature and importance of programs and research efforts and in interpreting the impact and meaning of such work to individual workers.

One effective means for including workers and their labor unions in the development and improvement of approaches to prevention is joint labor-management health and safety committees in the workplace. These committees consist of representatives of workers and managers. They meet periodically to systematically review workplace health and safety hazards and their control and to respond to specific complaints concerning workplace health and safety. For these committees to function effectively, labor representatives must be truly representative of workers and not simply appointed by management.

Joint labor-management health and safety committees have been legally authorized and are more generally active in some countries, such as Canada. In the United States, they are less common and usually are established through collectively bargained agreements. Some legislative proposals to reform OSHA would require operation of health and safety committees in many more workplaces than at present.

Studies in Canada, where joint health and safety committees have been mandated, suggest that this particular form of involvement can be unusually effective. Reduction in work injuries and resolution of health and safety problems without the need for governmental intervention has been documented. Effective committees tend to have co-chairs and equal representation, readily available training and information, and well-established procedures. An important feature of successful committees is sufficient authority for action, either as a committee or on the part of the management representatives.

Typically, labor-management health and safety committees meet on a monthly basis for 1 to 2 hours. They review, evaluate, and respond to worker and manager complaints and concerns about working conditions and workplace hazards. They periodically walk through the workplace to observe and assess working conditions and possible health and safety hazards. In addition, they systematically evaluate work practices and procedures and materials used in the workplace in regard to their impacts on workplace health and safety. Labor-management health and safety committees are most effective when seen as one component of a more general prevention program that also relies on the development and enforcement of government regulations.

gasoline in the late 1970s was initiated by the introduction into automobile engines of catalytic converters, which cannot function effectively in the presence of lead. Research by scientists, advocacy by non-governmental organizations and professional associations, and regulatory measures by the EPA and other agencies facilitated the removal of lead from gasoline. Now the geometric mean BLL of the U.S. population is about 2 μg/dL. Additional measures to ban lead as a pigment in paint, in water-carrying pipes, and in solders used for canned foods have also had a positive impact, although lead exposure continues, mainly from lead paint in older homes. Only about 2% of U.S. children age 1 to 5 have BLLs above 10 μg/dL, the CDC level of concern.[4] (See Chapters 11, 19, and 20.)

Environmental Tobacco Smoke

Since the U.S. Surgeon General's seminal report in 1964 on the hazards of cigarette smoking, the tobacco industry has fought back, such as by attacking the science that demonstrated the adverse health effects of environmental tobacco smoke on nonsmokers. Public awareness has increased and the percentage of U.S. smokers has decreased due to smoking cessation programs, one-on-one counseling by primary care physicians, educational and advocacy projects by non-governmental organizations, legislation restricting smoking, and individual and state lawsuits. As a result, levels of cotinine (a biomarker for environmental tobacco smoke) among nonsmokers during the 1990s decreased 58% for children, 55% for adolescents, and 78% for adults. (See Box 7-1.)

Roles of the Clinician

Once a clinician has identified a probable case of occupational or environmental disease or injury, it is crucial to take preventive action while also providing appropriate treatment and

rehabilitation services. Failure to consider the prevention opportunities along with the necessary therapeutic measures may lead to recurrence or worsening of the disease or injury in the affected person and the continuation or new occurrence of similar cases among other workers or community members. A clinician has at least the following five opportunities for preventive action after identifying a case of occupational or environmental disease or injury:

- Advise the patient.
- Contact an appropriate labor or environmental organization
- With the consent of the patient, contact the responsible party, such as the patient's employer or landlord.
- Inform the appropriate governmental regulatory agency.
- Contact an appropriate research or expert group.

Often some combination of these approaches is undertaken.

Advise the Patient

The clinician should always advise the patient concerning the nature and prognosis of the condition; the possibility that there may be appropriate engineering controls to remove the hazard; the need, even if only temporarily, for PPE, or, in extreme circumstances, the necessity to change job or place of residence. The clinician should alert the patient to the need to file a workers' compensation report to protect the worker's rights to income replacement and both medical and rehabilitation services (Chapter 31). This report also may lead the employer to report the case and may lead its insurance company to provide consultative services to the employer to assess the problem and recommend appropriate control measures.



Advice to employees and employers should be practical. (Drawing by Nick Thorkelson.)

If a health problem results in a contested workers' compensation claim or the need for making a report or complaint with an appropriate government agency, the clinician may be asked to provide advice to the patient concerning legal remedies (see later discussion). Patients' options may be limited: Workers may not wish to file a workers' compensation claim or make a complaint to a government agency for fear of job loss or other punitive action. Patients may find it impossible to change residence for themselves and their families.

