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Leading Work-Related Diseases and Injuries — United States

The National Institute for Occupational Safety and Health (NIOSH) has recently developed a suggested list of the 10 leading work-related diseases and injuries (Table 1). Three criteria were used to develop the list: the disease's or injury's frequency of occurrence, its severity in the individual case, and its amenability to prevention. The list is suggested with three purposes: 1) to encourage deliberation and debate among professionals about the major problems in this field of public health, 2) to assist in setting national priorities for efforts to prevent health problems related to work, and 3) to convey to a diverse audience the concerns of the leadership of NIOSH and the focus of the Institute's activities. The list is intended to be dynamic; it will be reviewed periodically for necessary updating as knowledge increases and as conditions change and are brought under better control.

TABLE 1. The ten leading work-related diseases and injuries — United States, 1982*

1. Occupational lung diseases: asbestosis, byssinosis, silicosis, coal workers' pneumoconiosis, lung cancer, occupational asthma
2. Musculoskeletal injuries: disorders of the back, trunk, upper extremity, neck, lower extremity; traumatically induced Raynaud's phemonenon
3. Occupational cancers (other than lung): leukemia; mesothelioma; cancers of the bladder, nose, and liver
4. Amputations, fractures, eye loss, lacerations, and traumatic deaths
5. Cardiovascular diseases: hypertension, coronary artery disease, acute myocardial infarction
6. Disorders of reproduction: infertility, spontaneous abortion, teratogenesis
7. Neurotoxic disorders: peripheral neuropathy, toxic encephalitis, psychoses, extreme personality changes (exposure-related)
8. Noise-induced loss of hearing
9. Dermatologic conditions: dermatoses, burns (scaldings), chemical burns, contusions (abrasions)
10. Psychologic disorders: neuroses, personality disorders, alcoholism, drug dependency

*The conditions listed under each category are to be viewed as *selected examples*, not comprehensive definitions of the category.

The following articles contain detailed discussions of occupational lung diseases, musculoskeletal injuries, occupational cancers (other than lung), and amputations, fractures, eye loss, lacerations, and traumatic death. Future articles will elaborate on the others.

OCCUPATIONAL LUNG DISEASES

The lung is both a target organ and a portal of entry for toxic substances. The likelihood of toxic exposure is high; for example, an estimated 1.2 million workers each year are potentially exposed to silica dust alone (*2*). The recognition of occupational lung diseases may be difficult, since the latent period for such diseases may be long—as long as 15 years for silicosis and 30 years or more for asbestos-related diseases. Other factors, such as cigarette smoking, may also contribute significantly to the disease process and hence obscure the association between work and the disease (*3*).

Six important components of occupational lung diseases are described below. Each is preventable, although years of effective control measures will be required to eliminate diseases of long latency. Because of the rapid rate at which new potentially toxic agents are introduced into the workplace, vigorous pre-market toxicologic testing of agents and effective disease surveillance are essential if epidemics of occupational lung diseases are to be avoided. The U.S. Public Health Service has established the following national objective for the prevention of occupational lung diseases: "by 1990, among workers newly exposed after 1985, there should be virtually no new cases of four preventable occupational diseases—asbestosis, byssinosis, silicosis, and coal workers' pneumoconiosis" (*4*). These diseases, as well as lung cancer and occupational asthma, are briefly discussed below.

Asbestosis: Asbestosis is characterized by diffuse, extensive scarring of the lung and progressive shortness of breath. Once established, the disease progresses even after exposure ends; there is no specific treatment. The latent period is 10-20 years. Smoking appears to increase the risk of death from asbestosis by a factor of two to three. Longitudinal studies of groups of asbestos insulation workers and shipyard workers have revealed that 10%-18% may be expected to die of asbestosis (*5*).

Byssinosis: This condition, characterized by both acute (reversible) and chronic lung disease, is associated with inhalation of the dusts of cotton, flax, or hemp. Symptoms include "chest tightness," cough, and obstruction of the small airways. Severely impaired lung function has disabled an estimated 35,000 current and retired textile workers (*6*). The specific causal agent(s) in the various dusts are yet to be identified (*7*).

