Understanding statistics on occupational illnesses

The reliability, validity, and use of data on work-related illnesses are better understood if one is aware of the peculiarities of the recordkeeping regulations and problems of recognizing and reporting occupational diseases

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Of major importance to the American worker was the explicit declaration in the Occupational Safety and Health Act of 1970 of congressional intent " . . . to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources." An important first step in providing such an environment is developing statistics which capture the incidence of illness and injury in the United States. How well do the presently collected statistics do this? What obstacles does the process of collecting good statistics face?

Under the act, the Bureau of Labor Statistics has been delegated responsibility for the collection, compilation, and analysis of occupational safety and health statistics. Pursuant to that authority, the BLS, in cooperation and consultation with the Occupational Safety and Health Administration (OSHA), the American National Standards Institute, Labor and Business Research Advisory Committees, and a Federal interagency working group, developed an occupational injury and illness recordkeeping system. Final recordkeeping regulations were adopted on July 2, 1971. Several modifications to the regulations have been made, but the basic structure has remained intact.

Before OSHA was established, the work-injury program of the BLS was based on the American National Standard Method of Measuring and Recording Work Injury Experience, commonly referred to as the Z16.1 standard. This standard, for all practical purposes, was limited to the measurement of work injuries; seldom were occupational illnesses reported. It was believed that the Occupational Safety and Health Act, with equal emphasis on occupational health, would provide a true and statistically confirmed picture of the incidence of occupational illnesses and diseases. But, what has emerged is a count of occupational illnesses and diseases which is superior to that of previous programs, but which is viewed as a gross underestimate of actual experience.

This article examines the concepts of the statistical system which produces estimates of occupational illnesses and diseases in the United States,[1] discusses some of the reasons for an undercount in those estimates, and evaluates the statistical system in its present form.

Measurement peculiarities

Three Federal Government agencies manage recordkeeping and reporting systems which measure occupational illnesses in the private sector: the Bureau of Labor Statistics and the Mine Safety and Health Administration, both of the U.S. Department of Labor, and the Federal Railroad Administration of the Department of Transportation.[2] The BLS, on behalf of OSHA, administers a statistical program covering most of the

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private sector economy. The exclusions are coal and metal and nonmetal mining industries which are covered by the Mine Safety and Health Administration, and the railroads which are under the Federal Railroad Administration's jurisdiction. However, these establishments maintain data consistent with OSHA's work injury and illness definitions and concepts. Each year, Mine Safety and Health Administration and the Federal Railroad Administration injury and illness data are combined with the BLS data to provide a measure of health and safety conditions in the total private sector.

Several aspects peculiar to the recordkeeping and reporting of occupational illnesses under these systems warrant discussion because of their impact on the reliability, validity, and use of the data. First, reporting by employers under each system is governed by regulation. The mandatory nature of reporting together with the uniform definitions help ensure the reliability of the information.[3] However, nonsampling biases can occur and problems unique to occupational illness statistics can impose other serious difficulties, some of which are discussed later. Second, whether an illness is occupational and, therefore, recordable is determined by the employer or representative physician or nurse. Unless the cause-effect relationship is direct and apparent, the illness is not likely to be recorded. Third, the survey covers a stated calendar year; hence, only new illnesses occurring during that year are recordable. The OSHA regulations require only that employers record illnesses at the time of diagnosis. Occupational illnesses which persist are not counted in subsequent years. The standard measurement used for comparative trend evaluation is the incidence of occupational illnesses, expressed as a rate per 100 workers. Prevalence of illnesses (the proportion of employees occupationally ill, regardless of when the condition arose), is not used in the reporting or dissemination of the data. Fourth, seven categories of illnesses are distinguished in employer reports: (1) skin diseases or disorders; (2) dust diseases of the lungs; (3) respiratory conditions due to toxic agents; (4) poisoning; (5) disorders due to physical agents; (6) disorders associated with repeated trauma; and (7) all other occupational illnesses. Incidence rates are developed by major industry division for each of these categories. Fifth, employers are not required to report illnesses by age, sex, race, or occupation, although employers have information on most of these variables. Sixth, regulations specifically require that employers record "bodily harm including adverse health effects resulting from a one-time exposure event" as an occupational injury and not as an illness.