However, it is essential to inform a patient of potential hazards. It is not appropriate to withhold this information because of the possibility of upsetting the patient. A clinician cannot assume that even a large and relatively sophisticated employer has adequately educated its workers about workplace hazards. Once a patient is informed of the work-relatedness of a disease in writing, this may start the time clock on notification procedures and statutes of limitations for workers' compensation (Chapter 31).

Contact an Appropriate Labor or Environmental Organization

If it is agreeable to the affected patient, the clinician should inform the appropriate labor or environmental organization of the health hazards suspected to exist. The provision of this information may help to alert others to a potential hazard, facilitate investigation of the problem, identify additional similar cases, and eventually facilitate implementation of any necessary control measures. (Keep in mind, however, that only a small percentage of workers in the private sector in the United States belong to a labor union and that relatively few community members are represented by community-based environmental organizations.)

With the Consent of the Patient, Contact the Responsible Party, Such as the Patient's Employer or Landlord

The clinician, only with the patient's express consent, may choose to report the problem to the responsible party, such as the patient's employer or landlord. This can be effective in initiating preventive action. Many employers do not have the staff to deal with reported problems adequately, but they can obtain assistance from insurance carriers, government agencies, academic institutions, or private firms. In addition to triggering workplace-based prevention activity, discussions with the employer may lead to obtaining useful information concerning exposures and the possibility of similar cases among other workers. Depending on the circumstance, it can be particularly helpful for the clinician to arrange with an employer to visit a patient's work area. This presents the opportunity to observe the possibly hazardous environment firsthand and to establish the necessary rapport with managers to involve them in prevention. Environmental situations are often more complex; it may be unclear which responsible party should be contacted. In these situations, it is often most prudent to contact the state or local health department (see next section).

Although the law prohibits employers from firing workers for making complaints to OSHA, it does not prohibit them from firing workers who have a potentially work-related diagnosis. In the United States, only the OSHA lead and cotton dust standards mandate removal of workers from jobs that are making them sick. In addition, the OSHA lead standard (but not the cotton dust standard) provides that, during the period of removal, employers much maintain removed workers' earnings, seniority, and other employment rights and benefits as if the workers had not been removed. (See Chapters 11, 19, and 20 for more information on lead.)

Inform the Appropriate Governmental Regulatory Agency

If a case of occupational or environmental disease or injury appears to be serious or may be affecting others in the same workplace, company, industry, or community, it is wise for the affected person or the clinician to consider filing a complaint with the appropriate governmental regulatory agency. (See discussion in the next section and Boxes 2-4 through 2-6.) The clinician should always inform the patient before notifying a governmental agency. Although regulations of OSHA and the Mine Safety and Health Administration (MSHA) protect U.S. workers who file health and safety complaints against resultant discrimination by the employer (loss of job, earnings, or benefits), this protection is difficult to enforce, and workers' fears are

not unfounded. Clinicians should familiarize themselves with pertinent laws and regulations. For example, if the worker does not file an "11(c)" (anti-discrimination) complaint within 30 days of a discriminatory act, the worker's rights are lost. In the United States, health professionals and workers (or their union, if one exists) have the right, guaranteed by the Freedom of Information Act, to obtain the results of an OSHA inspection.

Contact An Appropriate Research or Expert Group

Occasionally, the health professional who is reporting a work-related or environmentally-mediated medical problem may undertake or assist in a research investigation of this problem. No matter who conducts the research, investigation of the workplace or the environment and the identification and analysis of additional cases often lead to new information. Publication of epidemiologic studies or case reports alerts others to newly discovered hazards and ways of controlling them. The health professional may also assist with research to evaluate the effectiveness of preventive approaches, such as the impact of OSHA or EPA regulations.

AVAILABLE RESOURCES

Identifying and using the broad range of available occupational, environmental, and public health resources enables health professionals to offer their patients and others a wide range of services to help recognize and prevent occupational and environmental disease and injury. Resources are available from federal, state, and local government agencies; international organizations; academic centers; professional organizations; and labor, environmental, and community organizations.

There is much information on the Web sites of the following agencies and organizations, but it is helpful to know the focus of each and their relative strengths and limitations. The major U.S. agencies addressing occupational and environmental health and safety are located in several different parts of the federal government. The Department of Labor includes OSHA, MSHA, and other agencies that administer programs on job training, child labor, wages and hours of workers, and obtaining, analyzing, and disseminating national data on work and on occupational injuries and illnesses. The Department of Health and Human Services includes the National Institute for Occupational Safety and Health (NIOSH); other agencies within the Centers for Disease Control and Prevention (CDC); the National Institutes of Health (NIH), within which the National Institute of Environmental Health Sciences (NIEHS) is located; the Agency for Toxic Substances and Disease Registry (ATSDR); and other agencies that address public health, food and drug safety, and research on health care quality. Other federal agencies that address occupational and environmental health include the Environmental Protection Agency (EPA) and the departments of Agriculture, Defense, Energy, Housing and Urban Development, the Interior, Transportation, and Veterans Affairs.

