

Injuries and Occupational Safety

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Occupational injuries are caused by acute exposure in the workplace to physical agents, such as mechanical energy, electricity, chemicals, and ionizing radiation, or from the sudden lack of essential agents, such as oxygen or heat. Examples of events that can lead to worker injury include motor vehicle crashes, assaults, falls, being caught in parts of machinery, being struck by tools or objects, and electrocutions. Resultant injuries include fractures, lacerations, abrasions, burns, amputations, poisonings, and damage to internal organs.

Occupational and nonoccupational injuries represent a serious public health problem (Box 15-1). More than 5,000 workers died from occupational injuries in the United States in 2008.¹ Another 3.5 million workers sustained nonfatal injuries in 2008;² this estimate is conservative because it relies on employer reporting, excludes important groups of workers (such as workers who are self-employed and workers on small farms), and may miss counting many cases.³ An estimated 3.4 million workers were treated in emergency departments for work-related injuries and illnesses in 2004, with approximately 2% of them being hospitalized immediately or transferred to another hospital,

such as a trauma or burn center. Although these data include illnesses, more than 90% are injuries.⁴ The direct cost of serious occupational injuries in the United States in 2007 was estimated at \$53 billion,⁵ an amount that includes only wages and medical payments to workers whose injuries resulted in more than 6 days away from work.

CAUSES OF INJURY

Although the immediate cause of injury is exposure to energy or deprivation from essential agents, injury events arise from a complex interaction of factors associated with materials and equipment used in work processes, the work environment, and the worker. These factors include the following: physical hazards in workplaces or work settings, hazards and safety features of machinery and tools, the development and implementation of safe work practices, the organization of work, the design of workplaces, the safety culture of the employer, availability and use of personal protective equipment (PPE), demographic characteristics of workers, experience and knowledge of workers, and economic and social factors.

Box 15-1. Injuries are a Major Public Health Problem

In addition to the workplace, injuries occur at home and school, while traveling, and during recreation. In the United States, injuries are the leading cause of death for persons aged 1 to 44 years, surpassing deaths from cancer, heart disease, and infectious diseases. In 2007 in the United States, 182,479 injury deaths occurred (age-adjusted rate of 59 per 100,000 persons). Injuries contributed to more than 3.8 million years of potential life lost before age 65. In 2008, an estimated 30 million non-fatal injuries required treatment in an emergency department (age-adjusted rate of 9,909 per 100,000 persons).¹

Many injury causes are common in multiple environments, such as the workplace and home; others are more common in the workplace. Transportation events, violence, falls, and being struck by objects are examples of injury causes that are common in multiple settings; machinery, electrocutions, explosions, and overexertion injuries are more common in the workplace. Strategies for reducing and preventing injuries in multiple settings include changes to the environment (such as changes in roadway design), regulatory policy (such as specifying product safety parameters), and educational approaches. Broad injury prevention measures, such as those focused on improving roadway safety, improve workplace safety. And injury prevention measures in the workplace complement those occurring in other settings.

Reference

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overturn down the slope. The construction worker was thrown from the roller/compactor and crushed by its roll bar that landed on his back. An unknown amount of time after the rollover, a co-worker noticed the overturned machine. Emergency medical services were called and co-workers used an excavator to lift the roller/compactor off of the worker who was pronounced dead at the scene.⁶

This case illustrates how the occurrence of occupational injury events can be influenced by a variety of factors and circumstances. Some of the contributory factors are clear, whereas others are surmised:

- The residential construction worksite included sloped land that posed risks for operation of equipment such as roller/compactors. The roller/compactor manufacturer recommends that the machine not be used on slopes exceeding a 17-degree incline. The machine was being operated near a 45-degree incline.
- The roller/compactor was equipped with an interlocked seat belt that prevented machine operation unless the seat belt was buckled; however, it appears that the construction worker was sitting on the buckled seat belt, thus overriding this safety feature. Seat belts on machines such as roller/compactors serve to keep workers in a protective envelope or zone in the event of a rollover.
- The small company that employed the construction worker had some elements of a safety program—such as hazard training, monthly employer/management meetings to discuss safety practices, daily worksite inspections, and a progressive disciplinary system for unsafe practices, but the circumstances of this incident illustrate lapses and inadequacies in the program. The foreman and project managers reportedly assumed that each other had trained the construction worker, and they did not realize that the construction worker's training had been limited to observing a co-worker operate the roller/compactor, then demonstrating his ability to operate the machine. If a daily worksite inspection took place, it apparently did not result in any worker guidance

CASE 1

An 18-year-old construction worker was using a roller/compactor to compact soil that would be the foundation for a future townhouse. The foundation plot was next to uncompacted soil with a downward slope of approximately 45 degrees. Although the incident was not witnessed, machine tracks suggest that the construction worker maneuvered the roller/compactor partly onto the uncompacted soil next to the foundation plot, which caused it to

or change in procedures to address the uncompacted sloped soil next to the townhouse foundation. The nonuse of the roller/compactor seat belt by the construction worker was apparently not observed or went uncorrected by management.

The organization of work, in which workers were expected to work independently and frequently alone, contributed to a delay in lifesaving efforts and may have contributed to the failure to address the hazards of the sloped uncompacted soil and the construction worker not wearing the roller/compactor seat belt.

The young construction worker apparently was confident in his skills, despite what appeared to be very limited experience and training. This could have contributed to his not recognizing the dangers of the sloped and uncompacted soil and working without the seat belt.

The construction worker was a recent immigrant from Mexico and did not speak English. To communicate with the worker, the foreman and project managers used another worker as a translator. This could have contributed to the inadequate training and supervision provided to the worker, and the lack of appreciation for the worker's inexperience and limited skills.

The social and economic realities of construction work can result in high worker turnover, pressures to complete jobs despite unanticipated setbacks, and unanticipated hiring needs, all factors that might have contributed to the young construction worker being allowed to work with minimal training and supervision. The young construction worker had been hired and worked the previous workday to help complete the townhouse project. The task of compacting the townhouse foundation soil was necessary because the ground had previously failed a soil inspection. Pressures to complete the job may have contributed to the lapses in training and safety oversight.

This case illustrates how injury events can arise from a complex array of factors, not all of which contribute equally to an injury event. In addition, the responsibilities for a safe work

environment and safe work practices are not borne equally by all involved parties. Employers bear the greatest responsibilities, as they are responsible for providing a safe work environment, including the identification of potential safety hazards and the implementation of hazard controls and safe work practices and procedures. However, workers are also responsible for following established procedures and for reporting safety hazards to employers.

THE EPIDEMIOLOGY OF INJURIES

Occupational injuries are not random events. They cluster or are associated with specific types of workplaces and jobs, workplace exposures, and worker characteristics. Because occupational injuries are not random, they can be anticipated and steps can be taken to prevent them.