Incidence of illnesses understated

Is the measurement of occupational illnesses a numbers game? A review of historical data lends perspective to this query. Throughout the 1972–78 period, the proportion of illnesses to total injuries and illnesses in the private sector was relatively fixed at 3 percent. (See table 1.) Over the period, the number of illnesses declined by nearly one-third, from 210,500 to 143,500, and the overall incidence rate was halved. By comparison, the total injury and illness rate dropped 15 percent. This number and trend are contrary to the widespread belief regarding actual conditions in the Nation's workplaces. The bottom line of this common but unsubstantiated belief is that there are about 390,000 new illness cases annually.[4]

Table 1. Occupational illnesses as a proportion of total injuries and illnesses in the private sector, 1972–78

Year	Total injuries and illnesses[1]		Illnesses only[1]		Illnesses as a percent of total injuries and illnesses
	Number (in thousands)	Rate[2]	Number (in thousands)	Rate[2]	
1972[3]	5,657	10.9	211	.40	.037
1973	6,079	11.0	201	.40	.033
1974	5,916	10.4	[4]200	[4].40	.034
1975[5]	4,992	9.1	164	.30	.033
1976[5]	5,164	9.2	168	.30	.033
1977[5]	5,460	9.3	162	.28	.030
1978[5]	5,799	9.4	144	.20	.025

[1] Includes fatalities.
[2] The incidence rate represents the number of injuries and/or illnesses per 100 full-time workers and is calculated as follows: (N/EH) × 200,000, where:

N = number of injuries and/or illnesses
EH = total hours worked by all employees during the calendar year
200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

[3] Excludes railroads and mine activities, except oil and gas extraction.
[4] Excludes illness data for Mine Safety and Health Administration covered industries.
[5] Excludes firms with fewer than 11 employees.

Over the 1972–78 period, declines occurred in every illness category, except "respiratory conditions due to toxic agents." (See table 2.) The largest decline (about 62 percent) was for "all other occupational illnesses." Throughout the period, "occupational skin diseases or disorders" accounted for two-fifths or more of all occupational illnesses, indicating that illnesses likely to be recorded are those that are highly visible, have little or no latency, and are less controversial. Employers and employee awareness of the toxicity of chemicals might be inferred from the relatively steady increase in reported cases of "respiratory conditions due to toxic agents." Although the proportion of these cases nearly doubled over the period, its relative ranking remained the same.

In sharp contrast to the much publicized and frequently quoted occupational illness death estimate of 100,000 annually,[5] BLS data indicate that over the 1972–78 period, deaths from occupational illnesses ranged from 300 (in 1972, 1973, and 1976) to 700 in 1974. This is plausible, considering the criteria for recording occupational illnesses and the types of nonfatal illnesses reported.

Table 2. Occupational illnesses in the private sector, by category of illness, 1972–78

Category of illness	Number (in thousands)							Percent						
	1972	1973	1974	1975	1976	1977	1978	1972	1973	1974	1975	1976	1977	1978
Total illnesses[1]	[2]210.5	200.5	[3]200.4	[4]163.8	[4]167.9	[4]161.9	[4]143.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Occupational skin diseases or disorders	86.5	89.2	89.4	74.4	71.6	73.0	65.9	41.1	44.5	44.6	45.6	42.6	45.1	45.9
Dust diseases of the lungs	1.4	1.5	1.7	1.0	1.2	2.0	1.6	0.7	0.7	0.8	0.6	0.7	1.2	1.1
Respiratory conditions due to toxic agents	10.2	11.5	12.7	11.9	13.1	13.1	13.6	4.8	5.7	6.3	7.3	7.8	8.1	9.5
Poisoning	6.4	6.7	7.4	6.2	6.1	5.7	5.6	3.0	3.3	3.7	3.8	3.6	3.5	3.9
Disorders due to physical agents	30.1	27.5	27.1	21.2	24.2	23.6	16.7	14.3	13.7	13.5	13.0	14.4	14.6	11.6
Disorders associated with repeated trauma	23.8	23.6	24.6	23.7	23.0	23.4	20.2	11.3	11.8	12.3	14.5	13.7	14.5	14.1
All other occupational illnesses	52.1	40.5	37.4	24.9	28.8	21.1	19.9	24.8	20.2	18.7	15.2	17.2	13.0	13.9

