chapter 1

Growth of Occupational Health

by Leela I. Murthy, MSc, PhD

After passage of the Occupational Safety and Health Act (OSHAct) in 1970, the field of occupational health and safety continues to grow. In the United States, more experts are involved in the process of maintaining a safe and healthy workplace. Among them are physicians, nurses, safety professionals, and industrial hygienists. These professionals are collectively involved and work as a team. Today these professionals receive more training in occupational health than ever before.

Today, workers are more aware of the types of exposures they encounter in the workplace, and management better recognizes the need for employing trained personnel to maintain a safe and healthy work environment. However more needs to be done, particularly, in small businesses, which comprise more than 99% of the total U.S. work force (CBP, 1999). Many of these businesses cannot afford to hire trained occupational health and safety personnel on a full-time basis. Their only recourse may be to use these professional services on a contractual or shared basis with other small businesses.

According to the 1999 County Business Patterns of the U.S. Bureau of the Census, a total of 6,894,869 establishments employed 105,299,123 employees. Of these, approximately 6,877,784 (99.75%) employed fewer than 500 employees; another 10,903 (0.16%) establishments employed 500–999 employees, and 6,182 (0.09%) employed more than 1,000 employees (CBP, 1999). The percent distribution of establishments and employment by four employment-size classes are presented in Table 1-A.

Table 1-A. Percent Distribution of Employment In Four Employment-Sized Classes—1997, County Business Patterns, October 1999.

A. BY ESTABLISHMENTS

Employment Size Class	No. of Establishments	Percent Total
<100	6,734,738	97.68
100–499	143,046	2.07
500–999	10,903	0.16
1,000 or more	6,182	0.09
TOTAL	**6,894,869**	**100.00**

B. BY EMPLOYMENT

Employment Size Class	No. of Employees	Percent Total
<100	57,513,655	54.62
100–499	26,993,124	25.63
500–999	7,422,258	7.05
1,000 or more	13,370,086	12.70
TOTAL	**105,299,123**	**100.00**

Source: County Business Patterns, September 1999

Even with the progress made in using skilled professionals to identify and control occupational risks, occupational diseases and injuries continue to occur in the workplace. The latest detailed statistics on injuries and illnesses in the workplace are available from the Bureau of Labor Statistics (BLS), U.S. Department of Labor. The number of nonfatal occupational illnesses and injuries reported in the private sector in 1997 was 6.15 million. This was down from 6.2 million reported in 1996. Of the 6.15 million cases, about 1.92 million cases (31.2%) were from the Manufacturing industry. Wholesale & Retail Trade, and Services industries each accounted for about 23%–25% of total cases (BLS, 1998a). According to a recent report by the National Safety Council, the estimated number of occupational injury deaths (including homicide and suicide) for 1997 for all industries was 6,218, slightly higher than the 6,202 noted in the previous year (NSC, 1999).

For 1998, the National Safety Council estimated that 5,100 unintentional injury deaths (not including homicides and suicides) were attributed to injuries on the job versus 37,600 deaths off the job. The latter include motor-vehicle, public nonmotor-vehicle, and home deaths (NSC, 1999). Of the total 9.5 million disabling injuries in 1998, 3.8 million were occupationally related. Production time lost due to off-the-job injuries were approximately 140 million days in 1998 compared with 80 million days lost by workers injured on-the-job (NSC, 1999).

A part of the employer's burden of occupational deaths, illnesses, and injuries is the cost for workers' compensation claims. The National Safety Council estimated that the total costs of occupational deaths and injuries in 1998 were $125.1 billion, down from $127.7 billion for 1997. Total costs for 1998 included wage and productivity losses of $62.9 billion, medical costs of $19.9 billion, and administrative expenses of $25.6 billion. There were other losses ($12.0 billion) that included monetary value of time lost by workers other than those with disabling injuries, damages to motor vehicles, and fire losses (NSC, 1999).

The costs for workers' compensation claims are even more critical for small businesses. For them to remain financially competitive, they often have to reduce costs, particularly for health care and workers' compensation claims.

1970 WILLIAMS-STEIGER OCCUPATIONAL SAFETY AND HEALTH ACT

The Williams-Steiger Occupational Safety and Health Act (OSHAct) passed in 1970 (Figure 1-1). Its passage followed the recognition of work-related illnesses and injuries by the unions and by industries. The Occupational Safety and Health Administration (OSHA) in the Department of Labor was created to administer this act. According to this act,

> *...the OSHA Administrator shall, among other purposes, promulgate and revise occupational safety and health standards; encourage employers and employees in their effort to reduce the number of occupational safety and health hazards; provide for research in the field of occupational health; provide medical criteria which will ensure that no employee will suffer diminished health; and provide for training programs to increase the number and competence of personnel engaged in the field of occupational safety and health.*

The National Institute for Occupational Safety and Health (NIOSH) also was created by this act "to assure so far as possible every man and woman in the nation safe and healthful working conditions." NIOSH was placed in the Department of Health, Education, and Welfare, now renamed the Department of Health and Human Services. NIOSH conducts research for OSHA and provides

Public Law 91-596
91st Congress, S. 2193
December 29, 1970

An Act

84 STAT. 1590

To assure safe and healthful working conditions for working men and women; by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health; and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Occupational Safety and Health Act of 1970".

Occupational Safety and Health Act of 1970.

CONGRESSIONAL FINDINGS AND PURPOSE

SEC. (2) The Congress finds that personal injuries and illnesses arising out of work situations impose a substantial burden upon, and are a hindrance to, interstate commerce in terms of lost production, wage

An Act

To assure safe and healthful working conditions for working men and women; by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health; and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Occupational Safety and Health Act of 1970".

(3) by authorizing the Secretary of Labor to set mandatory occupational safety and health standards applicable to businesses affecting interstate commerce, and by creating an Occupational Safety and Health Review Commission for carrying out adjudicatory functions under the Act;

(4) by building upon advances already made through employer and employee initiative for providing safe and healthful working conditions;

(5) by providing for research in the field of occupational safety and health, including the psychological factors involved, and by developing innovative methods, techniques, and approaches for dealing with occupational safety and health problems;

(6) by exploring ways to discover latent diseases, establishing causal connections between diseases and work in environmental conditions, and conducting other research relating to health problems, in recognition of the fact that occupational health standards present problems often different from those involved in occupational safety;

(7) by providing medical criteria which will assure insofar as practicable that no employee will suffer diminished health, functional capacity, or life expectancy as a result of his work experience;

(8) by providing for training programs to increase the number and competence of personnel engaged in the field of occupational safety and health;

Figure 1-1. The OSHAct passed in 1970 after work-related illnesses and injuries were widely recognized by industries and unions.

"criteria for recommended standards for chemicals and mixtures of chemicals." NIOSH also provides information to the public on occupational topics via an 800-telephone number (800/35-NIOSH or 800/356-4674). They have a fax-on-demand service at 888/232-3299 and their web site address is http://www.cdc.gov/niosh. According to Part 85a of the act, NIOSH conducts health hazard evaluations in industries upon request by an employer, employee representatives, or by a union representative. NIOSH experts suggest innovative ways to control the particular substance (chemical or physical) from causing illness or injury to employees in the workplace.

Safety and Health Standards

Passage of the 1970 OSHAct resulted in promulgation of various safety and health standards (Figure 1-2). Throughout the years some regulations have been contested by specific industries; and the Circuit Court of Appeals decides the outcome of the appeal. In some instances, only a section of the regulation has been vacated. One example was the updating by OSHA of Subpart Z—Toxic and Hazardous Substances, specifically, Table Z-1, which provides permissible exposure limits (PELs) for various chemicals designated in the regulations as "Limits for Air Contaminants."

OSHA published a revised Table Z-1 in the July 1, 1989, issue of Code of Federal Regulations (CFR, 1989). The PELs that were originally promulgated by OSHA for the substances known to be hazardous were updated; the original limits were designated "transitional" and the updated limits were termed "final rule limits." Upon contest by the industries in the Court of Appeals, the "final rule limits" were vacated by the Court and the "transitional limits" were maintained as the current Permissible Exposure Limits (PELs).

In addition to promulgating standards, OSHA is authorized by the act to conduct inspections at worksites and to issue citations and civil penalties to enforce the standard. The act also allows states to have even more stringent standards than those of the national standard and to administer their own safety and health standards. States are not required to submit to the federal OSHA program, provided they establish and administer their own occupational safety and health standards, which are at least in as stringent as those of the federal program.

Section 8c of the OSHAct requires that employers maintain a record of work-related illnesses and injuries in the OSHA 200 Log. A copy of the OSHA 200 log (Figure 1-3) should be made available to employees, former employees, or their representatives, upon request. This record is to be posted in the workplace in February for a month. The employees are also responsible under Section 2(b) of the act by being encouraged (1) to reduce the number of occupational safety and health hazards in their place of employment and (2) to achieve safe and healthful working conditions (OSHAct, 1970 and 1991 [revised]).