Epidemiologic data allow those involved in injury prevention efforts to target groups and settings with high numbers or rates of occupational injuries, and to anticipate and take steps to prevent injuries in specific workplaces or work settings. Epidemiologic data on fatal and nonfatal occupational injuries differ and thus are addressed separately. Both categories of injuries require attention—fatal injuries, because they represent the most severe consequence of occupational injury and are devastating to families, communities, and workplaces; and nonfatal injuries, because of the sheer volume and aggregate costs to workers, families, employers, and society as a whole.

Fatal Injuries

In the United States, data on occupational injury deaths are considered to be very complete. Beginning in 1992, the U.S. Bureau of Labor Statistics (BLS) began collecting data through the Census of Fatal Occupational Injuries (CFOI), which uses multiple sources of data and involves verification of the work-relatedness of deaths.¹ A less complete system based only on death certificates, the National Traumatic Occupational Fatalities (NTOF) system, provides additional data since 1980.⁷ Data, such as medical-examiner records, also exist at the state level.

In 2008, there were 5,214 occupational injury deaths in the United States—3.7 occupational injury deaths for every 100,000 U.S. full-time equivalent workers in 2008.⁸ The distribution and risks for fatal occupational injury differ by demographic characteristics of workers. Men account for more than 90% of occupational fatalities and have occupational fatality rates approximately 10 times higher than those for women.⁷⁻⁹ In 2008, of all occupational fatal injuries, 70% were among white non-Hispanic workers, 15% among Hispanic workers, 10% among black non-Hispanic workers, 3% among Asian workers, and 1% among American Indians or Alaska Natives.¹ Hispanic workers have fatality rates consistently higher than the average for all workers,⁸ and they are a priority population for fatal occupational injury prevention (Box 15-2). Of all fatal occupational injuries in 2008, 63% occurred to workers between 25 and 54 years of age, 9% to workers younger than 25, and 28% to workers 55 and older.¹ Rates of fatal occupational injury generally increase with age, with the highest rates among workers 65 and older.⁷⁻⁹ The youngest and oldest workers present both challenges and opportunities for occupational injury prevention (Box 15-3).

In 2008, of all occupational injury deaths, 80% were among wage and salary workers; the remainder were among self-employed workers, whose fatality rate is more than three times greater than that of wage and salary employees.⁸ The types of jobs held by self-employed workers explain some of this difference.¹⁰ For example, high proportions of the self-employed work in agriculture and construction, two industries with the highest rates of fatal injury.^{8,9}

Transportation-related events accounted for 41% of the 5,214 occupational injury deaths in the United States in 2008 (Fig. 15-1). These events involved motor vehicles and mobile equipment, such as tractors and forklifts; occurred on and off the highway; and included pedestrians and bystanders as well as operators and drivers.⁹ Work-related road crashes provide unique challenges and opportunities for prevention (Box 15-4). Contact with objects or equipment accounted for 18% of the fatalities, including being struck by falling objects, being caught in running equipment or machinery, and being caught in or crushed by collapsing

materials, such as in trench cave-ins or collapsing buildings. Assaults and violent acts accounted for 16% of fatalities in 2008, with most of them involving homicides and some involving suicides. Violence-related injuries occur in a variety of work situations, and consequently prevention strategies vary (Box 15-5). Falls, mostly to a lower level, accounted for another 13% of the fatalities. Exposure to harmful substances or environments, such as electric current, temperature extremes, hazardous substances, and oxygen deficiency, accounted for 8% of fatalities. Fires and explosions accounted for 3% of the fatalities.⁹ Demographic characteristics vary; for example, homicide accounts for a higher proportion of deaths among women than in men.^{7,9}

Box 15-2. Hispanics Are a Priority Population for Occupational Injury Prevention

Concomitant with increases of Hispanics in the U.S. population, the proportion of Hispanics in the workforce has increased and is expected to continue to increase. The number of Hispanics in the U.S. workforce increased 54% between 1998 and 2008, and it is expected to increase another 33% by 2018, to more than 29 million Hispanic workers.

Hispanics frequently work in the most hazardous jobs, which helps explain their higher rates of fatal injuries. Fatality rates are highest for foreign-born Hispanic workers. Most of the fatally injured foreign-born Hispanic workers are from Mexico. It is not known to what extent language, literacy, culture, and vulnerable employment situations (such as work as a day laborer and illegal immigration status) contribute to the high injury death rate among foreign-born Hispanics. The National Institute for Occupational Safety and Health (NIOSH) and the National Institute of Environmental Health Sciences (NIEHS) have funded research projects to identify unique risks for Hispanic and immigrant workers and develop and evaluate unique prevention approaches, such as utilizing community-based organizations to communicate safety and health information to Spanish-speaking and immigrant workers.

Many groups are responding to the need for communication of occupational safety and health information to Spanish-speaking and foreign-born workers, addressing issues of language, literacy, and culture.

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Box 15-3. The Youngest and Oldest Workers Present Challenges and Opportunities for Prevention

The U.S. workforce is characterized by involvement of workers from early adolescence to beyond traditional retirement ages. The United States is somewhat unique among industrialized nations in the high participation of youth less than 18 years of age in the workforce. Youth employment can begin as early as the middle school years (11 through 13 years of age), and by the time that young people graduate from high school (17 and 18 years of age), nearly 80% have reported working. As the U.S. population has aged and people have lived longer than in the past, the number of older workers has increased—and this number is expected to continue to grow. The number of workers 55 years and older increased 63% between 1998 and 2008, and it is expected to increase an additional 43% by 2018 to nearly 40 million. In 2009, there were an estimated 1.2 million workers 75 years and older in the United States.¹

Because of their biologic, social, and economic characteristics, the youngest and oldest workers have unique patterns and risks for work-related injuries. While younger workers have lower rates than older workers for fatal injuries, their rates for nonfatal occupational injury are higher. The higher rates of nonfatal injury are frequently attributed to less experience and training on safety hazards in the workplace. In contrast, the oldest workers have the highest rates of fatal occupational injury, lower rates of nonfatal injury, and longer recovery times once injured. Decreased physical ability to tolerate and recover from injuries may account for the longer recovery times and increased fatality rates. While normal decrements in health associated with aging, such as reductions in visual acuity and slower reaction times, would theoretically lead to increased injuries among older workers, it would appear that work and life experiences contribute to the lower rates of nonfatal occupational injury among older workers. Furthermore, older workers may be assigned to less physically demanding tasks.

It is important to ensure that employers provide new workers with training on the specific safety hazards in their

work environment and guidance on how to safely perform their jobs. Additionally, there is potential value in providing youth with basic training on occupational safety before they enter the workforce, as a means of helping to keep them safe in their first jobs, and potentially contributing to a more safety conscious generation of new workers. Along these lines, NIOSH and its partners have designed curricula that can be integrated into high-school programming or be used in other group settings, such as in apprentice training. Several government and private sector entities have also developed educational materials to increase the safety of young workers up to 24 years of age.