Silicosis: Although the ill effects of exposure to free crystalline silica have been known for centuries, the prevalence of disabling silicosis remains high in certain groups of workers (*8*). Nearly 60,000 currently exposed workers in mines and foundries, in abrasive blasting operations, and in stone, clay, and glass manufacturing may be expected to suffer some degree of silicosis (*9*).

Coal workers' pneumoconiosis (CWP): The estimated prevalence of CWP among currently employed coal miners is about 4.5%. Approximately 0.2% of coal workers have been diagnosed as having progressive massive fibrosis, a potentially disabling form of CWP (*10*). In 1974, there were an estimated 19,400 cases of CWP. Some 4,000 deaths each year are attributed to legislatively defined "black lung disease" (*9*). Industrial bronchitis, another medical condition associated with exposure to coal dust, may lead to decreased ventilation capacity, but it is not well correlated with chest roentgenographic changes (*11*).

Lung cancer: The single most important cause of lung cancer is tobacco smoke (*12*). However, numerous occupational agents are associated with lung cancer, including arsenic, asbestos, chloroethers, chromates, ionizing radiation, nickel, and polynuclear aromatic hydrocarbon compounds (*13*). Tobacco smoke may interact synergistically with some of these agents (e.g., asbestos) to sharply increase the risk (*5*). Of special concern in this regard are workers currently or previously exposed to asbestos (estimated from 7.6 to 13.2 million) (*14, 15*); as many as 6,000 asbestos-related lung cancers may occur annually (*15*).

Occupational asthma: Hypersensitivity reactions to a wide variety of occupational organic and inorganic agents can cause asthma and hypersensitivity pneumonitis. The prevalence of occupational asthma varies from 10% to nearly 100% of workers in certain occupations (*16*). Many agents are incriminated as etiologic for occupational asthma, including grain dusts, flour, metals, inorganic chemicals, isocyanates, enzymes, and fungi. The list of agents associated with hypersensitivity pneumonitis is also long. If exposure continues, these conditions may result in progressive, irreversible pulmonary fibrosis.

Reported by Div of Surveillance, Hazard Evaluation, and Field Studies, Office of Director, NIOSH, CDC.

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MUSCULOSKELETAL INJURIES

In 1982, musculoskeletal injuries accounted for 580,000 (18%) of the estimated 3.2 million emergency-room-treated occupational injuries in the United States (*2*). Physical demands of many jobs make the musculoskeletal system highly vulnerable to a variety of occupational injuries and illnesses. Manual handling of materials, repetitive motions, and vibration are especially important etiologic factors in the development of these disorders.

Injuries associated with the manual handling of materials (e.g., unaided lifting and lowering): Low back injuries, often due to improper manual handling of materials, are the largest single subset of musculoskeletal injuries. The Bureau of Labor Statistics recently reported that approximately one million workers sustained back injuries in 1980 and that back injuries account for one of every five injuries and illnesses in the workplace. Approximately one-fourth of all workers' compensation indemnity expenditures in eight states were for back injuries (*3*).

Repetitive motion-associated trauma: Repetitive motion can cause "cumulative trauma disorders," including carpal tunnel syndrome, tendinitis, ganglionitis, tenosynovitis, bursitis, and epicondylitis. These disorders may be caused or aggravated by repeated twisting or awkward postures, particularly when combined with high force. The population at risk includes persons employed in such industries or occupations as construction, food preparation, clerical work, product fabrication, and mining.

Data from the National Occupational Hazard Survey suggest that 15%-20% of workers in these jobs are potentially at risk of cumulative trauma disorders (*4*). Data from the Bureau of Labor Statistics indicate that in 1980 approximately 23,200 occupational injuries were associated with repeated trauma (*5*).