The roles of governmental agencies and international organizations are briefly described in the next section. Chapter 30 describes government regulation in the United States and the European Union. The Appendix at the back of this book provides a list of non-governmental organizations. Chapter 32 provides a list of the 10 largest international labor federations and labor unions. Chapter 33 provides a list of environmental non-governmental organizations.

U.S. Government Agencies and Programs in Occupational Health and Safety

The U.S. Department of Labor

Several agencies and other units within the Department, which are described below, profoundly affect work and occupational health and safety.

The Occupational Safety and Health Administration (OSHA) establishes and enforces standards for hazardous exposures in the workplace and undertakes inspections, both routinely and in response to complaints from workers, physicians, and others. In about half of the states in the United States, the program is implemented directly by OSHA; in the other states, a state agency—often the state department of labor—implements the program. Both OSHA and the state agency may investigate a workplace in response to a complaint. Most state agencies make recommendations to improve the situation, but

only those states with OSHA-delegated authority can order changes to improve health and safety in the workplace and impose fines if these changes are not made. Box 2-4 describes how to use OSHA. Additional information is available at http://www.osha.gov.

The Mine Safety and Health Administration (MSHA) develop and enforces regulations to protect the health and safety of miners in the United States. Box 2-5 describes MSHA in detail. Additional information is available at http://www.msha.gov.

Box 2-4. How to Use the Occupational Safety and Health Administration (OSHA)

Michael Silverstein

This box describes three ways to utilize the services of OSHA.

Getting a Workplace Inspected by OSHA

The Occupational Safety and Health Act (OSH Act) of 1970 states that "any employees or representative of employees who believe that a violation of a safety or health standard exists that threatens physical harm, or that an imminent danger exists, may request an inspection..." If, but only if, OSHA "determines there are reasonable grounds to believe that such violation or danger exists," an inspector will be sent to perform an on-site inspection. Although the decision about whether to file a complaint rests with an individual worker, health care providers can help ensure that OSHA inspections are performed appropriately.

One can file an official complaint in writing, such as by filling out OSHA's online complaint form at http://www.osha.gov/pls/osha7/ecomplaintform.html. Handwritten or typed complaints can also be submitted to any OSHA office. A list of the OSHA offices can be found at http://www.osha.gov/html/RAmap.html.

In nearly half of the states, a state agency—not federal OSHA—is responsible for workplace safety and health inspections. One can find out if one's state has a state agency at http://www.osha.gov/dcsp/osp/states.html.

Complaints can also be made anonymously or by telephone, e-mail, or fax. OSHA will review these but will consider them "informal." It is less certain that OSHA will perform a worksite inspection after an informal complaint than if the complaint is written and signed. OSHA is required to keep names confidential upon request.

Patients who do not have union representatives and do not want to file complaints directly may, in writing, designate health care providers or others as their representatives. The OSH Act directs OSHA to investigate complaints from employees or their representatives. OSHA will review all other complaints but will consider them "referrals," with less certainty that it will perform a worksite inspection.

One should provide as much specific information about the issues of concern as possible. The OSH Act requires unannounced, on-site inspections only when there are reasonable grounds to believe that there is an imminent danger at a workplace or that a violation of an OSHA regulation threatens physical harm.

Call the OSHA area office and talk to an inspector or supervisor. While this is not required, it will increase the likelihood that OSHA will respond quickly and seriously. If workers have a U.S. senator, Congressional representative, or state legislator call on their behalf, their complaints are more likely to be seriously considered.

Getting an On-site Consultation

Free safety and health consultation services are available to employers in every state. OSHA consultation services are funded primarily by federal OSHA, but delivered by the 50 state governments, most commonly through a state labor department or university. The list of consultation programs can be found at http://www.osha.gov/dcsp/smallbusiness/consult_directory.html. OSHA will not conduct a consultation visit without an invitation from the employer. If one feels that an employer might benefit from an OSHA consultation, one can try to convince the employer to seek assistance. One can contact the state consultation program office and suggest that a consultant call the employer. The consultation program will contact employers and offer its services, but a consultant will only enter the workplace if the employer responds positively and invites the consultant to enter.

Consultants provide advice about complying with OSHA regulations and otherwise controlling workplace hazards, but they do not enforce the OSH Act and do not issue citations and penalties. If they find violations of OSHA regulations, they inform employers and advise them about how to correct the problems. They will not pass this information on to OSHA inspectors, except in very special circumstances.