At the other end of the age spectrum, older workers bring a wealth of experience and perspective to the workplace. As the workforce continues to age, it is important to understand workplace programs and policies that reduce the risk for injury among an older population facing the realities of the aging process, and to make reasonable accommodations to increase the safety of older workers. Modifying work tasks to account for age-related decrements in functioning may have the added benefit of increasing safety for workers of all ages.

Reference

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The incidence of occupational injury deaths varies by industry sector (Table 15-1), with the most deaths in 2008 occurring in the construction sector, and the highest fatality rates in the agriculture, forestry, fishing and hunting, and mining sectors.^{8,9} Numerous specific industries and occupations have injury rates far in excess of the average for all industries and occupations.^{7,8} For example, occupations with fatality rates (deaths per 100,000 full-time equivalent workers) more than 10 times higher than the national average in 2008 include the following: fishers

and related fishing workers (128), logging workers (120), aircraft pilots and flight engineers (73), structural iron and steel workers (47), and farmers and ranchers (40).^{8,9}

Nonfatal Injuries

There is no single data system in the United States that collects data on all nonfatal occupational injuries. The two primary national sources of data on nonfatal work-related injuries are data from the BLS annual survey of employers²

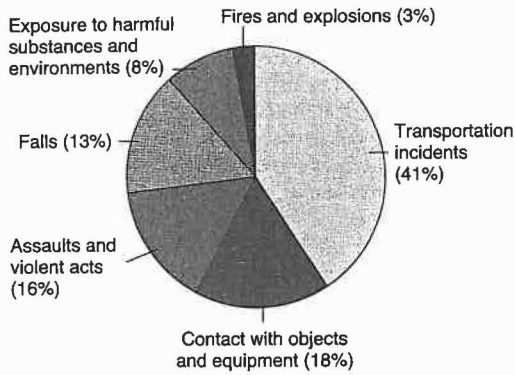


Figure 15-1. Events or exposures leading to occupational injury deaths, United States, 2008. (Source: Bureau of Labor Statistics. Census of fatal occupational injuries charts, 1992-2008 (revised data). Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, 2010. Available at: <http://www.bls.gov/iif/oshwc/cfoi/cfch0007.pdf>.)

and from emergency departments.⁴ Neither system is designed to capture all work-related injuries and both have limitations. The BLS survey is based on employer reports of injuries documented in records required by the Occupational Safety and Health Administration (OSHA). Based on the BLS survey, there were an estimated 3.5 million occupational injuries in 2008.² The BLS survey excludes the self-employed, farms with fewer than 11 employees, and federal government employees, and it may miss many cases that should be counted.³ Data on worker demographics and the circumstances of injuries are available only for lost workday cases in the BLS survey.¹¹ The emergency department system collects data on injuries treated in a nationally representative sample of emergency departments, with an estimate of 3.4 million occupational injuries and illnesses in 2004.⁴ The identification of these cases requires documentation in the emergency department record that the injury was work-related. Research on the completeness of the emergency department data has not been conducted, and information on industry and occupation are not currently available in the emergency department data. An estimated one-third of occupational injuries are treated in emergency departments.⁴ Data collected in both systems overlap and are not mutually exclusive. Illnesses, such as dermatitis, are included in both the emergency department data

and lost workday data from the BLS employer survey, but they represent less than 10% of cases in both systems.^{2,4} Although the data from the BLS survey and emergency departments have limitations and undoubtedly underrepresent the true burden of occupational injuries, they are likely to represent the majority of the more serious injuries, and they provide useful information on epidemiologic patterns of injury. Limited data are also available from the population-based National Health Interview Study (NHIS), which estimated 4 million medically consulted injuries and poisonings that occurred in paid jobs in 2008.¹²

Although not as dramatic as for fatal injuries, differences are seen across demographic categories for nonfatal injuries. Men account for approximately 60% to 70% of nonfatal work-related injuries treated in emergency departments and reported in the NHIS,^{4,12,13} but men account for approximately 85% of nonfatal work-related injuries requiring hospitalization.⁴ Men have rates that exceed those of women by 58% to 100%.^{4,11,13} In 2008, most nonfatal occupational injuries (67%) were among white, non-Hispanic workers, with fewer among Hispanic workers (22%) and black, non-Hispanic workers (7%).¹² About 70% of nonfatal injuries occur among workers 25 to 54 years of age.^{4,11,13} Those younger than 25 account for about 20% of injuries treated in emergency departments and reported in the NHIS,^{4,13} and 13% of injuries reported by employers as requiring at least 1 day away from work.¹¹ Workers older than 54 account for 8% to 9% of injuries treated in emergency departments and reported in the NHIS,^{4,13} and 16% of injuries reported by employers as requiring at least 1 day away from work.¹¹ The highest rates of nonfatal occupational injury are among workers about 18 to 24 years of age, with lower rates among workers less than 18 and among older age groups.^{4,13} The median number of days away from work, based on employer-reported data, was 8 in 2008, with the median days increasing steadily from a low of 4 days for workers 14 to 15 years of age to a high of 15 days for workers 65 and older.¹¹

In 2008, of employer-reported cases, 11% occurred among employees who had worked for less than 3 months for the employer, 20% among employees with 3 to 11 months of service, 36%

Box 15-4. Unique Challenges for Prevention of Roadway Occupational Deaths and Injuries

Roadway crashes are the leading cause of occupational injury deaths in the United States. Between 1992 and 2008, more than 23,000 workers died in highway incidents,⁹ averaging more than three deaths daily. Truck drivers account for more roadway fatalities than any other occupational group, and they have the highest rates for roadway worker deaths. However, work-related roadway crashes are not limited to the transportation industry, and many workers in occupations that are not related to transportation are killed each year. Some workers are killed while using vehicles provided by their employers, while others are killed driving their own vehicles to perform their jobs.

Preventing work-related roadway crashes is especially challenging. Unlike other workplaces, the roadway is not a closed environment. Although employers cannot control roadway conditions, they can take a number of steps to help keep their workers safe when driving, such as:

- Implementing and enforcing policies for mandatory use of seat belts
- Ensuring that no workers are assigned to drive on the job if they do not have valid driver's licenses appropriate for the types of vehicles they drive
- Providing fleet vehicles that offer the highest possible levels of occupant protection in the event of a crash
- Maintaining complete and accurate records of workers' driving performance, in addition to driver's license checks for prospective employees and periodic rechecks after hiring, are critical.
- Incorporating fatigue management into safety programs
- Ensuring that workers receive the training necessary to operate specialized motor vehicles or equipment
- Offering periodic screening of vision and general physical health for all workers for whom driving is a primary job duty
- Avoiding requiring workers to drive irregular hours or to extend their work day far beyond their normal working hours as a result of driving responsibilities

- Establishing schedules that allow drivers to obey speed limits and follow applicable hours-of-service regulations
- Setting safety policy in accordance with state graduated driver licensing laws so that company operations do not place younger workers in violation of these laws
- Assigning driving-related tasks to young drivers in an incremental fashion, beginning with limited driving responsibilities and ending with unrestricted assignments

Many of these recommended employer measures are included in the standard of the American National Standards Institute (ANSI) Safe Practices for Motor Vehicle Operations (Z15.1). This voluntary consensus standard, issued in 2006, provides minimum guidelines for employers to develop a motor vehicle safety program. These guidelines are meant for use by employers with vehicle fleets ranging from one vehicle to hundreds of vehicles.