Vibration-associated injuries: An estimated seven million workers in such occupations as vehicle operation are intermittently exposed to whole-body vibration, which significantly stresses the musculoskeletal system (*6*). Although the effects are poorly understood, preliminary data suggest that low back pain, vertebrogenic pain, and degenerative disk disease may be associated with whole-body vibration (*7,8*).

An estimated 1.2 million workers are exposed to "segmental" vibration, i.e., vibration principally of a part or parts of the body, of which the principal sources are handheld power tools, such as chain saws and jackhammers (*9*). These exposures are associated with "vibration syndrome," characterized by intermittent numbness and blanching of the fingers with reduced sensitivity to heat, cold, and pain (*10*). Vibration syndrome may affect up to 90% of workers in such occupations as chipping, grinding, and chain sawing (*11*).

Editorial Note: Musculoskeletal injuries can be prevented or reduced with such appropriate intervention measures as:

1. Substitution. Machines, such as hoists, cranes, and dollies, can substitute for workers in some aspects of the manual handling of materials.
2. Improved equipment design. Research has shown that improved design of some vibrating tools virtually eliminates hazardous vibration; suspension or isolation systems may be added to vehicles to greatly reduce whole-body vibration.
3. Task design. Manual tasks can be altered to minimize biomechanical stress to the worker (*12*).

4. Worker education. Injuries due to musculoskeletal stresses may be reduced by preplacement strength testing, training in proper ways to do a task, and on-site programs of exercise and physical therapy.
5. Variation of work practices. Periodic rotation of workers into jobs with different physical demands may help reduce the sequelae of biomechanical stress.

Reported by Div of Surveillance, Hazard Evaluations, and Field Studies, Div of Safety Research, NIOSH, CDC

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OCCUPATIONAL CANCERS (OTHER THAN LUNG)

Cancer kills approximately 430,000 people in the United States annually; the American Cancer Society estimates that some form of cancer will develop in one-fourth of all Americans (*3*). It is the second leading cause of death and the second leading cause of lost years of potential life in this country (*4*). A high proportion of all cancers are thought to be caused by "extragenetic" factors, including behaviors (e.g., cigarette smoking, alcohol and drug use, and sexual activities) and toxic environmental exposures in the workplace and the community (*5*). Evidence for these relationships has been developed principally through epidemiologic and toxicologic studies. The main epidemiologic observations have included: differences in the incidence of cancer between groups with different exposures, changes in the incidence of cancer following migrations, changes in the incidence of cancer over time, etc. Toxicologic studies have led to the identification of specific agents that cause cancer in experimental animals (*5*).

A possible occupational origin for malignant disease was first recognized when an unusually high frequency of scrotal cancer was observed among London chimney sweeps in 1775 (*6*). Since then, several types of cancer have been associated with industrial agents or processes (Table 1) (*7*). Numerous other occupational agents—such as beryllium, cadmium, ethylene oxide, phenoxy-acetic acids, and chlorophenols—or processes—such as newsprint pressroom work—are suspected of being carcinogenic and are under investigation by NIOSH.

Although general agreement exists concerning the overall incidence of cancer, considerable controversy surrounds the proportion of cancer cases attributable to occupational exposures. Several characteristics of cancer contribute to the difficulty in making such estimates:

1. Latency in the development of cancer. Occupational cancer usually becomes evident long after initial exposure to the carcinogen; this interval may vary from 5 years to more than 40 years (*9*), making it difficult to characterize important exposures long past.
2. Influence of exposures to multiple carcinogens. Cancer victims may have been occupationally exposed to many carcinogens; interaction of these agents or interactions between them and other factors may greatly increase the risk of cancer (*10*).
3. Influence of behavioral factors. Cigarette smoking, alcohol drinking, and dietary habits also influence the development of cancer (*11*). Moreover, these factors—especially cigarette smoking—interact with chemical and physical agents in the working environment to increase the risk of cancer (*12*); e.g., exposure to asbestos interacts with cigarette smoking to greatly increase the risk of lung cancer.