In 1981, the U.S. Congress mandated that OSHA would not inspect businesses with less than 10 employees unless (1) a fatality occurred or (2) there was an employee complaint. Businesses with less than 10 employees are also exempt from OSHA record-keeping requirements.

In many facilities, employers and staff are not aware of the chemical or physical hazards that may be present; or what occupational diseases can occur as a result of overexposure to these hazards. Some reasons for this include the following:

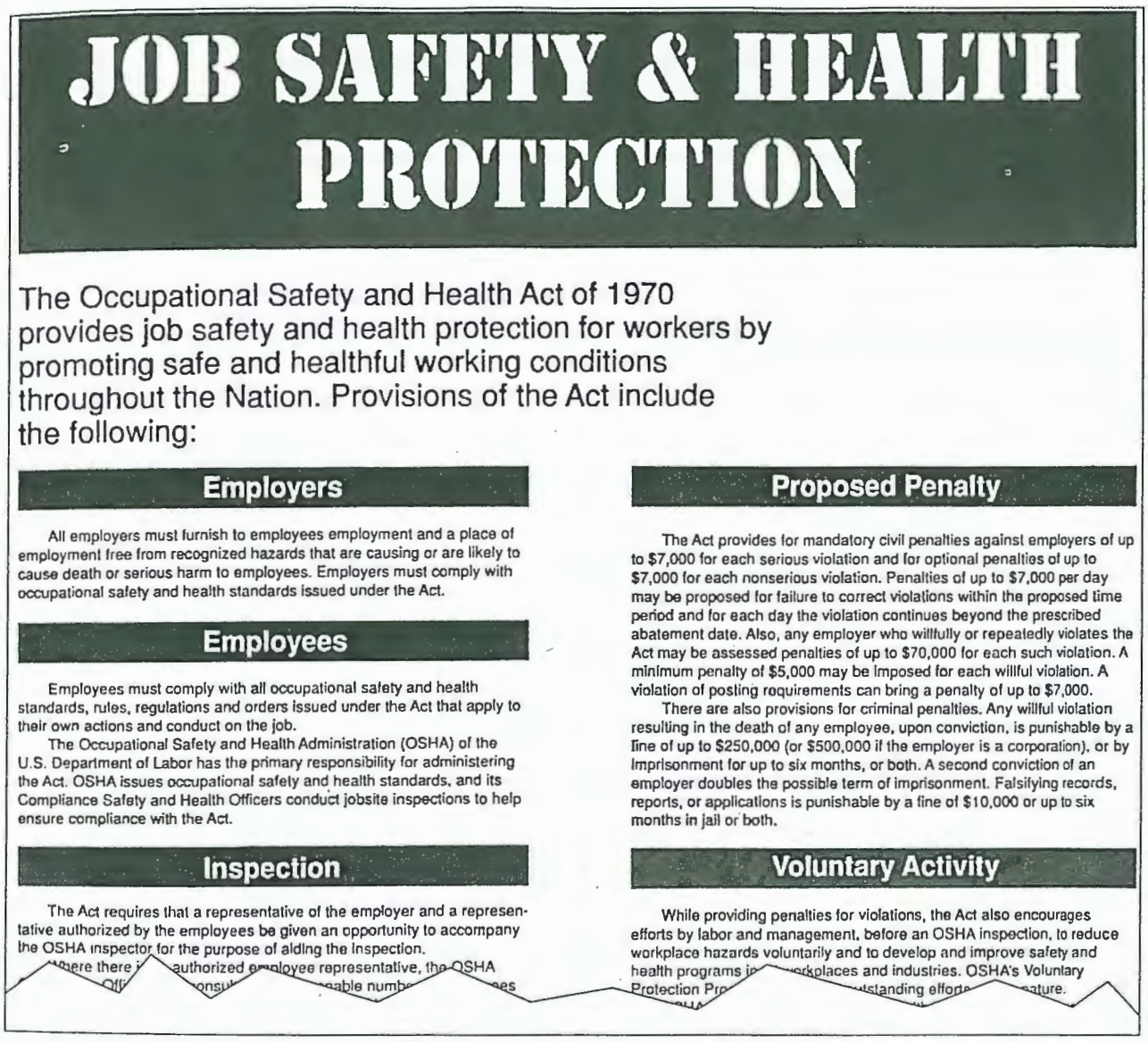
- Today there are so many trade-name products used in the workplace.
- Manufacturers' product information may not provide toxicity data on all the chemicals used in a facility. This makes it difficult to know what chemicals to sample there.

OSHA addressed this problem via the Hazard Communication Standard (29 *CFR* 1910.1200) for all manufacturing industries in the private sector, effective Nov. 25, 1985 (OSHA, 1985, 1987). This standard requires all manufacturers to evaluate the hazards of chemicals they use and produce.

The standard requires all facilities that use and produce chemicals to maintain a Material Safety Data Sheet (MSDS) for each chemical they use and produce. This information enables those who either use chemicals or formulate other chemicals from these chemicals to be aware of the toxicity of these chemicals. All facility employees must be informed about the toxicity of the chemicals being handled in their day-to-day work.

The Hazard Communication Standard requires the industries that use or produce chemicals to accomplish the following:

- Have a complete knowledge of the toxicity of these chemicals.
- Label the chemicals appropriately.
- Prepare a MSDS for each of the chemicals used in the workplace and place each in specific locations accessible to the employees.



JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Provisions of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Proposed Penalty

The Act provides for mandatory civil penalties against employers of up to $7,000 for each serious violation and for optional penalties of up to $7,000 for each nonserious violation. Penalties of up to $7,000 per day may be proposed for failure to correct violations within the proposed time period and for each day the violation continues beyond the prescribed abatement date. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $70,000 for each such violation. A minimum penalty of $5,000 may be imposed for each willful violation. A violation of posting requirements can bring a penalty of up to $7,000.

There are also provisions for criminal penalties. Any willful violation resulting in the death of any employee, upon conviction, is punishable by a fine of up to $250,000 (or $500,000 if the employer is a corporation), or by imprisonment for up to six months, or both. A second conviction of an employer doubles the possible term of imprisonment. Falsifying records, reports, or applications is punishable by a fine of $10,000 or up to six months in jail or both.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in workplaces and industries. OSHA's Voluntary Protection Pro

Figure 1-2. The Job Safety & Health Protection poster is shown. This is posted in the workplace.

- Maintain a Hazard Communication Program (HCP) that includes training of industrial hygienists and safety officers about specific hazards in the workplace.

In 1987, the Hazard Communication Standard was amended to include all nonmanufacturing industries in the private sector (OSHA, 1985, 1987, 1994), see Figure 1-4.

Recent Findings

According to a report published in April 1998, the most cited OSHA General Industry Standard during fiscal year 1996/97 was the Hazard Communication Standard (29 *CFR* Part 1910.1200). Violations for three of the top five (by number of violation) were for hazard communication lapses totaling close to $4.4 million in initial penalty. There were 1,094 violations for the OSHA 200 log and summary with an initial penalty of approximately $857,000, which was later adjusted to $55,146. There were 892 violations for the OSHAct general duty clause—employers must provide a safe workplace for employees—which resulted in an initial penalty of $4,537,000 (Keller, 1998).

At its 103rd session, the U.S. Congress found the following:

1. Despite the progress made in the reduction of occupational illnesses, injuries, and deaths during the past two decades, work-related injuries, illnesses, and deaths continue to occur at rates that are unacceptable and impose a substantial burden upon employees, employers, and the

Bureau of Labor Statistics
Log and Summary of Occupational
Injuries and Illnesses

NOTE: **This form is required by Public Law 91-596 and must be kept in the establishment for 5 years. Failure to maintain and post can result in the issuance of citations and assessment of penalties.** *(See posting requirements on the other side of form.)*

RECORDABLE CASES: You are required to record information about every occupational death, every nonfatal occupational illness; and those nonfatal occupational injuries which involve one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid). *(See definitions on the other side of form.)*

Case or File Number	Date of Injury or Onset of Illness	Employee's Name	Occupation	Department	Description of Injury or Illness
Enter a nonduplicating number which will facilitate comparisons with supplementary records.	Enter Mo./day.	Enter first name or initial, middle initial, last name.	Enter regular job title, not activity employee was performing when injured or at onset of illness. In the absence of a formal title, enter a brief description of the employee's duties.	Enter department in which the employee is regularly employed or a description of normal workplace to which employee is assigned, even though temporarily working in another department at the time of injury or illness.	Enter a brief description of the injury or illness and indicate the part or parts of body affected. Typical entries for this column might be Amputation of 1st joint right forefinger, Strain of lower back; Contact dermatitis on both hands, Electrocution—body
(A)	(B)	(C)	(D)	(E)	(F)
					PREVIOUS PAGE TOTALS →
					TOTALS (Instructions on other side of form.) →

OSHA No. 200 ★U.S.GPO:1980-282-256/15419

Figure 1-3 (continued)

Figure 1-3. The OSHA 200 Log contains a record of work-related illnesses and injuries.

nation in terms of lost production, wage loss, medical expenses, compensation payments, and employee disability.