Employees can also take steps to increase their safety while driving in the performance of their work, including the following:

- Using safety belts
- Avoiding placing or taking cell phone calls while operating a motor vehicle
- Avoiding other activities while driving, such as eating, drinking, or adjusting noncritical vehicle controls
- Never attempting to read or send text messages while driving

Source: Excerpted and updated from: Pratt SG. National Institute for Occupational Safety and Health Hazard Review: Work-related roadway crashes: challenges and opportunities for prevention. DHHS [NIOSH] publication no. 2003-119. Cincinnati, OH: NIOSH, 2003.

Further Reading

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with 1 to 5 years of service, and 31% with more than 5 years of service.¹¹ Most employer-reported injuries requiring time away from work in 2008 occurred Monday through Friday (86%), and between the hours of 8:00 a.m. and 4:00 p.m. (51%). Fifty percent of the employer-reported injuries occurred between 2 and 8 hours into the work shift, with the largest proportion (20%) occurring 2 to 4 hours into the shift.¹¹

The types of events leading to nonfatal occupational injuries follow a different pattern than fatal injuries. The most common events

resulting in nonfatal occupational injuries include contact with objects and equipment, bodily reaction and exertion, and falls.^{4,11} Figure 15-2 shows the distribution of nonfatal occupational injuries treated and released from emergency departments in 2004. Demographic characteristics vary; for example, bodily reaction and exertion, and falls, account for a higher proportion of injuries among women than in men.⁴

The number and rate of nonfatal injuries by industry division vary greatly from the number and rate for injury deaths (Table 15-2).

Box 15-5. Workplace Violence: A Complex Workplace Injury Phenomenon

Homicide is a leading cause of occupational injury death, and workplace violence accounts for many nonfatal injuries each year. Because of news coverage of sensational and more “newsworthy” events, many assume that disgruntled co-workers and former employees account for the bulk of these injury statistics. In reality, violence caused by co-workers or former employees is a relatively small part of the workplace violence problem in the United States. Most work-related violence in the United States is associated with crime, such as robbery, and violence from clients, customers, or patients.

Violence in the workplace has been categorized into four different types of events:

- *Type I: Criminal Intent:* These situations are typically associated with crimes such as robbery, shoplifting, and loitering. A preexisting relationship does not exist between the employee and the perpetrator, and the perpetrator does not have a legitimate reason for being in the workplace.
- *Type II: Customer or Client:* These situations involve customers or clients who have a legitimate reason for being in the workplace. The violence is associated with a business transaction or service. Perpetrators include customers, clients, patients, and inmates.
- *Type III: Worker-on-Worker:* These situations involve violence between co-workers or violence perpetrated against an employee by a former employee.
- *Type IV: Personal Relationship:* In these situations, the perpetrator has a preexisting relationship with the employee and the violence is associated with the relationship rather than the business. These situations

include acts of domestic violence against employees while they are at work.

Workplace violence occurs in a variety of workplaces and occupations, although there are some worker groups at increased risk for the more common Type I and II events, including police and corrections officers, taxi drivers, health care providers, and employees in retail settings.

While workplace violence is a complex phenomenon, there are a variety of strategies that employers and workers can use to reduce the risks for violence—some specific to work settings and tasks, and others more general. Workplace violence prevention strategies include the following: modifying the work setting and tasks to reduce the risks for robbery and/or assault (such as by posting signs in retail settings that minimal cash is kept on hand, providing physical barriers between employees and potential criminals or violent clients, ensuring good lighting, and using surveillance cameras and/or security guards); establishing workplace policies for “zero violence tolerance” and procedures for reporting and following up on all threats or violent acts; and training employees on how to handle criminals or violent customers or clients.

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Most injuries in 2008 occurred in the manufacturing sector, and the highest injury rates were in the transportation and warehousing sector.² The occupational injury rate in 2008, averaged across all industries and state and local governments, was 4.0 per 100 full-time equivalent workers. Because the BLS annual survey of employers excludes farms with fewer than 11 employees, the numbers of nonfatal occupational injuries reported for the agriculture, forestry, fishing, and hunting sector should be considered as conservative estimates. In a separate survey of U.S farm operators, the number of injuries was much higher than reported in the BLS survey of employers (74,800 occupational injuries; 13.1 injuries per 1,000 workers.)¹⁵

Clinical Presentation and Course of Injuries

Of all workers with occupational injuries, an estimated 34% are treated in emergency departments in the United States;⁴ the remainder are treated at workplaces, and at physician’s offices, clinics, and other medical treatment facilities. In 2004, the most common diagnoses of workers treated for occupational injuries in emergency departments were as follows: sprains and strains (28%); lacerations, punctures, amputations, and avulsions (25%); contusions, abrasions, and hematomas (17%); dislocations and fractures (7%); and, burns (3%).⁴ Most sprains and strains (55%) were to the trunk area (shoulder, back, chest, or abdomen), followed by the lower extremities (legs, feet, and toes) (25%).

Table 15-1. Number and Rate of Fatal Occupational Injuries, by Industry Sector, United States, 2008

Industry Sector	Number of Fatalities	Fatality Rate*
Construction	975	9.7
Transportation and warehousing	796	14.9
Agriculture, forestry, fishing and hunting	672	30.4
Government	544	2.4
Manufacturing	411	2.5
Professional, scientific, management, administrative	403	2.8
Retail trade	301	2.0
Arts, entertainment, recreation, accommodation, and food services	238	2.2
Wholesale trade	180	4.4
Other services, except public administration	178	2.6
Mining	176	18.1
Educational, health and social services	141	0.7
Finance, insurance, real estate, and rental and leasing	106	1.1
Information	47	1.5
Utilities	37	3.9
Total	5,214	3.7

Note: For 9 fatalities, industry sector not reported.

*Rate per 100,000 full-time equivalent workers

Source: Bureau of Labor Statistics. Fatal occupational injuries, total hours worked, and rates of fatal occupational injuries by selected worker characteristics, occupations, and industries, civilian workers, 2008. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, 2010. Available at: http://www.bls.gov/iif/oshwc/cfoi/cfoi_rates_2008hb.pdf. Accessed on June 18, 2010.