In addition, problems with the documentation of cancer and the nature and extent of etiologic exposures obscure important epidemiologic associations:

1. Errors in diagnosis and classification of cancer. Unusual neoplasms are often misdiagnosed; even correct diagnoses may be improperly categorized according to the International Classification of Diseases (ICD); an example is mesothelioma (*10*).
2. Lack of meaningful occupational histories. In only a few states is information collected on the work histories of cancer victims; hence, for many cases, crucial associations with occupational carcinogens are not apparent.

3. Difficulty in assessing exposures quantitatively. Precise measurements of levels and duration of exposures have not generally been available (*13*). Consequently, the ability to delineate dose-response relationships has been very limited.
4. The frequency of specific types of cancers. The occupational etiology of a very rare cancer due to a specific agent (e.g., hemangiosarcoma of the liver due to vinyl chloride) is much more readily documented than the occupational etiology of a cancer type potentially caused by several factors (e.g., lung cancer associated with exposure to chromates).
5. The "dilution factor." Highly significant differences in the rates of cancer among small subgroups of a population may be overlooked because these rates affect the overall rate for cancer in the larger study population only slightly, if at all (*8*).

Despite these difficulties, various attempts have been made to estimate the proportion of cancers related to occupation. These estimates span a broad range, from less than 4% (*5,14*) to more than 20% (*15*). While these estimates are obviously imprecise, little doubt remains that occupational factors are significantly related to an increased risk of cancer. Moreover, in

Table 1. Selected occupational cancers*

ICD-9†	Condition	Industry/occupation	Agent
155	Hemangiosarcoma of the liver	Vinyl chloride polymerization Industry vintners	Vinyl chloride monomer Arsenical pesticides
160.0	Malignant neoplasm of nasal cavities	Woodworkers, cabinet/furniture makers Boot and shoe producers Radium chemists, processors, dial painters Nickel smelting and refining	Hardwood dusts Unknown Radium Nickel
161	Malignant neoplasm of larynx	Asbestos industries and utilizers	Asbestos
158, 163	Mesothelioma (peritoneum) (pleura)	Asbestos industries and utilizers	Asbestos
170	Malignant neoplasm of bone	Radium chemists, processors, dial painters	Radium
187.7	Malignant neoplasm of scrotum	Automatic lathe operators, metalworkers Coke oven workers, petroleum refiners, tar distillers	Mineral/cutting oils Soots and tars, tar distillates
188	Malignant neoplasm of bladder	Rubber and dye workers	Benzidine, alpha and beta naphthylamine, auramine, magenta, 4-aminobiphenyl, 4-nitrophenyl
189	Malignant neoplasm of kidney, other, and unspecified urinary organs	Coke oven workers	Coke oven emissions
204	Lymphoid leukemia, acute	Rubber industry Radiologists	Unknown Ionizing radiation
205	Myeloid leukemia, acute	Occupations with exposure to benzene Radiologists	Benzene Ionizing radiation
207.0	Erythroleukemia	Occupations with exposure to benzene	Benzene

*Adapted from reference 7. †Modified International Classification of Diseases (ICD) rubric.

specific groups of workers exposed to specific carcinogens, the proportion who ultimately develop occupational cancer may be large. Of one group of workers distilling beta-naphthylamine who had more than 5 years of exposure, all reportedly developed tumors of the bladder (*17*); up to 11% of workers exposed to asbestos may ultimately develop mesothelial tumors (*16*).

Reported by Div of Surveillance, Hazard Evaluations, and Field Studies, NIOSH, CDC.

Editorial Note: Cancer caused by occupational agents, especially synthetic chemicals, is a problem of human origin, and should, therefore, be preventable. Substitution of noncarcinogens for carcinogens, enforcement of protective standards for exposure, design and application of engineering controls, and use of personal protective equipment by exposed workers are major modes of prevention.