Protecting Against Discrimination

The OSH Act prohibits an employer from discriminating against any employee for having filed a complaint or exercising any rights afforded by the Act. Some examples of discrimination are firing, demotion, transfer, layoff, losing opportunity for overtime or promotion, assignment to an undesirable shift, denial of benefits (such as sick leave), blacklisting with other employers, and reducing pay or hours. Employees believing they have been discharged or otherwise discriminated against may file complaints with OSHA or state counterpart agencies within 30 days of alleged discrimination. Complaints can be telephoned, faxed, or mailed. OSHA conducts an interview with each complainant to determine the need for an investigation. OSHA or the state agency must then complete an investigation within 90 days of the complaint. If evidence supports a worker's claim, OSHA will ask the employer to restore the worker's job, earnings, and benefits. If the employer objects, OSHA may take the employer to court to seek relief for the worker. Instructions for filing a discrimination claim can be found at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=11341.

Box 2-5. The Mine Safety and Health Administration (MSHA): Intensive Intervention in a Dangerous Industry

James L. Weeks

The Mine Safety and Health Administration (MSHA) in the Department of Labor writes and enforces regulations to protect the health and safety of the 200,000 miners in the United States. These miners work in underground and surface mines that produce coal, metal ore, and other nonmetal commodities (such as salt and trona) and in sand, stone, and gravel quarries. Mining is one of the most dangerous industries in the United States and worldwide, with high rates of injuries, coal workers' pneumoconiosis (CWP), silicosis, lung cancer, and noise-induced hearing loss.

MSHA represents intensive intervention in a dangerous industry It has demonstrated a concerted and multifaceted effort at controlling occupational hazards can succeed at reducing rates of injury, illness, and death. Its key components have included active enforcement, sufficient resources, surveillance, exposure monitoring, worker training, epidemiologic research, and engineering research and development—all of which have been supported by regulatory authority.

The Federal Coal Mine Health and Safety Act of 1969 was passed after a widespread miners strike for compensation for CWP and a disastrous mine explosion. It created agencies and programs for epidemiologic research, development of safe mining practices, and compensation for miners totally disabled by pneumoconiosis (the federal black lung program). This program established a series of presumptions, based on the miner's clinical status and work history, to facilitate decisions about eligibility when etiology is ambiguous. Since 1981, claims have been paid by operators who last employed miners or, when operators cannot be found, by a disability trust fund to which operators contribute.

The 1969 act was amended in 1977 by the Mine Safety and Health Act (Mine Act), which placed MSHA in the Department of Labor, extended authority to all mines and quarries, and required that miners receive training in health and safety when first hired and annually thereafter.

For the purpose of establishing regulations on exposure to hazardous substances, the legal and scientific requirements of MSHA and OSHA are essentially the same. But MSHA is significantly different from OSHA in its enforcement capabilities. Under MSHA, underground mines must be annually inspected four times and surface mines, twice; most OSHA inspections are discretionary. Under MSHA, inspectors are authorized to close all or part of a mine if there is imminent danger; OSHA inspectors must get a court order to close all or part of a workplace.