About 75% of the lacerations, punctures, amputations, and avulsions were to the upper extremities (arms, hands, or fingers). Almost 2% of occupational injuries resulted in hospital admission.⁴ Dislocations and fractures, caused mostly by falls, accounted for 40% of the hospitalizations among males and 33% among females.

Of the estimated 1.1 million injuries and illnesses with lost work days in 2008, the median

time away from work was 8 days. Median time away from work was highest for fractures (28 days), carpal tunnel syndrome (28 days), and amputations (26 days).¹¹

PREVENTION OF INJURIES

The Hierarchical Approach to Occupational Injury Control

Over the years, a number of models for occupational injury control have evolved. Many of these models categorize worker protection strategies based on a hierarchical approach,¹⁶ such as the five-tier model (Table 15-3). The hierarchical approach focuses on (a) eliminating hazards through design; (b) using safeguards which eliminate or minimize worker exposure to hazards; (c) providing warning signs or devices to identify and alert workers to hazards; (d) training workers in safe work practices and procedures; and (e) using PPE to prevent or minimize worker exposure to hazards or to reduce the severity of an injury if one occurs.

William Haddon, Jr., proposed 10 basic strategies for injury prevention that have several

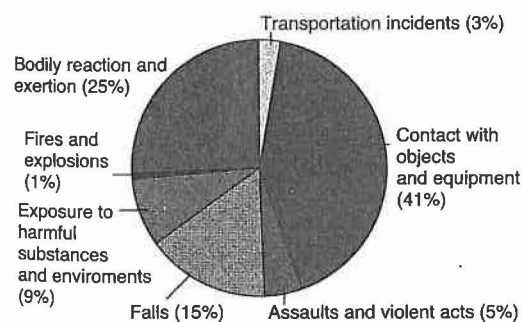


Figure 15-2. Events or exposures leading to occupational injuries treated and released from emergency departments, United States, 2004. (Source: Derk SJ, Marsh SM, Jackson LL. Nonfatal occupational injuries and illnesses—United States, 2004. *Morbidity and Mortality Weekly Report* 2007; 56: 393–397.)

Table 15-2. Number and Rate of Nonfatal Occupational Injuries, by Industry Sector, United States, 2008

Industry Sector	Number of Injuries	Injury Rate*
State and local government	867,600	5.9
Education and health services	653,600	4.7
Manufacturing	630,600	4.6
Retail trade	520,600	4.3
Leisure and hospitality	368,400	4.1
Construction	314,200	4.6
Professional and business services	249,100	1.8
Transportation and warehousing	233,600	5.5
Wholesale trade	211,300	3.6
Financial activities	101,600	1.4
Other services, except public administration	91,900	3.0
Information	48,700	1.9
Agriculture, forestry, fishing and hunting	43,700	4.9
Mining	23,700	2.9
Utilities	17,600	3.2
Total	4,376,300	4.0

*Rate per 100 full-time equivalent workers.

Source: Bureau of Labor Statistics. Workplace injuries and illnesses—2008. News Release USDL 09-1302. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, 2009.

similarities to the hierarchical approach, such as hazard elimination, hazard reduction, and use of barriers for protection.¹⁷ He also introduced the concept that injury causation was a chain of multifactorial events, each of which provided opportunities for intervention. Herb Linn and Alfred Amendola suggested an approach that, for injury control, combines the public health model with safety engineering analysis.¹⁸ Epidemiology, safety engineering, biomechanics, ergonomics, psychology, safety management, and other types of expertise comprise a multidisciplinary approach that is useful for identifying injury risk factors and developing control strategies.

Three main categories of control strategies correlate with the hierarchical approach: engineering controls, administrative controls, and the use of PPE.

Engineering Controls

Engineering controls, also known as passive controls, eliminate hazards through equipment or systems design or prevent worker exposure to hazards through the application of safeguards. Effective hazard elimination and safeguards are designed or retrofitted into equipment, work stations, and work systems to provide protection without direct worker involvement—thus, the term “passive controls.” To be most effective, engineering controls must be designed so that they do not adversely interfere with the work process or introduce additional hazards.

The optimal injury control strategy is to eliminate a hazard completely. Frequently, hazard elimination or the reduction of hazard severity can be accomplished through equipment or systems design.

Table 15-3. Safety Hierarchy

Priority Rank	Safety Action
1	Eliminate hazard and/or risk
2	Apply safeguarding technology
3	Use warning signs
4	Train and instruct
5	Use personal protective equipment

Source: Barnett RL, Brickman DB. Safety hierarchy. Journal of Safety Research 1986; 17: 49–55.

CASE 2

A 36-year-old male Hispanic laborer died after becoming engulfed in sawdust inside a sawmill storage silo. The flat-bottomed silo used a three-armed rotating sweep auger mechanism to funnel stored sawdust through an opening in the silo floor to a transfer auger, which

transported the sawdust to another part of the sawmill for use in generating electricity for the mill. Due to the flat-bottom design of the silo, the sweep auger was prone to frequent clogs, requiring workers to manually unclog the system with rakes and poles. On the day of the incident, the victim entered the silo to manually clear a clog, and, after a short time that he was inside, sawdust that had accumulated on the sides of the silo collapsed, completely engulfing him.

Although several factors contributed to this worker's death, the National Institute for Occupational Safety and Health (NIOSH) recommended retrofitting the silo with a mechanical leveling/raking device that improves the flow of loose materials, such as sawdust, to minimize or eliminate the need for worker entry into this confined space.¹⁹

Because hazard elimination is not always possible, other control strategies in the hierarchy must be implemented to achieve worker protection. If a hazard cannot be eliminated completely, then the next control level should be to prevent worker exposure through protective safeguarding approaches. These types of safeguards prevent worker exposure to the hazard, as long as the control is in place and functions properly.

For example, many types of industrial equipment require power transmission units that include belts, pulleys, gears, shafts, and other mechanisms necessary for the equipment to function. Workers can be exposed to serious, or even fatal, injury hazards if they contact these rotating or moving components. A fixed barrier guard that completely encloses the power transmission unit is an engineering control that protects workers from being caught in or struck by hazards by preventing worker contact with any moving parts. As long as the guard remains in place, the worker is protected from injury. Another engineering control is an optical sensor, also called a light curtain, used to protect the worker from injury when operating a mechanical power press (Fig. 15-3). The optical sensor is integrated into the press control mechanism so that if any part of the worker's body breaks the plane of light in front of the hazardous point of operation, the downward motion of the press

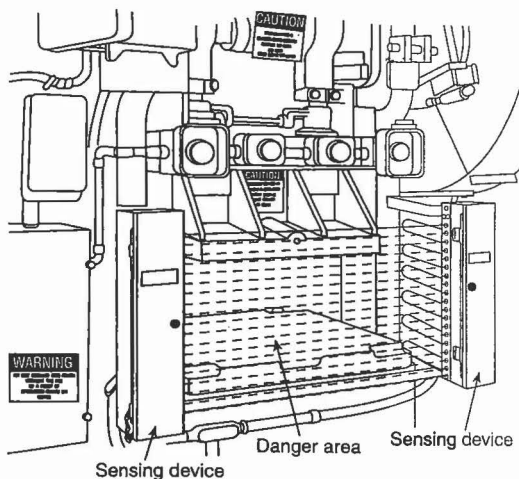


Figure 15-3. Photoelectric (optical) sensor installed on a mechanical power press to protect the point of operation. (Source: Occupational Safety and Health Administration. Concepts and techniques of machine safeguarding. Washington, DC: OSHA, 1980.)

ram cannot be initiated or, if motion has begun, the press ram is automatically disengaged.