Although it is difficult to predict a trend for the future incidence of occupational cancer, the increased volume and diversity of synthetic chemicals manufactured since World War II (*18*) raise serious concern about the risks from exposure to these substances. However, improved control technology, governmental regulatory activity to reduce exposures, surveillance of disease and risk factors, and vigilant use of preventive measures will ultimately reduce occupational cancer.

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*Additional references are available on request from the National Institute for Occupational Safety and Health, CDC.

SEVERE OCCUPATIONAL TRAUMATIC INJURIES

Severe occupational traumatic injuries usually occur suddenly on the job and are either fatal or require immediate medical care. Data on these events are available from several different sources, including: the National Electronic Injury Surveillance System (NEISS) of the Consumer Product Safety Commission (*4*); the Supplementary Data System (SDS) of the Bureau of Labor Statistics (BLS) (*5*); the Annual Survey of Occupational Injuries and Illnesses conducted by the BLS (*6*); and the National Safety Council (*7*). The National Safety Council and the Annual Survey of the BLS estimate occupational traumatic deaths.

These sources report different aspects of the problem because of differences in the scope of events that each system tries to reflect. NEISS reports cases of occupational trauma from a representative sample of U.S. hospital emergency rooms. SDS records information from Workers' Compensation claims filed in 33 states. As required by the Occupational Safety and Health Administration, the Annual Survey of the BLS reports traumatic events occurring in the private sector; thus, it does not include traumatic events in the public sector, on farms with 10 or fewer employees, and in firms regulated by other federal health and safety laws. The National Safety Council reports data from the National Health Survey (based on 41,000 annual interviews with heads of households) and data from several participating public and private organizations. The definition of "recordable injury" varies considerably among these systems.

Because of these differences, it is not easy to achieve a reliable national composite of severe occupational traumatic injuries. Within the limitations of these data sources, NIOSH estimates that at least 10,000,000 persons suffer traumatic injuries on the job each year. About 30% (at least 3,000,000) of these injuries are severe, and at least 10,000 are fatal.

Traumatic Deaths: Each year, an estimated 10,000 persons are killed on the job. The major causes of these deaths are (1) highway motor-vehicle incidents, including to and from work and job-related travel (34%); (2) falls (13%); (3) nonhighway industrial-vehicle incidents (11%); (4) blows (other than by vehicles or equipment) (8%); and (5) electrocutions (7%) (Table 1). Industries with the highest estimated rates of fatal traumatic injury are (1) mining and quarrying, (2) agriculture (including forestry and fishing), and (3) construction (Table 2).

Amputations: Although amputations account for less than 1% of estimated injuries, they often impair a worker's skills. An estimated 21,000 workers suffered amputations in 1982. Based on NEISS data, approximately 93% of these amputations were of fingers (*8*); and 4%, of hands and toes. Amputations of fingers most frequently resulted from fingers being caught in machines or hand tools (11%) or cut by moving objects, such as saws or slicers (10%). Other important sources of amputations included presses (6%), belts (5%), powered hand tools (2%), and doors or gates (2%). Other specific sources accounted for less than 2% each of occupational amputations.

According to SDS data, amputations occurred in a wide range of industries and occupations. The largest single proportion of amputations (2%) occurred in the manufacture of miscellaneous plastic products, and machine operators had the largest proportion of occupational amputations (8%).*

Fractures: Falls and blows from falling objects produce many types of injuries, the less severe forms being contusions, abrasions, and sprains. During 1982, an estimated 400,000 work-related fractures occurred. SDS data for 1980 included approximately 208,000 compensation claims for fractures. The most frequently listed sources of fractures included floors (13%), the ground (10%), and metal items (7%), suggesting falls as the main cause of such injuries. Specifically, falls to a working surface accounted for 15% of the fractures; blows from unspecified or falling objects accounted for 31%. Fractures occurred most frequently among truck drivers (5%), miscellaneous laborers (4%), and construction laborers (3%).*