2. Employers and employees are not sufficiently involved in working together to identify and correct occupational safety and health hazards and thus require better training.
3. Enforcement of occupational safety and health hazards has not been adequate to bring about timely abatement of hazardous conditions or to

U.S. Department of Labor

For Calendar Year 19 ____ Page ____ of ____

Company Name
Establishment Name
Establishment Address

Form Approved
O.M.B. No 1220-0029
See OMB Disclosure Statement on reverse.

Extent of and Outcome of INJURY						Type, Extent of, and Outcome of ILLNESS													
Fatalities	Nonfatal Injuries					Type of Illness							Fatalities	Nonfatal Illnesses					
Injury Related	Injuries With Lost Workdays				Injuries Without Lost Workdays	CHECK Only One Column for Each Illness (See other side of form for terminations or permanent transfers.)							Illness Related	Illnesses With Lost Workdays				Illnesses Without Lost Workdays	
Enter DATE of death. Mo./day/yr.	Enter a CHECK if injury involves days away from work, or days of restricted work activity, or both	Enter a CHECK if injury involves days away from work.	Enter number of DAYS away from work.	Enter number of DAYS of restricted work activity.	Enter a CHECK if no entry was made in columns 1 or 2 but the injury is recordable as defined above.	Permanent loss of hearing	Dust diseases of the lungs	Respiratory conditions due to toxic agents	Poisoning (systemic effects of toxic materials)	Disorders due to physical agents	Disorders associated with repeated trauma	All other occupational illnesses	Enter DATE of death. Mo./day/yr.	Enter a CHECK if illness involves days away from work, or days of restricted work activity, or both.	Enter a CHECK if illness involves days away from work.	Enter number of DAYS away from work.	Enter number of DAYS of restricted work activity.	Enter a CHECK if no entry was made in columns 8 or 9.	
(1)	(2)	(3)	(4)	(5)	(6)	(7) (a)	(b)	(c)	(d)	(e)	(f)	(g)	(8)	(9)	(10)	(11)	(12)	(13)	

INJURIES

ILLNESSES

Certification of Annual Summary Totals By _____ Title _____ Date _____

FOLD

OSHA No 2X

POST ONLY THIS PORTION OF THE LAST PAGE NO LATER THAN FEBRUARY 1.

deter violations of occupational safety and health hazards.

4. Millions of employees exposed to serious occupational safety and health hazards were excluded from the full coverage under the Occupational Safety and Health Act of 1970.
5. The lack of accurate data and information has impeded efforts to prevent work-related deaths, injuries, and illnesses.
6. Injury and illness statistics from the Construction industry showed that current regulations under the 1970 OSHAct did not adequately address the safety and health hazards of construction work (OSHRA, 1994).

Most of the titles discussed in the Reform Act of 1994 deal with OSHA; however, Title IX highlights NIOSH research in occupational safety and health. Some of the main requirements of this title for NIOSH are health hazard evaluations, safety research, contractor rights, a national surveillance program, and training, all of which have been conducted since its inception. Title XII dis-

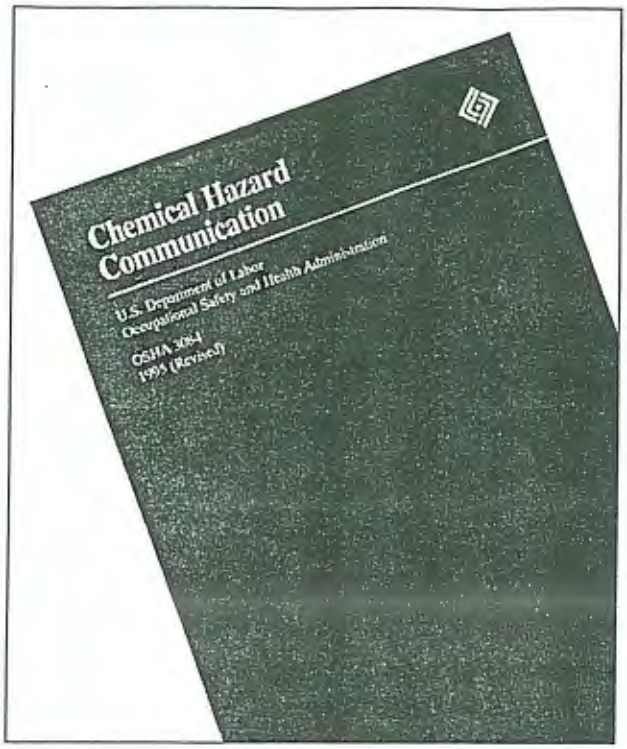


Figure 1-4. Facilities should have a Hazard Communication Program in the workplace. This includes training of industrial hygienists and safety practitioners about the specific hazards in the workplace.

cusses construction safety in great detail (OSHRA, 1994).

Some of these congressional findings are already being addressed. The Bureau of Labor Statistics (BLS) implemented a new plan in 1992 to conduct a systematic verifiable count of all fatal occupational injuries and to obtain descriptive data on the circumstances surrounding these events (NSC, 1994). This would yield better data on actual deaths than the estimated deaths that were used previously. The formation of occupational safety and health teams to identify occupational injuries and illnesses is also under way; data are being collected and reported. In addition to the requirement in Title IX, under the Small Business Initiative NIOSH is involved in the identification of problems in small businesses. A report on Identifying Hazardous Small-Business Industries — The Basis for Preventing Occupational Injury, Illness, and Fatality was published in May 1999 (NIOSH, 1999).

OSHA was criticized for not adequately addressing the safety and health hazards of construction work. To remedy this, OSHA and the Associated General Contractors of America (AGC) pledged to work together under a newly developed partnership charter to reduce workplace injuries and illnesses in the construction industry (BNA, 1998). Such partnerships help reduce illnesses and injuries since both industry and government are involved. Complete findings of the 103rd U.S. Congress can be obtained from the Comprehensive Occupational Safety and Health Act (COSHA) (OSHRA, 1994).

OCCUPATIONAL ILLNESSES, INJURIES, AND DEATHS

Occupational health and safety professionals use specific terms in their reporting systems. These terms are defined by the Bureau of Labor Statistics (BLS), U.S. Department of Labor, in the *Record Keeping Guidelines for Occupational Injuries and Illnesses* (BLS, 1986). The following definitions are used:

Nonfatal recordable injuries and illnesses are either

1. nonfatal occupational illnesses, or
2. nonfatal occupational injuries that involve one or more of the following:
   - loss of consciousness
   - restriction of work or motion
   - transfer to another job
   - medical treatment (other than first aid).

Unless otherwise mentioned, the terms *occupational illness* and *occupational injury* mentioned in this chapter mean they are of the nonfatal type.

- *Occupational injury* is an injury (such as a cut, fracture, sprain, strain, amputation, etc.) that results from a work event or from a single instantaneous exposure in the work environment.
- *Occupational illness* is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to factors associated with employment. It includes acute and chronic illnesses or diseases that can be caused by inhalation, absorption, ingestion, or direct contact. Repetitive motion diagnoses are considered occupational illnesses since there is not an instantaneous exposure event.
- *Lost workday* cases are cases that involve days away from work, or days of restricted work activity, or both.
- *Lost workday cases involving days away from work* are those resulting in days away from work, or a combination of days away from work and days of restricted work activity.

- *Incidence rates* represent the number of injuries and /or illnesses per 100 full-time workers and are calculated as:

  (N/EH) × 200,000

  where:

  N = number of injuries and/or illnesses

  EH = total hours worked by all employees during the calendar year

  200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

The National Safety Council has its own definition of *injury*:

> A disabling injury is defined as one that results in death, some degree of impairment, or renders the injured person unable to perform his or her regular duties or activities for a full day beyond the day of injury. This definition applies to all categories of incidents—motor vehicles (moving), work, home, other, and not classified.

Occupational Deaths

The number of fatal occupational injuries in 1996 for all industries was 6,112, down from 6,275 the previous year, according to the BLS (Toscano & Windau, 1998). However, the 1999 BLS report shows an increase in fatal occupational injuries to 6,238 in 1997, but these decrease to 6,026 in 1998. Details of these data are still pending (BLS, 1999). The 1998 report showed that highway traffic incidents and homicides continued to lead all other events in the number of fatal work injuries in 1996, contributing to more than one-third of the total that occurred during the year. The 1998 report also noted that work-related highway deaths accounted for one-fifth of fatal work injuries though the number of fatal work injuries fell to the lowest level in five years in 1996. Table 1-B presents the trend of occupational injury deaths (total deaths, assaults & violent acts, homicide, and suicide) for all industries for the years 1994 through 1998. Table 1-B shows that there was a steady decrease in homicide deaths—from 1,080 in 1994 to 709 homicides in 1998. Suicide deaths, on the other hand, increased from 214 in 1994 to 221 in 1995, decreased to 199 in 1996; but again increased to 216 and 223 in 1997 and 1998, respectively. (Toscano & Windau, 1998; News Release, BLS, 1998b; News Release, BLS, 1999.)