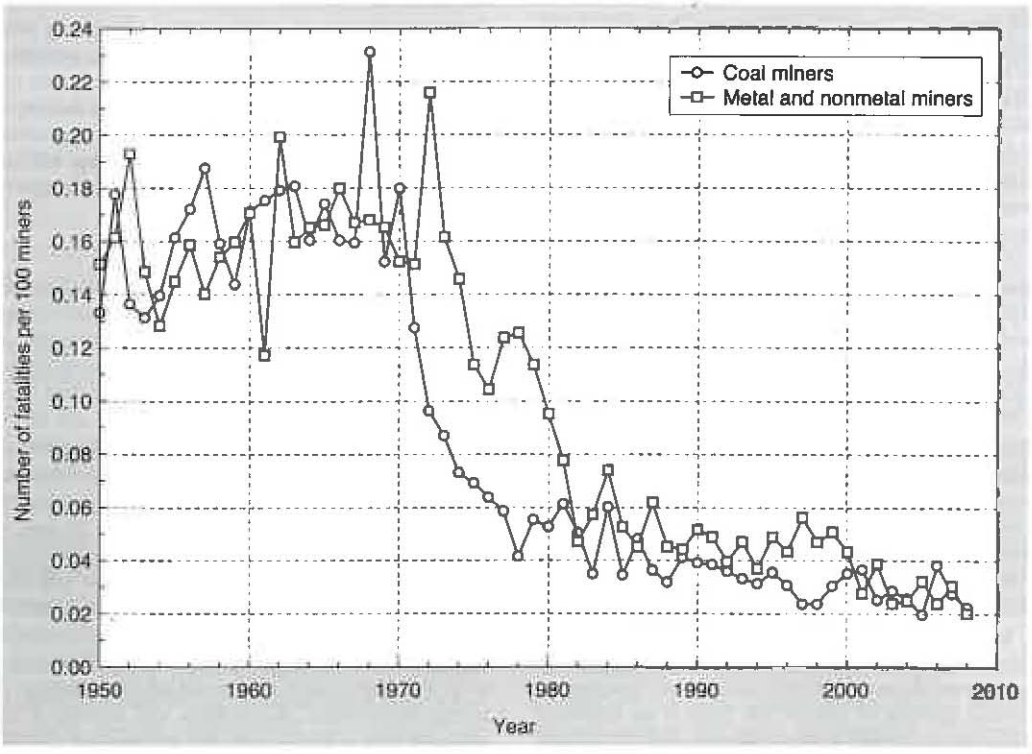


Figure 2-11. Rate of fatal injuries for coal and metal and nonmetal miners, United States, 1950–2008.

(*Continued*)

Box 2-5. The Mine Safety and Health Administration (MSHA): Intensive Intervention in a Dangerous Industry (Continued)

All mines are covered under MSHA; employers with 10 or fewer employees are exempt from OSHA general-schedule inspections. Mine operators must submit a mine plan and have it approved before they can produce; employers under OSHA's jurisdiction must obtain a permit only for certain confined-space conditions. MSHA has jurisdiction over less than 250,000 workers; OSHA, over about 100 million. Both agencies have about the same number of inspectors (including those in state plans), so the number of inspectors per worker under MSHA is approximately 400 times that under OSHA.

Mine-specific data on the number and rates of injuries, hours worked, and (coal) production are reported by mine operators to MSHA every quarter, and some of these data are available on the Internet. Surveillance data on exposure to dust, crystalline silica, other hazardous materials, and noise are also available from MSHA. In general, under OSHA, *estimates* of injury rates are available, by industrial category, based on an annual survey of a *sample* of employers; employers must post injury data annually, but they are not required to report it to OSHA. Neither MSHA nor OSHA guarantee the accuracy and reliability of surveillance data.

What has this regulatory intervention into the mining industry achieved? Before the passage of the 1969 act, the death rate of U.S. miners was about 0.25 per 100 workers per year—four times that of miners in Western European coal-mining countries. During the first 10 years after the Act was implemented, it declined to a level about the same as that in European mines. Since then, it has declined further to a death rate of approximately 0.03 per 100 workers (Fig. 2-11). Even so, it is the highest death rate of any major industry in the United States.

Regulation has also significantly reduced miners' exposure to respirable dust and the prevalence of CWP (Fig. 2-12). Respirable coal mine dust was measured at 6 to 8 mg/m³ before the 1969 act, but, for the same job, declined to less than 3 mg/m³ within 6 months. For continuous mining operators, the level is now regularly below 1 mg/m³. This progress was achieved in spite of mine operators claiming, in 1969, that it was impossible to reduce exposure to the statutory limit of 2 mg/m³. Exposure remains high at some mines and with some mining methods. Over the past decade, perhaps due to deregulation, CWP has nearly doubled among experienced miners and there are numerous "hot spots" with high prevalence of advanced CWP.