[1] Includes fatalities. Because of rounding, components may not add to totals.
[2] Excludes railroad and mine activities, except oil and gas extraction.
[3] Excludes illness data for Mine Safety and Health Administration covered industries.
[4] Excludes firms with fewer than 11 employees.

So vastly divergent are actual estimates of occupational illnesses obtained through direct survey of employers from those based on other indirect estimating methods that a review of the problems associated with measuring occupational illnesses is warranted. Because of the complexity of the issues involved, this review is likely to create uncertainties about the validity of any count of occupational illnesses; but, it should lend some credence to the widespread assumption that the current national statistics understate the incidence of occupational illnesses.

Cause-effect relationship elusive

Occupation can be related to disease in three basic ways: as a cause; as a contributing factor; or as an aggravating factor. Except in very rare disease cases, such as mesothelioma from asbestos exposure and angiosarcoma from exposure to vinyl chloride, a cause-effect relationship between the disease and the work environment is not so uniquely evident. Generally, the relationship of an illness to an occupation is elusive because most occupational diseases are clinically indistinguishable from general, chronic-type diseases of nonoccupational origin. Even when occupation is considered to be contributory or aggravating, it is difficult to determine the extent of job influence because, in most cases, the causes of the disease cannot be fully traced; a multiplicity of factors may be involved, including the age of the worker, diet and nutrition, smoking, and general life style, to name a few.

There are numerous and complex issues surrounding the identification and recognition of occupational diseases. A brief description of some of the major problems can provide deeper insight into why current occupational illness statistics are often assessed as understating the true health and safety conditions of the workplace.

Etiology. Determining the cause or causes of disease is not always easy and is even more difficult when the disease is suspected of originating in the work environment. Even for cancer cases where undisputed exposure to carcinogenic agents in the work environment has occurred, "the lack of histological or biological markers of cancer of specific organs has made it difficult to differentiate occupational cancer from cancer from other causes."[6] Harmful exposure can occur on and off the job; while it would be ideal to be able to assign a factor to the degree of influence of occupational and nonoccupational exposures, this is not yet possible. The cause of occupational disease is further clouded by lack of knowledge of "dose-response" relationships. The effects of toxic substances are based primarily on animal tests, the results of which are not easily extrapolated to human populations. Epidemiological study can also aid in establishing a hypothesis of the causes of occupational diseases but cannot lead to direct cause-effect association.

Symptoms. The relationship between occupation and disease is unlikely to be inferred from a study of a worker's symptoms. Although a worker may have one or more symptoms that suggest an occupational relationship, there is a reluctance to declare the disease as occupational in origin for lack of solid evidence. On the other hand, symptoms may point to a specific disease, but the disease onset and the present condition of the worker may be obscured by other factors, especially in respiratory disease cases. It would be unrealistic to expect employers to accept responsibility for a disease condition which is also affected by the general environment and nonwork-related factors, unless the evidence overwhelmingly points to the work environment as the source. Even in cases properly diagnosed as occupationally related, the employer may be reluctant or refuse to accept liability, because the disease may have originated in the past under a different employer. The time lags between exposure, onset, and diagnosis will generally present serious problems regarding proper accountability.

Latency. The long latent periods of certain diseases obscure the cause-effect relationship and also impede timely recognition of the disease for recordkeeping purposes. For example, occupational cancer may be

detected only after the worker has left the hazardous work environment or has retired; if after retirement, it is unlikely to be attributed to a past occupation. Under these circumstances, a legitimate occupational disease case would not be included in the statistics because of the restrictive recordability criteria.

The latent periods of disease have important implications for conducting epidemiological studies of morbidity and mortality, the results of which may identify populations at excess risk of specific diseases. Adequate follow-up of retirees, living and deceased, is required to avoid drawing false conclusions.