The National Safety Council adopted the BLS Census of Fatal Occupational Injuries (CFOI) figures as the authoritative count of work-related deaths. The CFOI counts intentional (including homicide and suicide) as well as unintentional work injuries. Using the CFOI data, the Council published details of occupational injury deaths and death rates for the years 1993–1997, including preliminary data for 1998, which are presented in Table 1-C (NSC, 1999). An increase in injury deaths in 1997 was noted in all industries except Trade and Services. The increased trend in injury deaths for the Construction, Services, and Government industries continued in 1998. The total number of deaths for 1998 is not yet known since the number of homicide and suicide deaths are not yet available (NSC, 1999). A slight increase in unintentional deaths (excluding homicide & suicide) for all industries was noted, from 5,069 in 1996 to 5,148 in 1997, but decreased to 5,100 in 1998. When death rates were compared for 1996 and 1997, a slight increase in death rates were noted for Agriculture, Manufacturing, and for Government but decreased in all other industries as noted in Table 1-D (NSC, 1999).

Preliminary BLS data are available for unintentional injuries at work for 1998. Table 1-E presents the National Safety Council's estimated number of occupational unintentional injury deaths, disabling injuries, and death rates by industry division for 1998 (NSC, 1999). In 1998 there was a total of 5,100 unintentional deaths for all industries, with a death rate of 3.8 per 100,000 workers, and 3.8 million disabling injuries. The Mining industry employed only 618,000 workers but showed a death rate of 24.3 per 100,000 workers, the highest death rate among all industries. The next highest death rate (22.1/100,000

Table 1-B. Fatal Occupational Injury Deaths Due to Assaults and Violent Acts for All Industries—1994–1998, Bureau of Labor Statistics U.S. Department of Labor, 1999.*

Deaths	1994	1995	1996	1997	1998
Total	6,632	6,275	6,112	6,238	6,026
Assaults and Violent Acts	1,321	1,280	1,144	1,111	960
Homicide	1,080	1,036	912	860	709
Self-Inflicted Injury	214	221	199	216	223

* *Sources:* (1) Toscano & Windau, 1998; News Release, BLS, Aug 4, 1999.

Table 1-C. Occupational Injury Deaths by Industry—1993–1998, National Safety Council, 1999.

Deaths	1993	1994	1995	1996	1997	1998
Total	**6,331**	**6,632**	**6,275**	**6,202**	**6,218**	—
Homicide and Suicide	1,296	1,294	1,257	1,133	1,070	—
Unintentional						
All Industries	5,035	5,338	5,018	5,069	5,148	5,100
Agriculture	842	814	770	768	799	780
Mining and Quarrying	169	177	155	152	156	150
Construction	895	1,000	1,021	1,073	1,105	1,120
Manufacturing	698	734	640	663	679	660
Transportation & Public Utilities	753	819	784	923	927	920
Trade	450	492	462	454	451	450
Services	632	676	608	671	670	680
Government	528	534	529	321	339	340

Source: Injury Facts,™ formerly *Accident Facts,*® National Safety Council, 1999.

Table 1-D. Occupational Injury Death Rates by Industry—1993–1998, National Safety Council, 1999.

Deaths/100,000 Workers	1993	1994	1995	1996	1997	1998
Total	**5.2**	**5.3**	**4.9**	**4.8**	**4.7**	—
Homicide, Suicide	1.0	1.0	0.9	0.9	0.8	—
Unintentional						
All Industries	4.2	4.3	4.0	4.0	3.9	3.8
Agriculture	26.0	22.8	21.5	21.3	22.5	22.1
Mining and Quarrying	25.3	26.5	24.8	26.8	24.7	24.3
Construction	13.3	14.4	14.3	14.4	14.1	13.9
Manufacturing	3.6	3.7	3.1	3.2	3.3	3.2
Transportation & Public Utilities	11.0	11.6	11.0	12.7	12.2	11.9
Trade	1.8	1.9	1.8	1.7	1.7	1.7
Services	1.6	1.7	1.5	1.6	1.5	1.5
Government	2.6	2.7	2.7	1.6	1.8	1.7

Source: Injury Facts,™ formerly *Accident Facts,*® National Safety Council, 1999.

workers) was seen in the Agriculture industry, which had 3,450,000 workers on the payroll. Of the 132,772,000 workers in all industries, only 8,045,00 (58.4%) were in the Construction industry, with 1,120 deaths noted, yielding a death rate of 13.9 per 100,000 workers. These data again show that using deaths alone may be erroneous since the number of workers in some industries are fewer compared to those in Manufacturing, Wholesale & Retail Trade, and Services industries. Table 1-E also shows that the Services industry had the highest number of disabling injuries (900,000) compared to the Mining industry, which had 30,000 disabling injuries. These data show that the number of disabling injuries is greater among industries employing larger numbers of workers.

NIOSH monitors occupational injury deaths using the National Traumatic Occupational Fatalities (NTOF) surveillance system (Jenkins et al, 1993). In the Apr 24, 1998, *Morbidity and Mortality Weekly Report* (*MMWR*), NIOSH reported on the magnitude of work-injury deaths for the United States from 1980 through 1994. This NIOSH report showed that the annual total number of deaths and crude death rates decreased from 7,405 (7.5 per 100,000 workers) in 1980 to 5,406 (4.4 per 100,000 workers) in 1994. The report also identified high-risk industries and occupations both at national and state levels. National death rates were calculated using denominators from employment data from the BLS' Current Population Survey (BLS, 1980–1985). Only deaths of civilian workers were used for this survey (Jenkins et al, 1993). The Construction industry had the highest number of deaths in the period 1980–1994, with 16,091 deaths (18.2%). However, when the death rates were calculated, the Mining industry topped the list with 30.5 deaths per 100,000 workers, because there were fewer workers in the mining industry than in the construction industry. (One has to be very careful in discussing death rates!) The largest number of deaths occurred among the occupation category Precision production/crafts/repairers with 17,392 deaths (19.6%), but the highest death rates were seen among Transportation/material movers with 23.0 deaths per 100,000 workers (Jenkins et al, 1993).

Table 1-E. Unintentional Injuries at Work by Industry—1998, National Safety Council, 1999.

Industry Division	Workers[a] (000)	Deaths[a]	Change from 1997	Deaths per 100,000 Workers[a]	Disabling Injuries
All Industries	**132,772**	**5,100**	**–1%**	**3.8**	**3,800,000**
Agriculture[b]	3,450	780	–2%	22.1	140,000
Mining, quarrying[b]	618	150	–4%	24.3	30,000
Construction	8,045	1,120	+1%	13.9	410,000
Manufacturing	20,666	660	–3%	3.2	650,000
Transportation and public utilities	7,713	920	–1%	11.9	380,000
Trade[b]	27,087	450	–[c]%	1.7	730,000
Services[b]	45,575	680	+1%	1.5	900,000
Government	19,618	340	–[c]%	1.7	560,000

Source: National Safety Council estimates based on data from the Bureau of Labor Statistics, National Center for Health Statistics, state vital statistics departments, and state industrial commissions.

[a] Deaths include persons of all ages. Workers and death rates include persons 16 and older.

[b] Agriculture includes forestry, fishing, and agricultural services. Mining includes oil and gas extraction. Trade includes wholesale and retail trade. Services includes finance, insurance, and real estate.

[c] Less than 0.5%.

Occupational Injuries

The BLS also noted that wide variations existed in the frequency of nonfatal workplace incidents (illnesses and injuries) by industry, even for industries that produced similar types of goods and services. This variation may be due to the fact that different processes, and thereby different agents, are used to produce the same product; hence the nonfatal incidents may be different in two industries producing the same product. For example, using the Standard Industrial Classification, SIC 243, for the industry group Millwork, Plywood, and Structural members, the incidence rate for illnesses and injuries was 13.6 per 100 full-time workers in 1996. At the detailed industry level (4-digit level), the incidence rates ranged from 5.3 in Softwood veneer and plywood (SIC 2436) to 13.8 in Hardwood veneer and plywood (SIC 2435) to 14.5 in Millwork (BLS, 1998b).

Table 1-F presents the number of nonfatal occupational injuries reported by the Bureau of Labor Statistics for 1996 and 1997. It can be seen from Table 1-F that 78.1% of the total nonfatal injuries (5,799,900) occurred in three industrial sectors in 1996: Manufacturing (1,668,000–28.8%), Wholesale & Retail Trade (1,491,100–25.5%), and Services (1,380,800–23.8%) industries. The same three industries also accounted for 78% of the injuries in 1997 and for total cases with and without lost workdays, in both 1996 and 1997.

For the surveillance of nonfatal occupational injuries, NIOSH uses the National Electronic Injury Surveillance System (NEISS) developed by the Consumer Product Safety Commission (CPSC) (McDonald, 1994). National estimates of the magnitude and risk for nonfatal occupational injuries treated in hospital emergency departments for 1996 showed that workers at highest risk were young and male (*MMWR*, 1998). For the NEISS, data were collected at 91 hospitals selected from a stratified probability sample of all hospitals in the United States and its territories; NIOSH used data from 65 hospitals for its survey. The *MMWR* report showed that of the 3.3 million workers treated for occupational injuries in emergency departments in 1996, approximately 765,762 (23.2%) workers were in the age-group, 16–24 years; of these, 544,374 (71.1%) were men. Hands and fingers were the anatomic sites sustaining the most injuries, accounting for 30% of total injuries treated in emergency hospitals (*MMWR*, 1998).