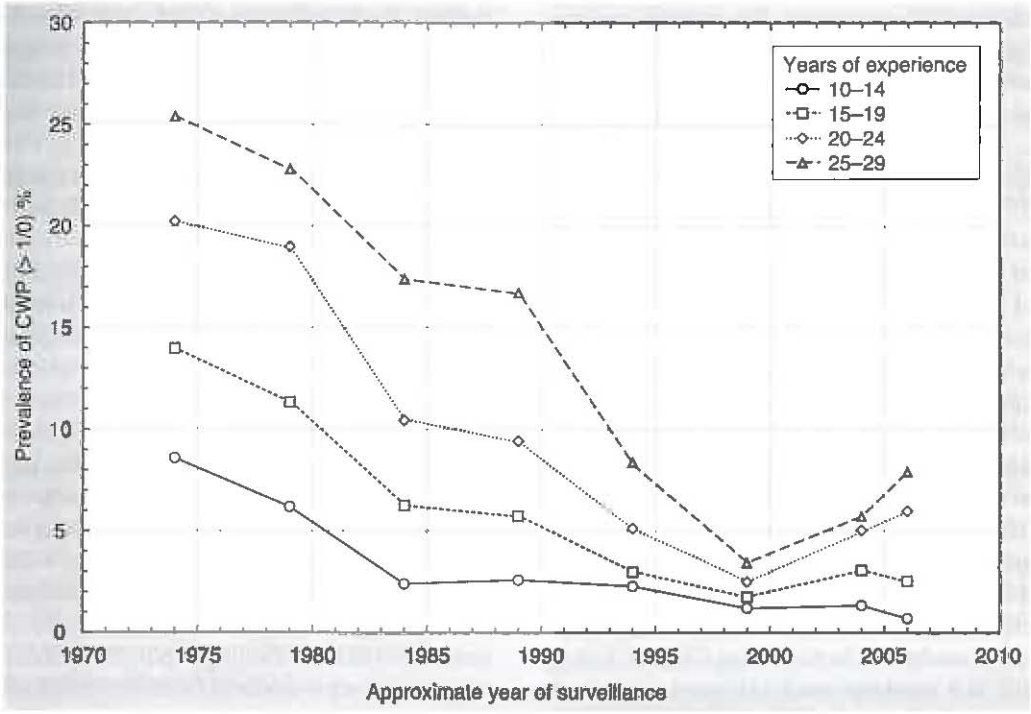


Figure 2-12. Prevalence of coal workers' pneumoconiosis (CWP) among coal miners, United States, 1974–2006, by miners' years of experience.

(Continued)

Box 2-5. The Mine Safety and Health Administration (MSHA): Intensive Intervention in a Dangerous Industry (Continued)

In addition, noise exposure remains high, exposure to crystalline silica is elevated, and underground miners are exposed to high levels of diesel exhaust.

From 2001 to 2005, preventable and predictable mine fires at four different coal mines killed nearly 30 miners. In 2007, elementary roof-control methods were neglected at a deep mine, resulting in a massive roof fall and the death of six miners and three rescue workers. These events prompted Congress to pass the Mine Improvement and New Emergency Response Act (the MINER Act) to improve emergency preparedness. In light of the failure of rescue efforts for recent disasters, these provisions are clearly needed, but stronger enforcement and disaster prevention—which the MINER Act did not address—could accomplish more. Indeed, as if to underscore the need, in early 2010, an explosion fueled (most likely) by methane and coal dust killed 29 miners at a mine in West Virginia. In sum, these disasters were the result of failure to control the best understood hazards of underground coal mining: fires, roof falls, and gas and dust explosions. Lack of knowledge about prevention methods did not contribute to these disasters; failure to use that knowledge did.

The Wage and Hour Division of the U.S. Department of Labor provides additional worker protection by enforcing federal minimum wage and overtime laws, minimum ages for various type of work, restrictions of young workers' exposure to specific hazardous tasks, provisions of the Family and Medical Leave Act, and field sanitation standards for migrant farmworkers.

The Department also administers workers' compensation programs for federal workers, longshoremen, and former energy workers, and provides benefits for miners who have developed coal workers' pneumoconiosis ("black lung").

The National Institute for Occupational Safety and Health (NIOSH)

Established by the OSH Act in 1970, NIOSH is part of the CDC, in the Department of Health and Human Services. It is responsible for conducting and supporting research to improve workplace safety and health, promoting and supporting training in occupational safety and health, providing technical assistance to employers and employees, and developing the scientific basis for standards and other policies.

One NIOSH program that is particularly relevant to health care practitioners of all types is the Health Hazard Evaluation (HHE) program, in which NIOSH responds to requests for investigations of workplace hazards. (See Chapter 34.) An HHE is a worksite study designed to evaluate potential workplace health hazards. HHEs can be requested by a management official, three current employees, or any officer of a labor union representing an employee. However, with an employee's consent, a health care professional can also contact NIOSH and speak with representatives of the HHE program. The program places a high priority on identifying and preventing emerging threats. The program generally will not conduct evaluations for known hazards, but will instead typically provide written information to the requestor. When an evaluation is conducted, NIOSH reports the results to the workers, the employer, and the U.S. Department of Labor, and makes recommendations for reduction or removal of the hazard. While the HHE program serves as a useful surveillance mechanism through which NIOSH is kept aware of emerging workplace concerns, NIOSH also conducts much additional surveillance to determine the number of workers exposed to specific hazards and in which industries and occupations they are at risk.

NIOSH supports research through *(a)* intramural programs that it conducts, *(b)* cooperative agreements that it initiates and in which it participates, and *(c)* research grants that extramural investigators initiate and conduct. In 1996, NIOSH established the National Occupational Research Agenda (NORA), a framework to guide occupational safety and health research—not only for NIOSH, but for the entire occupational health and safety community. Now, NORA organizes research by industry sector, although cross-cutting issues remain important. To disseminate research findings, NIOSH publishes reports and other materials that are designed to inform workers, employers, and occupational safety and health professionals of hazards and how to avoid them.

To further assist professionals and the public, NIOSH provides a toll-free information system.