Many engineering controls are interlocked to ensure that they cannot be removed without disabling the machine or equipment. An interlock is a device that is integrated into the control mechanism of a machine or work process to prevent the work cycle from being initiated until the interlock is closed, signaling the equipment that the work cycle can be initiated. One example is a skid-steer loader with interlocked driver controls that require the operator be properly positioned inside the equipment, with the seat belt fastened, before the equipment can be started and the bucket raised. Interlocks, which are usually electrical or mechanical controls, need to be designed so that they are not easily bypassed or disabled.

Although engineering controls should be viewed as primary tiers of prevention, it is not always possible to develop such controls for all potentially hazardous work situations. Administrative controls are the next tier for reducing or minimizing worker exposure to injury hazards.

Administrative Controls

Administrative controls are management-directed work practices or procedures which,

when implemented consistently, will reduce the exposure to hazards and the risk of injury. They are sometimes referred to as active controls because they require worker involvement to be effective. The use of warning signs and devices, and worker training on safe work practices and procedures, are considered administrative controls since workers must be actively involved for these to be effective. Workers must adhere to warning signs that identify potential injury hazards and apply the training they have received properly. Other examples of administrative controls include housekeeping procedures requiring that spills or debris be cleaned up quickly to reduce the potential for a slip, trip, or fall injury (Fig. 15-4), and implementation of a hazardous energy control policy for workers performing maintenance activities on a machine. Lockout/tagout procedures are important components of a hazardous energy control policy (Fig. 15-5).



Figure 15-4. Example of poor housekeeping on a construction site. Numerous cords and debris create a potential tripping hazard for workers. (Photograph by Earl Dotter.)

However, to be effective, the procedures must be written and consistently implemented, and workers must be trained in their use.²⁰

Personal Protective Equipment

Personal protective equipment consists of devices worn by workers to protect them, by reducing (a) the risk that exposure to a hazard will injure the worker or (b) the severity of an injury if one does occur. Although the hazard still exists, the potential for worker injury is mitigated by use of PPE. The use of PPE in many work environments and situations is essential

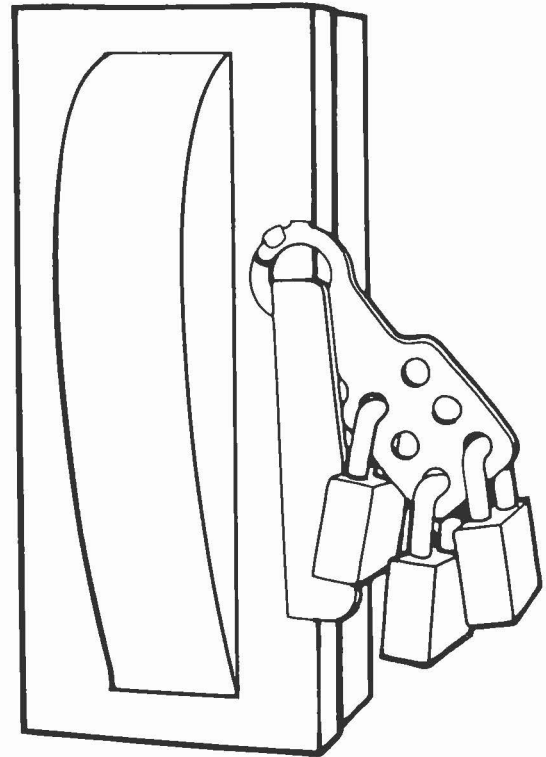


Figure 15-5. Lockout hasp on an electrical control panel, which provides a method for applying a lock (lockout) to the panel during maintenance or repair to ensure that the equipment is not energized until the work has been completed. The control panel should also be tagged (tagout) with a label indicating that work is being performed. Workers should be provided with individually keyed locks, and only the worker who applied the lock should remove it. (Source: Occupational Safety and Health Administration. Concepts and techniques of machine safeguarding, Washington, DC: OSHA, 1980.)

for worker protection. However, PPE is usually viewed as the lowest tier in the hierarchy of controls. If hazardous exposures cannot be eliminated through engineering controls or the application of administrative controls, then PPE provides another opportunity for worker protection. Examples of PPE designed to reduce worker injuries include protective hard hats, eyewear and face shields, steel-toed safety shoes, fall restraint devices, and personal flotation devices (Fig. 15-6). When worn properly and consistently, these devices can prevent, or at least reduce the severity of, traumatic injuries. Fall restraint devices, such as lanyards and body harnesses, do not prevent workers from falling, but they protect them from suffering more serious injuries or fatalities due to falls from elevations (Fig. 15-7).

Combined Application of Controls

A comprehensive approach to worker injury prevention efforts inevitably includes all tiers of



Figure 15-6. Example of worker using multiple forms of personal protective equipment, including hard hat, face shield, hearing protection, work gloves, knee pads, and work boots. (Photo courtesy of Mine Safety Appliance Company.)

the control hierarchy to achieve maximum worker protection. In most work environments, a combination of engineering controls, administrative controls, and PPE will be required to have a complete and effective injury prevention program. The following examples illustrate how the combined application of controls can be used to achieve an enhanced level of worker protection.

Tractors equipped with a rollover protective structure, an engineering control, significantly reduce the risk that the operator will be injured in a rollover event (Fig. 15-8). However, more effective protection can be achieved if a seat belt, an administrative control, is worn to keep the operator within the protective envelope of the rollover protective structure. A similar example is the increased protection afforded by the combined use of seat belts, mandated in company safety policies and programs, in motor vehicles that are also equipped with air bags.

Training

Training refers to methods to assist individuals in acquiring knowledge (safety information on potential workplace hazards), changing attitudes (perceptions and beliefs regarding safety), and practicing safe work behaviors (organizational, management, or worker performance). Despite inadequate data on the direct relationship between training and injury, evidence suggests a positive impact of training on establishing safe working conditions.²¹ Training is one of the key factors accounting for differences between companies with low and high injury rates. It is often critically important for developing and implementing effective hazard control measures.^{21,22} Training increases hazard awareness and knowledge, facilitates adoption of safe work practices, and leads to other workplace safety improvements. Training is an administrative control, as workers must properly use training they have received on a consistent basis for it to be effective in preventing injuries.