In addition to the NEISS data, other data systems provide occupational morbidity surveillance systems, e.g., the 1988 National Health Interview Occupational Health Supplement, the 1996 National Hospital Ambulatory Medical Care Survey (NHAMCS), and the Annual Survey of Occupational Injuries and Illnesses maintained by the Bureau of Labor Statistics. Each data system has its drawbacks and one must be careful while discussing or comparing morbidity data using the various sources. For example, the NHAMCS system lacks industrial and occupational data though it provides comparisons between work-related and other injuries treated in the hospitals. The BLS system excludes self-employed people and farms with fewer than 11 employees; thus age-specific injury rates cannot be calculated from this survey. The NEISS system, on the other hand, is a continuous, ongoing surveillance system that includes industrial and occupational data and thus readily provides a mechanism for follow-up telephone interviews with injured workers (McDonald, 1994).

Table 1-F. Number of Nonfatal Occupational Injuries* by Industry and Lost Workday Cases—1996 and 1997, Bureau of Labor Statistics, U.S. Department of Labor, 1998.

Industry	Total Cases		Lost Workday Cases					
			Total		With Days Away from Work		Cases Without Lost Workdays	
	1996	1997	1996	1997	1996	1997	1996	1997
Private Industry	5,799.9	5,715.8	2,646.3	2,682.6	1,785.8	1,746.5	3,153.6	3,033.2
Agricultural, Forestry & Fishing	108.4	106.9	49.0	53.8	37.0	39.0	59.4	53.1
Mining	32.4	35.1	19.5	22.6	14.7	17.7	12.9	12.5
Construction	476.1	485.6	216.8	227.4	179.1	187.1	259.3	258.3
Transportation & Public Utilities	494.6	477.1	293.0	281.3	217.3	213.3	201.6	195.8
Manufacturing	1,668.0	1,662.1	782.9	785.4	419.5	405.4	905.1	876.1
Wholesale & Retail Trade	1,491.1	1,480.1	637.8	657.6	452.3	439.4	853.3	822.5
Finance, Insurance, & Real Estate	128.5	124.6	49.5	47.6	38.0	37.8	79.0	77.0
Services	1,380.8	1,344.2	597.8	606.9	428.1	406.8	783.0	737.2

Source: News Release, BLS, Aug 12, 1998.
* = in thousands

Occupational Illnesses

Information on occupational illnesses is far less quantitative than that for occupational injuries, for the following reasons:

1. Illnesses related to work exposures may not have been diagnosed as being work-related.
2. In chronic exposure of workers, the recording of such exposures may not have been included in the BLS Annual Survey estimates. Then these may have underestimated the magnitude of the occupational disease problem.

Similar to definitions provided by BLS for the recording of occupational injuries, specific definitions for some categories of occupational disease and disorder are used to classify recordable illnesses along with a few examples (BLS, 1986):

- *Dust diseases of the lungs (pneumoconioses).* Examples: silicosis, asbestosis, and other asbestos-related diseases; coal worker's pneumoconiosis; byssinosis; siderosis; and other pneumoconioses.
- *Occupational skin diseases or disorders.* Examples: contact dermatitis, eczema or rash caused by primary irritants and sensitizers or poisonous plants; oil acne; chrome ulcers; chemical burns or inflammations.
- *Respiratory conditions due to toxic agents.* Examples: pneumonitis; pharyngitis; rhinitis or acute congestion due to chemicals, dusts, gases, or fumes; farmer's lung.
- *Poisoning (systemic effects).* Examples: poisoning by lead, mercury, cadmium, arsenic, or other metals; poisoning by carbon monoxide, hydrogen sulfide, or other gases; poisoning by benzene, carbon tetrachloride, or other organic solvents; poisoning by insecticide sprays such as parathion, lead arsenate; poisoning by other chemicals such as formaldehyde, plastics, and resins.
- *Disorders due to physical agents.* Examples: heatstroke, sunstroke, heat exhaustion, and other effects of environmental heat; freezing, frostbite, and effects of ionizing radiation (isotopes, x-rays, radium); effects of nonionizing radiation (welding flush, ultraviolet rays, microwaves, sunburn).
- *Disorders associated with repeated trauma.* Examples: noise-induced hearing loss; synovitis, tenosynovitis, and bursitis; Raynaud's phenomenon; and other conditions due to repeated motion, vibration, or pressure, such as carpal tunnel syndrome.
- *All other occupational illnesses.* Examples: anthrax, brucellosis; infectious hepatitis; malignant and benign tumors; histoplasmosis; coccidiomycosis.

According to the National Safety Council, in 1997 the number of occupational illnesses recognized or diagnosed in the private sector was 429,800, down from 493,000 noted in 1996. Of the 429,800 cases, about 259,300 cases (60.3%) were noted in the Manufacturing industries. Wholesale & Retail Trade accounted for 43,800 cases (10.2%); and the Services industries for 75,200 cases (17.5%) of total cases (NSC, 1999).

In 1996, the number of occupational illnesses recognized or diagnosed in the private sector was 439,900; of these, 264,900 (60.3%) were in the Manufacturing industries (NSC, 1998). About 281,100 (64%) illnesses reported in 1996 belonged

to the repeated trauma disorders category and 203,000 (72.2%) of them were noted in the Manufacturing industries (NSC, 1998).

Table 1-G presents the number of occupational illnesses published by BLS for 1997. A total of 429,800 cases were reported for all industries combined. As mentioned earlier, the Manufacturing industry reported 259,300 (60.3%) cases; the Services industry accounted for 75,200 (17.5%) cases; and the Wholesale & Retail Trade industry showed 43,800 (10.2%) cases. Total lost workday cases in the Manufacturing industry accounted for 63.5% of all cases (116,600 of 183,600); the total lost workday cases for Services industry was 24,100 (13.1%); and 21,300 (11.6%) for Wholesale & Retail Trade industry. Again, as noted in the occupational injury statistics, 400 of the 600 nonfatal occupational illnesses in the Mining industry were due to lost workdays, and another 600 cases without lost workdays. Table 1-G also shows that the Manufacturing industry topped the list with 198,600 (71.9%) of the 276,000 cases in private industry for disorders associated with repeated trauma. Detailed statistics within each industry are available from BLS *Survey of the Occupational Injuries and Illnesses for 1996* (BLS, 1998a).

Incidence Rates of Disease or Injury

Incidence rates of disease or injury are sometimes used rather than actual numbers; for example, the total number of illnesses may not put the industry in the top 10 high-risk industries, but if we look at the rate of illness or the rate of injury, it may be high. A good example is that of the Shipping industry where the rate of injuries may be higher than that found in the Manufacturing industry though the number of workers in the former may be one-tenth that in the latter industry. Similarly, the incidence rate in the Mining industry may be quite high compared to the Manufacturing industry though the Mining industry has only 3% of workers compared to those in the Manufacturing industry. Therefore, when summarizing such data it may be better to use both actual numbers and rates when making comparisons.

The incidence rate can be determined either in terms of *number of injuries and illnesses* or in terms of *lost workdays*. When discussed as the *number of injuries and illnesses*, the incidence rate is defined as the number of injuries and illnesses *times* 200,000 *divided* by the total hours worked by all employees during the period covered. The 200,000 used is the base for 100 full-time equivalent workers, i.e., for work conducted 40 hours per week for 50 weeks in a year. When discussed as the number of lost workdays, the incidence rate is defined as the *number of lost workdays* multiplied by 200,000 divided by the total hours worked by all employees during the period covered. The 200,000 is again the base for 100 full-time equivalent workers, i.e., for work conducted 40 hours per week for 50 weeks in a year.

Table 1-H presents the incidence rate of nonfatal occupational illnesses and injuries by industry and case type for 1997 (News Release, BLS, 1998c). The data in Table 1-H show that the Manufacturing industry topped the list with an incidence rate of 10.3 per 100 full-time workers followed closely by the Construction industry, Agriculture industry, and Transportation & Public Utilities industry with incidence rates of 9.5, 8.4, and 8.2 per 100 full-time workers, respectively. Table 1-H also shows that the incidence rate for cases without loss of work-

Table 1-G. No. of Nonfatal Occupational Illnesses* by Industry and Lost Workday Cases—1997, Bureau of Labor Statistics, U.S. Department of Labor, 1999.