It can be accessed by telephone at 1-800-CDC-INFO (1-800-232-4636). NIOSH specialists provide technical advice and information on subjects in occupational safety and health.

NIOSH supports comprehensive Occupational Safety and Health Educational Resource Centers (ERCs) and academic training programs that focus on occupational safety and health professional training and also provide continuing education and research training. They are a useful source of academic expertise and may be able to fund pilot research projects to permit preliminary investigation into new or emerging hazards.

U.S. Government Agencies and Programs in Environmental Health

The National Center for Environmental Health (NCEH)

NCEH, within CDC, coordinates a series of national programs to promote a healthy environment by targeting environmental exposures and provides technical assistance, on request, to state and local health departments. It helps to prevent disease and death resulting from interactions between people and their environment, including those due to chemicals. It also addresses hazards and impediments to walking and bicycling due to poor urban planning. NCEH has programs that address many environmental health problems and ways state and local health departments can improve their capabilities to address them. Its National Biomonitoring Program directly measures human exposure to toxic substances in the environment by measuring the substances or their metabolites. Based on the findings of this program, NCEH periodically publishes national reports to provide an overview of human exposure to environmental chemicals, a comprehensive assessment of the exposure of the U.S. population to chemicals in the environment.

The Agency for Toxic Substances and Disease Registry (ATSDR)

ATSDR, which is administratively part of CDC, was established to address health concerns arising from chemical pollution at Superfund sites. Its mission is to assess hazardous substances in the environment and mitigate their effect on public health. ATSDR performs public health assessments of waste sites and health consultations on specific hazardous substances. It also maintains disease registries, responds to emergency releases of hazardous substances, performs applied research in support of public health assessments, develops and disseminates information, and provides education and training on hazardous substances. ATSDR is obligated to formally respond to written citizen requests. (See Box 2-6.)

The National Institute of Environmental Health Sciences (NIEHS)

Part of the National Institutes of Health (NIH), NIEHS conducts and supports research to better understand how the environment influences development and progression of disease. It supports university-based resources; publishes Environmental Health Perspectives, a journal available in print and online; and produces documents on community-based participatory research and environmental justice and various research publications. NIEHS funds research and training in environmental health, including 22 university-based Environmental Health Core Science Centers, all of which have community outreach and educational components. NIEHS also funds worker education programs related to hazardous materials and environmental health education science curricula for grades K through 12.

The Environmental Protection Agency (EPA)

The mission of the EPA is to protect human health and to safeguard the natural environment on which it depends. By developing and enforcing regulations, it administers the Clean Air Act; the Clean Water Act; the Comprehensive Environmental Response, Compensation and Liability Act (Superfund); the Resource Conservation and Recovery Act; and the Toxic Substances Control Act (see Chapter 30). Although the EPA is primarily a regulatory agency, it also has research and laboratory facilities, training and outreach programs, and environmental justice initiatives that may provide expertise and technical assistance. It provides grants, studies environmental issues, sponsors partnerships, teaches people about the environment, and publishes information.

Box 2-6. How to Request Assistance from the Agency for Toxic Substances and Disease Registry (ATSDR)

Michelle Watters

ATSDR was established by the CERCLA (Superfund) legislation in 1980 to assist in evaluating public health impacts involving hazardous waste sites. A federal public health agency of the U.S. Department of Health and Human Services, it is administered together with the National Center for Environmental Health (NCEH), part of the Centers for Disease Control and Prevention (CDC). ATSDR does not have a regulatory role at hazardous waste sites, but it makes public health recommendations to the Environmental Protection Agency (EPA) and other government agencies concerning hazardous waste sites. ATSDR performs applied substance-specific research, exposure investigations and health studies, maintains registries, and provides information and health education on hazardous substances. ATSDR also receives requests from government agencies and citizens to investigate public health concerns from hazardous releases.

While public health practitioners and health care providers can access a variety of ATSDR educational materials and training opportunities on hazardous substances on the ATSDR Web site (http://www.atsdr.cdc.gov), more specific concerns or questions can be directed at any time to (800) 232-4636 or <cdcinfo@cdc.gov>, the regional ATSDR offices (http://www.atsdr.cdc.gov/dro/index.html), or the environmental divisions of state health departments. Information on chemical releases and permits from operating facilities can be obtained from the EPA Web site (http://www.epa.gov/enviro/index.html), EPA regional offices (http://www.epa.gov/epahome/postal.htm#regional), or state environmental agencies. Environmental emergencies that present sudden threats to public health should be reported to the National Response Center (800-424-8802).

By petitioning ATSDR in writing to perform a public health assessment, any person or group can request ATSDR to address health concerns related to an uncontrolled release of a hazardous substance from a waste site or former facility. The petition should include available relevant environmental data and the facility name, location, description of the release, and relevant health data.