Diagnostic problems. Lack of medical expertise is a genuine obstacle to detection and recognition of occupational disease. Most doctors engaged in the practice of occupational medicine (particularly those outside the industrial setting) are not sufficiently trained to qualify for certification.

Presently about 15 universities and medical centers offer programs in occupational medicine or occupational health nursing, or both. The National Institute for Occupational Safety and Health has incorporated 12 institutions into a special program of accelerated training in occupational health and safety, called the Educational Resource Centers Program.[7] These centers are located throughout the United States and provide academic and continuing educational programs in four core occupational safety and health disciplines—occupational medicine, occupational health nursing, occupational safety, and industrial hygiene. With the extensive worker and establishment coverage under the act and the large potential for unhealthful exposure due to the thousands of chemicals manufactured or in use in industry today, quick remedy for the shortage of expertise should not be expected.

Unfortunately, there are no reliable data on the number of occupational doctors, but fragmentary evidence suggests about 1,000 to 2,500. Occupational doctors working in an industrial setting are in a unique position to monitor the health of workers, if they have access to pertinent records, including information on chemical substances in use, measurement results of exposure levels, and inplant laboratory analyses of industrial hygienists.

On the other hand, few doctors in private practice have a background in occupational medicine and are much less likely to be aware of the influence of a job on a worker's health. Even if private practitioners did have such training, they may not know precisely what unhealthful exposures their patients encounter in the workplace. Also, the number of patients seeking treatment from an identical place of employment and with the same symptoms may be too small for the doctor to make an occupational connection. Finally, the doctor relies on the patient's account of the condition, and, as a result, occupational relationship is likely to be overlooked.

Another factor limiting a doctor's ability to identify and recognize an occupational relationship of an illness is use of rather standard diagnostic techniques when, in fact, different techniques may be warranted. An estimated 63,000 chemicals are believed to be in use in the United States and about 1,000 new chemicals are added each year, most without having been tested for their health effects before manufacture or use.[8] Therefore, it is not surprising that a lag in appropriate diagnostic techniques is existent and real. In addition, incomplete or carelessly taken medical and job histories of ill workers can lead to wrong impressions concerning the workers' health status and origin of symptoms or disease.

Employee awareness. Lack of awareness among employees regarding hazardous exposures inhibits their identifying and recognizing a disease as occupational. This is especially true in cases where the doctor relies on the patients' account of the work environment. Failure to mention possible influences of the workplace, for whatever reason, would seldom induce an independent probe on the doctor's part. In injury cases, the treating doctor is very likely to ask probing questions relating to the injury event; in the case of an illness, the same doctor is likely to ask only questions related to the patient's symptoms. The importance of this factor depends to a large extent on employer training of workers in general safety and health matters, employer notification of workers about the harmful properties of substances to which they are exposed, and employer training of the exposed group in the proper methods of handling and use of those substances.

Susceptibility. Individuals vary as to their susceptibility to disease. One worker may contract a disease at relatively low levels of exposure, while another worker may not, even if exposed to high levels of the identical substance. This confounds the cause-effect occupational relationship of diseases and indicates that even nonoccupational factors may operate in such cases.

Tolerance levels are based not only on the workers' genetic makeup but also on physiological characteristics, age, sex, nutrition, and other factors. Because of these influences, rates of absorption, distribution, metabolism, and excretion of toxic substances in the body vary among individuals. Even in the same individual, specific body organs are affected differently by toxins. While susceptibility does not directly inhibit detection and recognition of occupational disease, it has important implications for evaluating dose-response relationships, particularly in terms of health standards setting.

Multiple exposure. Cause-effect relationship is almost totally obscured when a worker is exposed to two or more hazardous substances on the job. Toxicological studies can determine probable effects of exposure to a specific substance; however, there has been little assessment of the effect of multiple exposures.

The interaction of toxic chemicals can produce unsuspected harmful effects. These synergistic and even potentiating ill effects make it difficult to determine the prime etiological agent. In fact, the chemical interaction may produce a totally new kind of toxic agent which requires special analysis for its debilitating effects.