Industry	Total Cases	Lost Workday Cases		Cases Without Lost Workdays	Total Cases of Disorders Associated with Repeated Trauma
		Total	With Days Away from Work		
Private Industry	429.8	183.6	86.9	246.2	276.6
Agricultural, Forestry & Fishing	——	2.0	1.5	——	1.4
Mining	1.2	0.5	0.4	0.6	0.5
Construction	6.9	3.4	2.7	3.5	2.0
Manufacturing	259.3	116.6	40.7	142.8	198.6
Transportation & Public Utilities	20.4	9.2	7.4	11.2	10.6
Wholesale & Retail Trade	43.8	21.3	12.7	22.5	23.1
Finance, Insurance, & Real Estate	17.4	6.6	4.9	10.8	13.1
Services	75.2	24.1	16.7	51.1	27.1

Source: News Release, BLS, Aug 4, 1999.
* = in thousands

days followed the trend of total cases of injuries and illnesses (News Release, BLS, 1998c).

Table 1-I presents the incidence rates of nonfatal occupational injuries by Industry Division for 1997 (News Release, BLS, 1998c). Table 1-I shows that though the Construction industry had 5.6 million workers compared to 101.7 million workers in all industries, the injury rate in the Construction industry was the highest among all industries (9.3 per 100 full-time workers). This was followed by the Manufacturing industry (8.9 per 100 full-time workers), and the Transportation & Public Utilities and Agriculture industries, each with an incidence rate of 7.9 injuries per 100 full-time workers. (News Release, BLS, 1998c). This is a cause for concern for it shows that safety conditions must be improved in such industries. The same situation was noted in these three industries with regard to total lost workday cases; the total workday cases was also high in the Mining industry with an incidence rate of 3.7 injuries per 100 full-time workers. Intensive surveys should be conducted to determine the cause of such injuries in these industries and intervention procedures instituted to prevent further injury among the workers.

Workers' Compensation

In addition to time lost to the employer and to the worker (due to productivity and wage loss) because of injury or illness nationwide, the true cost of work-related deaths and injuries is much greater than the cost of workers' compensation insurance alone (NSC, 1999). The total cost of workers' compensation claims in 1998 was $125.1 billion, according to the National Safety Council estimate. This included wage and productivity losses of $62.9 billion, medical costs of $19.9 billion, and administrative expenses of $25.6 billion. Other employer costs amounting to $12 billion were also included, such as time lost by workers other than the injured or disabled worker, the time taken for investigation of the injury, write-up of reports, etc. In 1998, the cost per worker was $940, the cost per death was $910,000, and cost per disabling injury was $28,000 (NSC, 1999).

More small businesses are becoming aware of the problem. This is evident from a study showing the most effective solutions for intensive smoking cessation programs came from partnerships among the medical provider, employer, and employee (patient). Results of the study showed that though the partnerships possessed a weak knowledge base of health care cost containment methods, they had a strong level of confidence (85%) that lifestyle modification programs such as smoking cessation could help control health care costs (Lesmes, 1992).

Data published by the National Council on Compensation Insurance (NCCI) showed that the most costly lost-time workers' compensation claims for 1996 and 1997 by *Part of Body* were for those involving multiple body parts. The claims filed in 1996 and 1997 averaged nearly $21,500 per workers' compensation claim. Other high claims were those that involved the head or central nervous system ($20,614), neck ($14,756), leg ($13,214), knee ($12,252), arm or shoulder ($10,726) and lower back ($10,833). The average cost for all claims by *Part of Body* was $10,488 (NSC, 1999).

Regarding the *Nature of Injury*, the NCCI reported that the most costly lost-time workers'

Table 1-H. Incidence Rate Per 100 Full-time Workers of Nonfatal Occupational Injuries and Illnesses by Industry and Case Type—1997, Bureau of Labor Statistics, U.S. Department of Labor, 1999.

Industry	1997 Employment (000's)	Injuries & Illnesses			
		Total Cases	Lost Workday Cases		Cases Without Loss of Workdays
			Total	With Days Away From Work	
Private Industry	101,666.5	7.1	3.3	2.1	3.8
Agriculture, Forestry, & Fishing	1,765.4	8.4	4.1	3.0	4.2
Mining	595.9	5.9	3.7	2.9	—
Construction	5,637.1	9.5	4.4	3.6	5.0
Manufacturing	18,656.9	10.3	4.8	2.4	5.4
Transportation & Public Utilities	6,170.8	8.2	4.8	3.7	3.4
Wholesale & Retail Trade	28,583.6	6.7	3.0	2.0	3.7
Finance, Insurance, & Real Estate	6,952.2	2.2	0.9	0.7	1.4
Services	33,304.8	5.6	2.5	1.7	3.1

Source: News Release, Bureau of Labor Statistics, Department of Labor, Dec 17, 1998.

Table 1-I. Incidence Rate Per 100 Full-time Workers of Nonfatal Occupational Injuries by Industry Division—1997, Bureau of Labor Statistics, U.S. Department of Labor, 1999.

Industry	1997 Annual Employment (000's)	Total Cases	Lost Workday Cases		Cases Without Loss of Workdays
			Total	With Days Away From Work	
Private Industry	101,666.5	6.6	3.1	2.0	3.5
Agricultural, Forestry & Fishing	1,765.4	7.9	4.0	2.9	3.9
Mining	595.9	5.7	3.7	2.9	—
Construction	5,637.1	9.3	4.4	3.6	5.0
Manufacturing	18,656.9	8.9	4.2	2.2	4.7
Transportation & Public Utilities	6,170.8	7.9	4.7	3.5	3.2
Wholesale & Retail Trade	28,583.6	6.5	2.9	1.9	3.6
Finance, Insurance, & Real Estate	6,952.2	2.0	0.8	0.6	1.2
Services	33,304.8	5.3	2.4	1.6	2.9

Source: News Release, Bureau of Labor Statistics, Department of Labor, Dec 17, 1998.

compensation claims were for those resulting from amputation, averaging $23,600 per workers' compensation claim in 1996 and 1997. Other high claims were for injuries resulting in "other trauma" ($15,995), fracture ($13,848), and carpal tunnel syndrome ($12,611). The average cost for all claims by *Nature of Injury* was $10,488 (NSC, 1999).

Trends in the workers' compensation claims by state for 1996–1998, for the United States, and the amount of compensation paid in 1996 are presented in *Injury Facts*™, formerly *Accident Facts*®, published by the National Safety Council (NSC, 1999).

OCCUPATIONAL HEALTH AND SAFETY PROGRAMS

An effective occupational health and safety program relies on the accessibility of occupational health and safety practitioners, who are skilled in the following:

- recognizing occupational disease
- evaluating the workplace for hazardous conditions
- instituting appropriate medical surveillance programs.

Recognizing Occupational Disease

Recognizing occupational disease is crucial to establishing the correct diagnosis and further treatment of the worker, thus preventing aggravation or recurrence of the disease in the worker. This does not stop with the recognition of disease in one worker. If occupational disease is suspected, the occupational physician should do the following:

- Determine whether the disease noted is occupational.
- Determine if other workers doing the same job and using the same materials are at risk for the same disease.
- Treat the affected worker(s).
- Adopt preventive measures to prevent recurrence of the disease among the remainder of the work force.

Importance of Occupational Health and Safety Programs

An integrated occupational health and safety program is vital in all workplaces. Although industrial hygiene, safety, and environmental professionals often are asked to evaluate a workplace, their evaluations will be incomplete without access to an occupational medical professional familiar with the workplace. For example, industrial hygienists and safety practitioners may not be aware that an occupational disease or condition has occurred as a result of an occupational exposure, without access to the medical information obtained during the evaluation conducted by the occupational physician and nurse.

Medical Surveillance Programs

Preventive occupational medical surveillance programs are essential to maintaining a safe and healthy workplace. They also reduce the occurrence of occupational diseases, occupational disease conditions, and occupational injuries. Within the context of the Americans with Disabilities Act (ADA), the attending physician and occupational health nurse can perform medical evaluations on all new workers and on those who have been reas-

signed to new jobs. For special jobs, specific medical tests may be necessary, e.g., baseline tests.

To prevent aggravation of an occupational disease, perform periodic physical examinations on all workers. These physical examinations should include routine urinalysis, blood tests, and specific urine tests for chemicals known to be toxic. For example, a worker who is exposed to trichloroethylene (TCE) should be monitored for TCE along with its metabolites, trichloroethanol and trichloroacetic acid in urine tests, since both the chemical and the two metabolites are known to be toxic. (Note that this test differs from the routine urinalysis done in a physician's office.) Depending upon the half-life of the chemical in question, monitor the affected worker periodically, not annually as is normally done during physical examinations. In the case of trichloroethylene, the half-life of the chemical is longer than five hours; hence the worker should be monitored at the end of the workweek using the following media: exhaled air, urine, and blood. Then the consequences of the worker's exposure throughout the week are taken into consideration. Thus, an annual examination of the worker is not appropriate, but monitoring the worker at the appropriate time, i.e., at the end of the workweek, is extremely important.

Occupational Health and Safety Professionals

Since the passage of the OSHAct the number of industrial hygienists and safety professionals trained in the United States has gradually increased. Rapid changes in technology also have increased the demand for such professionals, yet in the 1980s many industries understaffed in these areas. NIOSH conducted two nationwide surveys, a decade apart. Some results of the second survey, the National Occupational Exposure Survey (NOES) (1981–1983) are described herein. A stratified sample of industries was statistically chosen excluding the following industry types: mining; certain agricultural sectors; federal, state, and local governments; financial institutions, wholesale and retail trade, and certain professions (NIOSH, 1988).