The elements of effective training programs are (a) assessing training needs specific to the work task; (b) developing the training program to address these needs specifically; (c) setting clear training goals; and (d) evaluating the post-training knowledge and skills and providing feedback to the workers.²¹ Other important



Figure 15-7. Worker wearing a full-body harness with attached lanyard properly tied off to a life line. (Photo courtesy of the Mine Safety Appliance Company.)

characteristics of a successful program are management commitment to safety and training that is initiated as soon as a worker is hired and then is followed up with periodic retraining and reinforcement.^{21,22}

Unique characteristics of the specific workforce must be considered when developing

or implementing safety training programs. Language, literacy, cognition, and cultural issues may diminish the effectiveness of training when programs are not tailored to account for unique or diverse characteristics of the workforce. Workplace safety training appears to be most effective when it includes active learning experiences that stress worksite application, and when it is developed and implemented in the context of a broader workplace-based prevention approach.²¹

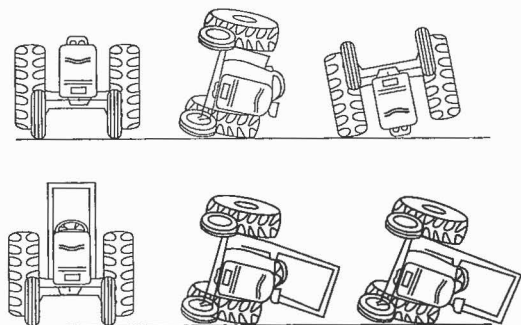


Figure 15-8. Tractor with a two-post roll-over protective structure (ROPS) frame installed. A ROPS is designed to reduce the risk of injury or death by preventing the tractor from rolling onto and crushing the operator. A properly fastened seat belt greatly improves the chances that the operator will stay within the protective envelope provided by the ROPS (the seat). (Source: National Institute for Occupational Safety and Health. Safe grain and silage handling. DHHS (NIOSH) Publication No. 95-109. Washington, DC: Author, 1995.)

Standards

Many standards aim at protecting workers from traumatic injury. These standards cover a multitude of hazards and address the work environment, work practices, equipment, PPE, and worker training. The two primary types of worker protection standards consist of (a) mandatory standards, such as those promulgated by OSHA or other regulatory agencies, and (b) voluntary standards, such as those developed through independent organizations, like the American National Standards Institute (ANSI), through a consensus process involving various stakeholders in an industry—typically including representatives from labor, management, and government. Numerous specifications, codes, and guidelines for machinery, equipment, tools,

and other materials can also assist engineers and designers in developing safer products and systems, many of which have application in the workplace. Examples include the National Electric Code (NEC) published by the National Fire Protection Association (NFPA) and numerous consensus standards from the American Society of Mechanical Engineers (ASME) and the American Society for Testing and Materials (ASTM).

Injury Control: Roles and Responsibilities

Occupational injury prevention is not the sole responsibility of a single person or group. Employers, workers, public health and safety practitioners, researchers, regulators, and policy makers each share in the responsibility for prevention. A multidisciplinary approach involving interaction among diverse groups is crucial to developing and implementing effective occupational injury prevention strategies.

Within an organization, active participation by both management and workers is essential to an effective safety program. Safety and prevention should be integrated throughout the organization with everyone sharing responsibility. Employers are responsible for establishing written safety policy, developing a comprehensive safety program, and effectively implementing that program at the workplace. A competent person or committee should be designated with responsibility for overall planning and implementation of company safety policy. This person or committee should have sufficient knowledge concerning safety policy, standards, regulations, and hazard abatement, and should actively participate with managers and workers in coordinating and overseeing the safety program.

An effective safety program will strive to identify hazards through job safety analysis or other methods of systems safety analysis and will eliminate or control identified hazards through the various approaches previously described. Workers, managers, and safety specialists should work together to analyze the job and potential hazards and to recommend changes or controls to abate them to avoid an injury event. Table 15-4 includes injury hazards with examples from each of the three main categories of hazard control

strategies: engineering, administrative, or PPE. The most comprehensive safety programs will typically require strategies from all three categories. In industries or jobs where the work environment is not constant, site hazard assessments should be performed prior to beginning work in any new or changing environment. Occupations such as farming, logging, construction, oil and gas extraction, and mining are characterized by frequently changing work sites and require a site hazard assessment prior to commencing work in any new or changed environment. This requirement is particularly important in industries such as construction and utility maintenance, where worksites change not only from job to job but also from day to day—even hour to hour, with constant potential for new hazards.

Employers are also responsible for ensuring proper maintenance of vehicles, equipment, and machinery and their safety features, such as machine guarding, interlocks, warning systems, and barriers. Where job hazards cannot be eliminated or controlled, employers are responsible for providing appropriate PPE, such as fall arrest systems, respirators, hearing protectors, hard hats, or eye protectors.

Employers must also ensure that workers receive appropriate training in minimizing their risk—including training on safety policy and practice, hazard recognition and control technologies, and the appropriate use of PPE. Enforcement of safety policy is also a critical employer responsibility. The demonstrated commitment of management to safety is a major factor in successful workplace safety programs.²³⁻²⁵ Employers are more likely to have successful safety programs when they demonstrate concern by having top managers personally involved in safety activities and routinely involve workers in decision making about safety matters. As part of a comprehensive safety program, employers should require systematic reporting and tracking of occupational injuries and assessment of this information for corrective action to prevent similar occurrences.

Workers also play a vital role in workplace safety. Their participation is essential. Workers share in the responsibility for complying with safe work practices and policies, maintaining a safe work area, and using appropriate PPE when required by their employer. Workers should also