Eye Loss: Although it is difficult to measure the extent of eye loss or blindness among workers, NIOSH estimates (based on NEISS data) indicate that approximately 900,000 occupational eye injuries occurred in 1982. For 84% of these, the trauma was minor, caused mostly by foreign bodies (e.g., pieces of metal, wood, or glass) in the eyes. Burns and avulsions—44% of which were caused by chemicals or acids—accounted for nearly 15% of the estimated occupational eye injuries.*

Lacerations: An estimated 2,250,000 work-related lacerations occurred in 1982, representing 24% of all job-related injuries treated in hospital emergency rooms. Data from compensation claims described in SDS indicate that fingers (48%), arms (24%), legs (13%), and the head and neck (9%) were most likely to be seriously lacerated. These lacerations resulted primarily from being struck by an object (32%) or from striking against a stationary object (25%). The major sources of lacerations are knives (13%), other sharp metal items (13%), saws (6%), glass items (5%), nails (5%), and machines (3%). The settings in which workers incurred the largest proportion of lacerations were eating and drinking establishments (7%), grocery stores (4%), general building construction (2%), and meat packing (2%).*

*The remaining percentages are divided among a variety of specific categories, each accounting for less than the smallest percentage given.

Reported by Div of Safety Research, National Institute for Occupational Safety and Health, CDC.

Editorial Note: Recent analyses of potential life lost due to various causes indicate that "accidents and adverse effects" are the leading cause of the loss of potential years of life in this country (*9*). Occupational injuries occur at a rate† twice that of injuries in the home or in public places (*7*), and severe traumatic injuries are an important component of all occupational injuries. Severe occupational trauma is second only to motor-vehicle incidents as a cause of unintentional death in the United States (*7*).

Despite the number of occupational injuries, effective prevention is practiced in many workplaces, and approximately 48% of all employment establishments report no recordable injuries in a given year (*6*). As with other occupational health hazards, the prevention of severe occupational traumatic injuries rests on the basic principles of control technology: engineering controls, work practices, personal protective equipment, and monitoring of the workplace for emerging hazards. Severe occupational traumatic injuries can be prevented by

TABLE 1. Distribution of occupational traumatic deaths, by cause—United States, 1980-1981*

Cause	Percentage
Highway motor-vehicles incidents	34.1
Falls	12.5
Industrial vehicles or equipment	11.4
Blows (other than by vehicles or equipment)	8.0
Electrocutions	6.8
Gun shots	4.5
Aircraft crashes	3.4
Entrapment	3.4
Fires	3.4
Plant machinery operations	3.4
Explosions	2.3
Gas inhalations	2.3
Other	4.5
Total	100.0

*Adapted from Bureau of Labor Statistics: Occupational Injuries and Illnesses in the United States by Industry, 1981. U.S. Department of Labor Bulletin 2164, January 1983. These revised statistics pertain to private-sector establishments (excluding nonmetal mining and railroads) with 11 or more employees.

such specific measures as physical barriers between the worker and the source of injury (e.g., machine guards, light curtains, worker-independent safety circuits, proximity sensors on robots); changes in the design of tools (e.g., knives and slicers) and tasks to reduce the hazard; use of personal protective equipment (e.g., seat belts, protective eye- and footwear, helmets, harnesses); training of workers in the safe performance of tasks; and repeated systematic inspection of the workplace for emerging or previously undetected hazards. A visible, serious, and persistent commitment to safety by both management and labor appears crucial for preventing severe occupational traumatic injuries.

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†Injuries per million exposure hours.

TABLE 2. Occupational traumatic death rates per 100,000 workers, by industry—United States, 1982*

Industry	Rate
Mining and quarrying	55
Agriculture	52
Construction	40
Transportation and public utilities	26
Government	10
Services	6
Manufacturing	6
Trade	5

*Adapted from (7) Accident Facts, National Safety Council, 1983 Edition. These rates are estimated by the National Safety Council based on data from the National Center for Health Statistics, state departments of health, state industrial commissions, and the Bureau of Labor Statistics. Agriculture includes forestry and fishing; services includes finance, insurance, and real estate; government includes federal, state, and local; trade includes wholesale and retail.

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