The NOES data was collected from a sample survey of 4,490 businesses employing nearly 1.8 million workers. The facilities were divided into small (8–99 employees), medium (100–499 employees), and large (500 or more employees). From NIOSH's survey, 446,700 of 505,700 (88.3%) were small facilities with an estimated 11.1M of 33.2M (33%) employees, of whom 74.2% were men. Approximately 73% of the total work force were in nonadministrative jobs (73.3% in small, 75.8% in medium, and 70.5% in large facilities).The data from NIOSH's National Occupational Exposure Survey (NOES 1981–1983) showed that only 30%–35% of the industries had hired such occupational health and safety professionals or used consultants in the 1980s (NIOSH, 1988).

Occupational Health and Safety Team

To achieve the safest and healthiest workplace, it is important to use skilled professionals from various disciplines, including physicians, nurses, safety engineers, industrial hygienists, chemists, physicists, medical technicians, ergonomists, statisticians, etc. To maintain a safe and healthy workplace, all these members should work together, perhaps in a group designated the Occupational Health and Safety Team. All members of the team should be

- technically competent
- aware of the type of hazards present in the workplace and their health consequences
- aware of the health and safety programs conducted in the workplace.

Unions and management alike recognize the need for such professionals. Increased awareness of the benefits of such a team approach to occupational safety and health resulted in the hiring of more occupational health professionals in industries. Unfortunately, in a small business, this may not be possible. In this case, consultants can be used, or one of the workers can be trained to become aware of the health and safety factors in the workplace. He or she, in turn, can train other workers, who can help to maintain a safe and healthful workplace. If needed expert consultants can support workplace efforts. In this way, all workers will be protected from the hazards that occur in that worksite.

Why is a team necessary? Can hiring only a physician be sufficient? Not really—an occupational physician can diagnose the occupational disease and describe what may have caused it if he or she is aware of the exposure of the worker. But more support is needed to maintain a safe and healthful workplace. An industrial hygienist monitors the worker (personal monitoring) and the workplace (area monitoring). A safety professional places the appropriate controls (engineering con-

trols such as machine guards, appropriate ventilation, etc.). A chemist analyzes the samples, etc., an occupational health nurse monitors the ongoing health status of the worker. The entire team is necessary even for one occupational disease recognized in the workplace.

Consider adequate ventilation. Often, a change in the flow of air in the workplace can make a difference for the workers, particularly when large fans are used in a big room and the fan blows air right on their faces or bodies. If an exhaust fan is used in such a case, the workers will not be exposed to the air containing the fumes or gases thus preventing inhalation exposures. Noise exposure is another situation that may require enclosure to protect workers from excessive noise exposures. When large machinery is used which causes a lot of noise, an enclosure may be necessary for the worker who watches over the machinery. The worker on such machinery should wear earplugs and see that appropriate safety shields are placed on the machine. If a substance is known to cause lung effects, the industrial hygienist should evaluate the exposure, alleviate the situation, and conduct both personal and area monitoring of that worksite, etc. These examples show the importance of an integrated occupational health and safety team.

Once the disease has been found to be occupationally related, the entire team of health and safety professionals should be involved in preventing further disease from occurring among the work force. The team approach includes the following members:

- industrial hygienist(s) who can determine the causative agent by using data from the MSDS and confirm its presence by performing industrial hygiene (personal and area) monitoring of the workplace. If necessary, the industrial hygienist would recommend appropriate personal protective equipment (PPE)
- chemist(s) to perform the sampling and analytic tests
- safety practitioner(s) to determine if safety factors are involved in the causation of the disease and if so, attempt to abate them
- physician(s) to be involved in the diagnosis, treatment, and follow-up of the worker
- occupational health nurse(s) to implement the medical surveillance program.

Once the findings are available, the team can discuss the situation, make the necessary changes to prevent further disease from occurring among the remainder of the work force, and conduct continued medical surveillance of the work force. Working as a team, the occupational physician, with the help of the occupational health nurse, industrial hygienist, and safety practitioner, can prevent occupational diseases by maintaining a safe and healthful work environment.

Recently, new technologies, employment shifts from manufacturing to service industries, and more competition among similar producers are contributing to the introduction of new substances into the workplace. That means that the current crop of occupational diseases can vary from those seen in the 1970s and 1980s. Some examples of the newer problems include the following:

- video display terminals being used in the workplace associated with both ergonomic and visual problems
- continued use of new chemicals to replace the more toxic ones used earlier (some of the newer ones without being adequately tested)
- toxic chemicals being "reintroduced" in the form of trade-name compounds, the composition of which is rarely known to users
- exposure of workers to hazardous physical and biological agents as well as chemical substances.

These examples suggest that the techniques used for recognizing and preventing occupational diseases have to be modified with every change made in the process.

Distinguishing an occupational disease from other medical problems can be difficult, and depends most importantly on a comprehensive occupational history taken by the attending physician who knows that occupational diseases are almost always preventable. Two NIOSH surveys (NIOSH: 1972–1974 and 1981–1983) may indicate a trend away from full-time, on-staff occupational health professionals. Frequently the occupational health activities are being conducted by contract physicians. Many may not be familiar with occupational medicine. For those who are taking an occupational history, the following points should be considered:

1. current job, previous jobs, longest job held
2. type of exposures (gas, liquid, mist), name of chemical(s) and level of exposures, if known
3. length of exposure
4. protective devices used, if any; if used appropriately and in working condition
5. types of control technology methods used to minimize exposure of the workers to the inciting chemical(s)
6. symptoms occurring during exposure, continued symptoms during nonworking hours, or

symptoms experienced upon reexposure after the weekend break
7. severity of symptoms
8. potential for nonoccupational exposures, e.g., hobbies, household chores, etc.

A good record-keeping system is equally important to a comprehensive occupational history. Such record keeping can be useful for determining or preventing further occupational diseases, for future litigation, or for general research.

Health and Safety Committees

In many medium-sized companies, health and safety committees provide health and safety programs. Depending upon the size and type of workplace, functions of the health and safety committee range from ascertaining health and safety hazards to complete responsibility for the health and safety of the workplace. The health and safety committee should also maintain good incident prevention programs so that workers will be trained and experienced to use the safety equipment when necessary. In the case of a small business, the owner or facility manager may be the only one in the health and safety committee (Hoover et al, 1989; Rovins, 1989).

STARTING AN OCCUPATIONAL HEALTH PROGRAM

To begin an adequate occupational health program in your facility, obtain the services of an occupational physician or occupational health nurse, an industrial hygienist and safety practitioner. If your facility has limited resources, cross training can help fill in any gaps in the team. For example, an industrial hygienist could be cross-trained in safety procedures. If the company uses more machinery than chemicals, a safety practitioner could be hired and trained in industrial hygiene techniques. Training courses in all branches of occupational health and safety including ergonomics are given by the National Safety Council and its chapters and in 15 NIOSH-sponsored Educational Resource Centers across the country. Employers can benefit from this kind of training, and with the knowledge gained in the courses will better be able to institute appropriate occupational safety and health programs.

Before beginning an occupational health program, the occupational health and safety team should discuss the current conditions of the workplace and inventory all potential chemical, physical, and biological hazards that exist in the workplace, including raw products, intermediate products, catalysts, by-products, final products, slag, etc. Including workers at an open meeting to survey the kinds of products they may be using is also a good idea. They may be using a product, chemical, or compound that may not be actually used during the production process, e.g., a special type of soap to clean the oil off their hands, or a lotion to soothe their dry hands or a brace that they may have brought from home for daily use, which can cause problems. Many of these compounds used are trade-name products; hence, input from workers regarding symptoms, exposure situations, problems of any sort, e.g., drying of hands, itching due to chemicals dripping on hands, etc., is useful to an occupational health professional.

Medical and Industrial Hygiene Services

Whatever the size of the facility, establishing and maintaining a safe and healthy workplace by providing medical and industrial hygiene services is key, since the work force is the main asset to the employer (Hoover, 1989; Rovins, 1989).

The occupational health and safety team should assess the exposure conditions in the workplace and take appropriate measures to improve working conditions, e.g., exposures to hazardous chemicals and to physical hazards; most often, exposures to noise, excessive heat, intense cold, ergonomics, etc. In two surveys conducted a decade apart, NIOSH assessed the provision of medical services, industrial hygiene, and safety programs in the United States (NIOSH, 1988). Some of the medical services, industrial hygiene, and safety programs noted during the survey are presented in Table 1-J.

Table 1-J shows that 1 in 1,000 facilities had a physician in charge, 2 in 1,000 had a nurse on site; however, 25% of the facilities had emergency health care provision, and 44% of facilities had off-site health care. More than 47% of the facilities recorded health information on workers, 28% of workers had formal safety training but only 3% monitored fumes, gases, etc. About 46% of facilities required personal protective devices but another 22% used no personal protective devices, and 45% of facilities maintained the OSHA 200 log.