Table 15-4. Injury Hazards and Example Control Strategies by Category

Injury Hazard	Engineering Controls	Administrative Controls	Personal Protective Equipment
Motor vehicle crashes	Ensure all vehicles are equipped with air bags	Implement a mandatory seat belt policy	Provide helmets and eye protection for workers whose job requires operating motorcycles or bicycles
Assaults	Install bullet-resistant barriers or enclosures in retail settings	Train workers in nonviolent response when confronted with volatile situations	Provide body armor for public safety workers
Falls from elevation	Install grids or screens over skylight fixtures that meet OSHA standards for protection from falls through skylights	Train workers to set up extension ladders at the proper inclination angle of 75 degrees	Provide personal fall arrest systems during work at elevations
Falls to same level	Redirect downspouts away from walkways with high pedestrian traffic	Implement a policy encouraging workers to clean up or report floor spills promptly	Provide or require workers to wear shoes with slip-resistant soles
Caught in	Ensure that controls on skid-steer loaders are interlocked and require operators to be properly positioned with seat belts fastened before the vehicle can be started and the bucket raised	Develop standard procedures for safely clearing material jams on machinery and equipment	Ensure long hair is tied back or covered when working around machinery with rotating or moving components
Struck by	Install fencing or other physical barriers around robots or other moving equipment, with access through interlocked gates	Minimize forklift traffic during shift changes to reduce exposure to moving forklifts during times when large numbers of workers pass through an area during a short time period	Provide protective hard hats, eyewear, and shoes
Contact with electrical energy	Install ground fault circuit interrupters (GFCIs) in damp or wet locations	Develop and implement a hazardous energy control policy for all maintenance and repair activities	Provide electricians with properly rated di-electric gloves when procedures require work on energized components, such as troubleshooting an electrical panel
Overexertion	Use mechanical lifting devices, such as ceiling mounted cranes, to lift heavy and bulky items	Use job rotation schedules with different physical demands to reduce the frequency of lifting and repetitive motion tasks	Provide workers with nonslip safety gloves during materials handling tasks
Confined spaces	Where possible, locate serviceable components, such as pumps, agitators, and gauges outside of confined spaces so that entry is not required for maintenance, repair, or monitoring	Ensure workers test any confined space for flammable, toxic, or oxygen-deficient atmospheres prior to entry; identify and post warning signs outside of all confined spaces	Provide self-contained breathing apparatus (SCBA) or other appropriate air-supplied respirators if entry is required into spaces with flammable, toxic or oxygen-deficient atmospheres

participate in company-sponsored training. They should report injuries and unsafe conditions for corrective action. As the experts in their jobs, workers should be involved in systems safety analysis and development of safe solutions. Workers' input into recommended design or modification of safety controls, processes, or

technology and into the development of safe work practices increases the acceptance of positive changes and, thus, the success of safety programs.

An effective workplace safety program that minimizes injuries results from a multidisciplinary activity that actively involves every level

of the workforce, from the employer and upper-level managers to employee representatives and hourly workers. Each must assume some responsibility for safety and must work together interactively to achieve the common goal of preventing injuries.

Researchers provide science-based approaches to workplace injury prevention. The development of injury prevention strategies and technologies, through laboratory studies and field

evaluations, yields evidence-based strategies and solutions to existing and emerging hazards. It is important for researchers and industry to work together in partnership throughout the research process to ensure that prevention strategies are relevant and applicable to the workplace, to demonstrate and evaluate prevention effectiveness in actual work settings, and to facilitate the transfer of research results to implementation and practice in the workplace. Injury prevention

Box 15-6. Unique Role for Public Health Agencies in Occupational Safety

In 2008, the National Institute for Occupational Safety and Health (NIOSH), in conjunction with the Council of State and Territorial Epidemiologists (CSTE), updated the publication *Guidelines for Minimum and Comprehensive State-Based Public Health Activities in Occupational Safety and Health*. This publication highlights the important role of state public health agencies in fostering occupational safety and health, based on the three core functions of public health identified by the Institute of Medicine in 1988: assessment, policy development, and assurance.

Assessment: Assessment involves the regular and systematic collection, analysis, and communication of the public's health, including statistics on health status. There are numerous state-level data sources for assessing occupational injuries that include injuries not captured in the national occupational injury systems overseen by the Bureau of Labor Statistics (BLS). These unique state-level data include hospital discharge data, emergency department data, workers' compensation records, burn center data, and poison control centers' data. CSTE has identified key occupational injury indicators that use existing state-level data to assess and track trends in occupational injuries at the state level, and these have been reported by 15 states to date. In-depth analyses of state-based occupational injury surveillance data have been conducted in several states, leading to state-specific injury prevention efforts, including prevention of burns and injuries among teen workers.

Policy development: Policy development involves the responsibility to develop public health policies based on scientific knowledge. Examples of how state health departments can contribute to sound policy development to improve worker safety include the following: collaborating with stakeholders in establishing state-wide occupational safety objectives, such as the Healthy People 2020 objectives for the nation to reduce occupational injuries; collaborating with public health partners to encompass the prevention of occupational injuries in broad state-wide injury prevention programs and plans (such as those focused

on reducing transportation injuries and injuries to adolescents); developing programs and working relationships with partners such as state labor departments and OSHA to collectively work toward preventing occupational injuries; and developing program capacity to identify and respond to emerging occupational safety hazards or unique prevention opportunities.

Assurance: Assurance involves making sure that services are available at the state-level to achieve agreed upon goals, such as injury prevention generally, or occupational injury-specific goals. State health departments should have sufficient occupational safety expertise and resources to meet their populations' information needs and to be able to provide appropriate referrals for technical assistance.

Public health agencies have statutory, regulatory, and philosophical commitments to protect the public's health, including vulnerable groups who may fall outside the jurisdiction of federal or state regulatory agencies. The NIOSH/CSTE publication noted above provides guidelines on developing state-based public health programs in occupational safety and health, ranging from minimum activities that can be performed with existing state health department staff and data, to more comprehensive approaches that require additional resources. It is intended that these guidelines will be used by state health agencies to develop the capacity for minimum activities in every state and to enhance existing programs. Numerous examples of state-based public health activities in occupational safety and health suggest that state public health agencies have a critical and complementary role to state labor agencies in preventing occupational injuries.

Further Reading

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research results will only be effective in reducing injuries if they are directly communicated and transferred to employers, trainers, safety practitioners, regulators, and policy makers who can implement research results for prevention action. This research-to-practice process, developing and applying science-based prevention strategies in the workplace, is also a shared responsibility of the multiple entities with vested interest in workplace injury prevention.

Government agencies also play a role in preventing occupational injuries. Federal and state labor agencies are involved in data collection on occupational deaths and injuries through the BLS, and they serve a regulatory function by establishing standards for safe work practices and enforcing those regulations. Federal OSHA, and 27 states and territories authorized by OSHA, promulgate and enforce mandatory minimum standards for occupational safety and health. Federal and state labor agencies also provide consultative services to employers and education to raise awareness about their standards and injury prevention practices. State health departments are involved in occupational safety at varying levels, including the following: the collection, analysis, and interpretation of unique data not collected by BLS; disseminating occupational injury prevention recommendations using state networks; and ensuring that occupational injury prevention is encompassed within state injury prevention plans. Increasing state health department involvement in occupational safety holds considerable potential for improving worker safety (Box 15-6).

Occupational injuries continue to exert too large a toll on the workforce. While the rate of fatal injuries in the United States has decreased markedly over time, the rate of nonfatal injuries has not been reduced as much.⁴ The prevention of workplace injuries requires concerted and consistent efforts from multiple parties using multiple strategies. In addition to the primary stakeholders in the workplace, additional groups can help reduce occupational injuries. These groups include researchers who provide the evidence base for effective prevention strategies and technologies, manufacturers and distributors of industrial equipment and tools that design and promote safety features of equipment, insurers who provide monetary incentives for good safety

records and practices, and health care providers and public health practitioners who provide their patients and constituents with information on preventing workplace injuries.

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Occupational and Environmental Health

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Disease and Injury

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