ATSDR then gathers and reviews information about the site. Considerations are made regarding whether an assessment has already been performed that addresses the health concerns, whether a hazardous substance has been released, and whether a public health assessment is the most appropriate response. The petitioner is sent a written response as to whether the petition process will continue.

The ATSDR site team assembled includes environmental scientists, physicians, toxicologists, epidemiologists, and others. The site team gathers available environmental and exposure data from the site and identifies public health issues and the petitioner's concerns. A scoping visit may be made to the site to meet with the petitioner and other community members. A post-scoping debriefing session is held to determine whether there is a plausible relationship between possible human exposure and adverse health outcomes from a release given the location, concentration, and toxicity of the substance.

Petitioners are informed in writing of ATSDR's decision about the most appropriate public health response or if the petition has not been accepted. The public health response typically is a health consultation by ATSDR or a state public health agency that evaluates the available environmental exposure data and examines the exposure routes.

A *health consultation* is a written evaluation about the hazardous substance released at a site and the likelihood that human exposure can occur or has occurred, and if the level of exposure could result in harm. A *public health assessment* (PHA) is a more comprehensive document that examines multiple exposure pathways. Depending upon the complexity of the site, community advisory panels may be formed to act as a liaison between ATSDR and the community. If a public health hazard is determined to be present at the site, recommendations are made for reducing or eliminating the exposure and additional public health responses. ATSDR works with the EPA and other environmental and health agencies to ensure that the recommendations can be implemented. Before the PHA becomes final, there is a public release of the document for community review and comment. A public meeting may also be held to discuss the findings and public health action plan.

Its Web site includes tools to identify contaminant sources at the neighborhood level ("Enviromapper"), Toxic Release Inventory information, and real-time air pollution mapping, among other resources.

State and Local Government Agencies

Public health departments generally perform some environmental control and sanitation, and many have programs on childhood lead screening. Some address other housing issues, such as radon detection, window safety, and water incursion, although sometimes these programs are located in a department of housing. Control of vectors, including rats, mosquitoes, and other pests, is an additional responsibility of many health departments. State departments of environmental protection or environmental resources are tasked with many of the enforcement responsibilities required by EPA regulations,

although there is growing recognition of the need for regional collaboration among states for many of these responsibilities. These state-level departments or the EPA may provide information about certified laboratories that perform environmental testing. Some state health departments have strong units that address occupational safety and health. Some major cities have strong environmental health units within their public health departments. State, county, and municipal Web sites are useful sources of information. Government agencies are also listed in the blue pages of telephone books.

In those states with collaboration among different entities, such as departments of health, workers' compensation divisions, academic programs, and state-plan occupational safety and health programs, effective partnerships have been established that link surveillance to interventions so that hazards can be identified and reduced. Because of inadequate resources, many states do not have sufficient resources to address environmental and occupational health issues effectively.

International Organizations

The World Health Organization (WHO)

WHO is the directing and coordinating authority for health within the United Nations system. WHO aims to strengthen national systems to respond to the needs of working populations, establish basic levels of health protection for all workers, and ensure all workers access to preventive health services. The Occupational Health Group of WHO operates a network of Collaborating Centres that actively participate in its Global Plan of Action on Workers' Health. The Department of Public Health and Environment of WHO aims to promote a healthier environment, intensify primary prevention, and influence public policies in all sectors so as to address the root causes of environmental threats to health. The Pan American Health Organization (PAHO) is the regional organization of WHO for North and South America as well as the Caribbean.

The International Agency for Research on Cancer (IARC)

The mission of IARC, which is part of WHO, is to coordinate and conduct research on the causes of human cancer and the mechanisms of carcinogenesis, and to develop scientific strategies for cancer prevention and control. IARC is involved in both epidemiological and laboratory research and disseminates scientific information through publications, meetings, courses, and fellowships.

The International Labor Organization (ILO)

ILO is devoted to advancing opportunities for women and men to obtain decent and productive work in conditions of freedom, equity, security, and human dignity. Its main aims are to promote rights at work, encourage decent employment opportunities, enhance social protection, and strengthen dialogue in handling work-related issues. In promoting social justice and internationally recognized human and labor rights, ILO continues to pursue its founding mission that labor peace is essential to prosperity. ILO helps advance the creation of decent jobs and the kinds of economic and working conditions that give working people and business people a stake in lasting peace, prosperity, and progress.

The United Nations Environment Programme (UNEP)

The mission of UNEP is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.

Intergovernmental Panel on Climate Change (IPCC)

IPCC is the leading body for the assessment of climate change. It was established by UNEP and the World Meterological Organization (WMO) to provide the world with a clear scientific view of the current state of climate change and its potential environmental and socioeconomic consequences.

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