Improvement needed

After considering the recordkeeping criteria and the factors inhibiting detection and recognition of occupational disease, one can better understand why the BLS estimates of occupational illnesses are suspected of being seriously understated. However, in this regard, three points must be emphasized. (1) Other widely publicized and quoted estimates of occupational diseases are not based on rigorous statistical techniques and fall far short of being accurate and valid descriptions of occupational illness incidence. (2) It cannot be stressed too much that mere association of an occupation with the illness of a worker is not causation; at most, it indicates areas where further research may be warranted. Therefore, studies based on such sources as the Social Security Administration's disability files or the National Center for Health Statistics' Health Interview Survey cannot establish an unequivocal causal relationship of a disability or impairment to occupation, even though the disabled or impaired person's occupation is identified in the statistics. (3) In terms of the recording and reporting of occupational illnesses, the statistics generated through the BLS annual survey are a reliable measure of real-world experience. However, in terms of statistical validity, the data may be wanting because chronic and long latent diseases, although not totally excluded, are largely beyond the scope of the system. The current system captures only disease cases that are unequivocably visible.

The problems associated with occupational disease detection and recognition are largely exogenous to the national occupational disease statistical program in effect and cannot be solved by government alone. Improvement of occupational disease statistics will require the cooperation of all affected parties. Because of the complexities involved in the occupational disease area, including medico-legal, political, economic, and privacy issues, expectations for a quick or easy solution are unrealistic as is a solution without some compromise among the affected principals—employers, workers, unions, government, and the medical profession.

To the extent that the annual survey excludes chronic and long latent diseases of occupational origin, an undercount does exist. There is as yet no reliable measure of that undercount. The only other comprehensive source of occupational disease statistics lies in State workers' compensation records. However, the same difficulties in establishing an occupational link apply to workers' compensation cases.

Perhaps the more important aspect of the controversy over occupational illness statistics concerns the usefulness of the present data, given the fact that, within the context of current regulations and procedures, they inculpably constitute a weak measure of the "suspected" total national experience. □

FOOTNOTES

[1] Occupational illness and disease are used interchangeably in this article and include all incidents which meet the following definition: "Any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases which may be caused by inhalation, absorption, ingestion, or direct contact."

[2] These agencies also collect occupational injury information for development of injury estimates covering the total private sector. However, occupational injury occurrence is obvious both to the employee and employer and the statistics resulting are not seriously questioned, compared with occupational illness data. Hence, the focus of this article is on occupational illnesses. Omitted from discussion are illness data covering Federal, State and local government workers.

[3] In terms of actual data collection, one major difference between the three agencies is that the Mine Safety and Health Administration and the Federal Railroad Administration cover the universe of employers under their respective jurisdictions, while BLS uses a random probability sample survey to collect data from Occupational Safety and Health Administration covered employers.

[4] The 390,000 count first appeared in *The President's Report on Occupational Safety and Health—May 1972.* Since then, it has repeatedly been cited in numerous publications and at congressional hearings. This estimate was based on a study of occupational diseases in California in 1970, through a manipulative process which was never fully documented.

[5] The 100,000 occupational death figure also appeared in *The President's Report.* According to the National Institute for Occupational Safety and Health, the data source for this figure was the 1951 Registrar General's Occupational Mortality Report for England and Wales in which excess deaths (observed versus expected) summed up over all occupations yielded an occupational disease death ratio which was applied to the U.S. workforce.

[6] Thomas F. Mancuso, *Occupational Cancer and Medical Causality,* a paper presented at the 65th Annual Convention of the International Association of Industrial Accident Boards and Commissions, Sept. 10, 1979.

[7] *Directory of Academic Programs in Occupational Safety and Health,* Department of Health and Human Services, National Institute for Occupational Safety and Health, 1979, Publication No. 79-126.

[8] *A Scientific Framework for Establishing a Consistent Federal Policy on the Evaluation of Substances as Potential Human Carcinogens,* Draft Staff Discussion Paper, Office of Science and Technology Policy, Oct. 20, 1978.