NIOSH EDUCATION AND TRAINING PROGRAMS

According to the 1970 OSHAct, NIOSH was mandated to provide professional education either directly, or indirectly through contracts. To accom-

plish this, NIOSH established a nationwide system of Educational and Research Centers (ERC) and other Training Programs Grants (TPG). These feature both full-degree and short-course professional education programs for occupational safety and health professions. They are currently provided by a network of universities across the country. NIOSH funds the ERC and TPG at each university, and their programs are reviewed annually by NIOSH.

In addition, internal NIOSH training and educational resources are now directed to provide ancillary services not easily conducted by the ERC and TPG facilities. One service that NIOSH provides is the development and evaluation of prototype training and educational curricula for new targeted populations, e.g., the formation of preservice occupational safety and health (OSH) curricula for vocational and technical education programs and for small business operators and workers.

The vocational and technical occupational safety and health (OSH) curricula are tailored for secondary school teachers; and address trade-specific OSH training (e.g., electrical safety) and cross-cutting issues (e.g., lockout/tagout). Each curriculum includes the following:

- topic-specific background information and instructor lecture notes
- student learning activities
- an accompanying video
- pre- and post- measures, overheads, a glossary of key terms, and a list of appropriate reference materials.

A second training and education service being provided by NIOSH includes the development and evaluation of multimedia CD-ROMs and Internet-delivered occupational safety and health courses. Planned efforts include the following:

- translation of the secondary school occupational safety and health curricula discussed previously
- safety training for miners
- development of research simulations for professional education
- a consortium of ERC/TPGs, an Internet degree program to train industrial hygienists.

The third training and educational service provided by NIOSH includes the development of models and partnerships for improved occupational safety and health training. One model is the development of means to measure social outcomes and impacts that result from occupational safety and health training in the workplace. In cooperation with the Educational Foundation for the National Restaurant Association (EFNRA), NIOSH is assisting in a nationwide study to assess injury-reduction that occurs after occupational safety and health training developed by EFNRA.

NIOSH is also sponsoring community-based intervention models to increase awareness of child labor laws, and reduce injuries to young workers. In two California communities, in partnership with UCLA and UC-Berkeley, and in a third partnership with the Massachusetts Department of Health, NIOSH is exploring intervention effectiveness to increase awareness through different community-based communication channels, e.g., the business community, churches, schools, social and professional organizations, and parent and student groups.

Table 1-J. Availability of Medical Services, Industrial Hygiene, and Safety Programs in Small Business Establishments: National Occupational Exposure Survey (NOES), 1981–1983 (NIOSH, 1988).

Health and Safety Programs	*%*
Facilities with physician in charge	0.1
Full-time (FT) physician	0.3
Part-time (PT) physician	0.2
Facilities with nurse on site	0.2
Registered nurse on site	9.4
Licensed practical nurse on site	6.9
Facilities with emergency health care FT	24.6
Facilities with emergency health care PT	8.7
Contract physician on site or on call	1.6
Facilities with health care on off-site location	44.4
Facilities with preplacement examination	21.1
Facilities that require post-illness examination	35.5
Facilities that require exit examination	0.5
Facilities that record health information on workers	47.3
Facilities with regular safety inspection	48.7
Facilities with formal safety training	22.1
Workers with formal safety training	28.3
Facilities monitoring fumes, gases, etc.	3.7
Facilities with personal protective devices required	45.9
Facilities with personal protective devices recommended	16.0
Facilities with no personal protective devices	22.1
Facilities with scheduled preventive maintenance programs	62.3
Facilities that maintain OSHA Form 200 Log	45.2
Facilities that provide one or more screening tests	6.2
Facilities that provide blood tests	8.9
Facilities that provide urine tests	9.2

SMALL BUSINESSES

Statistics show that more than one million small businesses were started in the United States in the

1980s (*U.S. News and World Report,* 1989). In addition, small businesses, defined as those with fewer than 100 workers, now employ nearly 60 percent of the work force and are expected to generate half of all new jobs by the year 2000 (*U.S. News and World Report,* 1989; Bureau of the Census, 1996).

According to NIOSH, of the approximate 6.5 million private industry establishments in the United States, more than 6.3 million (98%) have between 1 and 99 employees, and more than 5.6 million (87%) have between 1 and 19 employees. Since many of these small business do not have resources for occupational health and safety programs, and most of them never will be inspected by OSHA, greater focus should be made on these small businesses with regard to prevention activities (NIOSH, 1998). If we use the NIOSH category of a small business as one with fewer than 100 employees, the 1994 County Business Patterns of the U.S. Census Bureau would show that 253 establishments are identified as small business industries. These small business industries included 4 million establishments and more than 30 million workers, roughly 30% of all employees in private industry. Again, NIOSH points out that these small business industries accounted for more than 1.6 million nonfatal occupational injury cases and 58,000 cases of illnesses in 1995, and 2,287 work-related fatalities in 1994. Occupational fatality, injury, and illness data were available for only 105 of the 253 small business industries at the 4-digit industry level, i.e., Standard Industrial Classification code. One major reason for nonavailability of data in these small business industries was due to small numbers of events occurring in these industries.

Currently, a small business has to deal with regulations mandated by the various government agencies, e.g., OSHA, EPA, etc., in the same way as the medium- and large-sized industries including those regarding the health and safety of its employees. The U.S. Securities and Exchange Commission (the Commission) has therefore focused its proposals on facilitating access to the public market for start-up and developing companies, and on lowering the costs for small businesses that undertake to trade their securities in the public market. The Commission undertook a host of proposals designed to facilitate the raising of seed capital by small businesses and to reduce the compliance burdens placed on these companies (*Federal Securities Law Reports,* 1992).

If such proposals are adopted, small businesses would incur significant cost savings for issuers without compromising investor protection. The small businesses can then concentrate on implementing appropriate occupational safety and health programs, either by themselves or in groups with other companies with the same four-digit Standard Industrial Classification (SIC) industry code. In the past few years, innovations used by some small businesses have been discussed in professional meetings, which give impetus to other small businesses to do the same and thus improve the safety and health of their work force.

Though small businesses (except those with fewer than 10 employees) are subject to the overall coverage of the OSHAct of 1970, most small employers are not required to keep injury and illness records because of the exemption in 29 *CFR* 1904.15; however, a few states still require all small employers to maintain OSHA 200 logs. Small business employers must comply with the requirements of 29 *CFR* 1904.15 only under (1) obligation to report on fatalities or on multiple hospitalization incidents; and (2) obligation to maintain OSHA 200 log when selected to participate in a statistical survey of occupational injuries and illnesses (BLS, 1986).

Small businesses still must comply with OSHA regulations, display the OSHA poster, and report to OSHA within eight hours (instead of the current 48 hours) any work-related incident that results in a fatality or the hospitalization of multiple employees (OSHA, 1993).

Another law that affects small business employers is the Americans with Disabilities Act (ADA) that went into effect on July 26, 1992. According to the ADA, any business with 25 or more employees was covered under the ADA and employers with 15 or more employees became covered in 1994. The ADA requirement applies not only to hiring practices but also to all employment-related activities, including layoffs, promotions, training, and pay. It also covers benefits, mandating, for example, that companies provide the same insurance coverages to all employees, including the disabled. For thousands of employers, the ADA has raised new questions, new uncertainties, and the fear of expensive, time-consuming lawsuits. For smaller businesses, the maximum on damages is $50,000. As a result of employers trying to understand the ADA law, many changes are expected to take place in the near future.

SUMMARY

The field of occupational health and safety has grown steadily since passage of the OSHAct. However, more needs to be done as occupational illnesses and injuries continue to occur. Occupational health, safety, and environmental professionals should work as a team to reduce the number of occupational injuries and illnesses. Newer chemicals and technologies are continuously introduced to the workplace, some of them without appropriate toxicity testing. The Hazard Communication Standard helps since it requires maintaining a Material Safety Data Sheet (MSDS) on each chemical used in the workplace. If any type of hazardous exposure occurs, the industrial hygienist and safety practitioner are intricate parts of the occupational health and safety team and should be consulted. Recognizing that a disease is occupational is sometimes a problem since the symptoms can be similar to those of nonoccupational illness. This accentuates the need for trained occupational health and safety staff to evaluate each situation. This can start with a comprehensive occupational history—including appropriate questions about chemicals being used, length of exposure, symptoms noted, etc. Then, with the help of the occupational safety and health team who will confirm the use of that chemical, the occupational components of the disease can be ascertained and appropriate treatment provided. Control methods should be instituted to prevent the spread of any occupational disease among other workers.

Small businesses can be at a disadvantage since they may not have in-house occupational health and safety professionals. However, nonprofessionals can benefit from the occupational safety, health, and environmental training opportunities available, including those offered by the National Safety Council and NIOSH Educational Resource Centers (ERCs). Preventing an occupational disease is far better than treating a worker after the disease has occurred, to avoid consequences including lost work days, workers' compensation problems, litigation, etc. With a growing network of trained occupational health and safety professionals and support services, increasing numbers of workplaces will benefit from reduced injuries and illnesses and safer work conditions.

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