IX. Occupational Disease Surveillance with Existing Data Sources

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Introduction

Data on disease collected by federal and state groups for surveillance or administrative purposes may also be a relatively easy and efficient means of surveillance of occupational disease. However, two major aspects of these data usually limit their usefulness for occupational disease surveillance. First, conditions related to occupational exposure must be included in the data system, and must be found with some regularity in the geographic area under surveillance. Second, information on the occupation or employment setting of persons in the data system must be included or accessible in some manner.

The availability of employment information varies among federal and state health and administrative data systems. Although occupation and industry information is collected for many of the data systems, inconsistencies in the collection or processing of these data limit their use for occupational disease surveillance. In this paper we will discuss several useful sources of data including state death certificates, cancer registries, state workers' compensation files, hospital discharge records, and other health data sources. We will describe each data source briefly and discuss its advantages and disadvantages.

Occupational Mortality Surveillance

Although England and Wales have used death certificates as a national surveillance system for occupation-related mortality for many years,[1,2] the United States has conducted only one national occupational mortality study.[3] It is more common in the United States for state health departments to conduct occupational mortality surveillance.[4] The pioneering efforts of Dr. Samuel Milham in his studies of occupational mortality in Washington State[5,6] established the feasibility and utility of this approach on a state-specific basis.

Since early 1981, a significant effort has been undertaken to establish a national system for surveillance of occupational mortality. With the support of the National Institute for Occupational Safety and Health (NIOSH), the National Center for Health Statistics (NCHS), the National Cancer Institute (NCI), and the Bureau of the Census, 40 states and the District of Columbia (Figure 1) have initiated efforts to code information on the industry and occupation (I & O) of decedents. Starting in 1988, 23 of these states provide decedent I & O data to NCHS in machine-readable form for analysis and dissemination (Figure 2).

Federal support for these state health departments has taken many forms. NIOSH, NCI, and NCHS cooperatively support state efforts to uniformly collect[7] and code[8] the decedent I & O information. In addition to standardizing coding practices, NIOSH developed computer software to support the editing and analysis of the I & O data.[9]

Most analyses of state mortality data are based on sex- and race-specific, age-standardized proportionate mortality ratios (PMR). The PMR is a summary mortality measure reflecting a comparison of the observed number of deaths for specific causes in an occupation or industry group with the expected number of deaths due to that cause in a standard population. The PMR does not use information on the population at risk.

In investigations of occupational cohorts, the population at risk is typically estimated by enumerating the historical

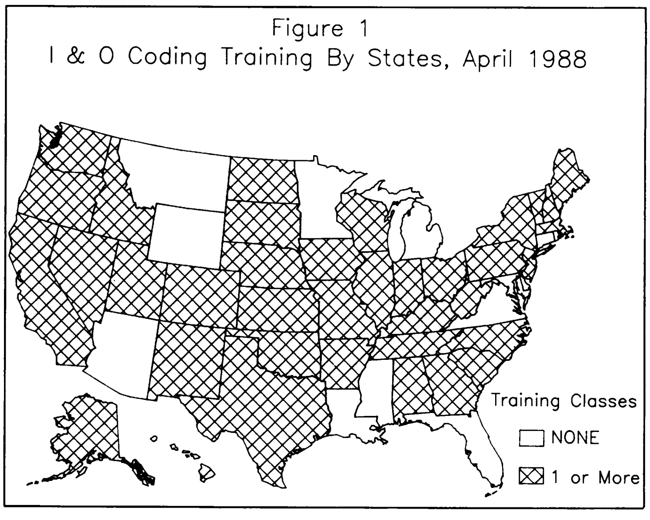

FIGURE 1—I & O Coding Training by States, April 1988
Training Classes: ☐ None; ☒ 1 or More.

NOTE: Author affiliations and addresses are listed on p. 7.

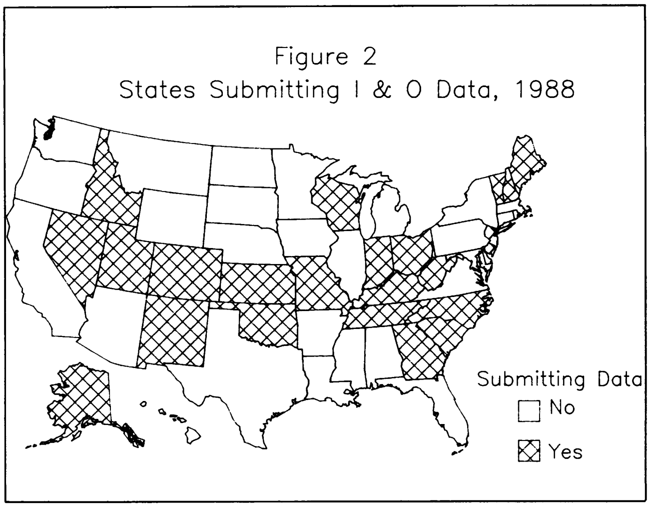

FIGURE 2—States Submitting I & O Data, 1988
Submitting Data: □ No; ▩ Yes.

cohort employed at a particular worksite. Census data, the estimated number of people employed within a particular industry or occupation, is another source of population at risk data. Among state-based PMR studies of occupational mortality, the "standard" population is usually the total population of deaths for that study. Information on occupation and industry are obtained from the death certificate and coded using adaptations of the 1980 US Bureau of the Census system for the classification of occupation and industry.[10]

The PMR is a well accepted epidemiologic measure for the surveillance of occupational mortality. Through reanalysis and careful interpretation, PMR analyses identify occupational or industrial groups with possibly increased risk from cause-specific mortality (i.e., hypothesis generation). For states with heavy concentration of a particular occupation or industry, PMR analyses may permit the identification of unusual associations between that occupation or industry and cause-specific mortality. Such an approach has been used in Rhode Island for the jewelry industry,[11] in Iowa for farmers,[12] and in Washington State for aluminum-reduction workers and the paper and pulp industries.[13] However, to the extent that "usual" employment is measured by death certificate data, one should question whether excess mortality relates to current data or past workplace hazards. Disease latency presents some problems of interpretation, particularly if the state or region has undergone fundamental changes in its industrial base.

Surveillance of occupational mortality is particularly important for evaluating cause-specific mortality risks among small businesses or industries or among occupational groups not otherwise amenable to traditional methods of cohort mortality study. For example, an excess risk of bladder cancer among service station attendants was observed in several state occupational mortality studies[14]; increased lung cancer mortality was observed among California workers in the automobile repair industry[15]; and several cancer types were observed to be significantly increased for janitors and cleaners in New York State.[16] Each group is exposed to multiple toxic substances and is difficult to study using traditional cohort methods. Table 1 presents statistically significant and elevated PMRs for site-specific cancer from a study of occupational mortality for the period 1980–82 in Upstate New York. A casual review of the table provides a sense of the common findings in these reports of occupational mortality surveillance.

Investigators should, however, recognize the limitations of occupational mortality surveillance. As discussed previously, the PMR does not use information on the population at risk and is dependent on some standard population for computations. Other statistical methods such as the mortality odds ratio (MOR) may be useful in overcoming these limitations.[17] Interpretation of the PMR requires additional information on the suspect industry and occupation. Detailed information on specific exposures or hazards may be neither available nor imputed from exposure or hazard databases (NOES/NOHS reference). The PMR is based on the entry of "usual industry and occupation" on the death certificates. However, usual I & O may not accurately represent the employment history of the decedent[17–20] and analysis may miss previous jobs where significant exposures occurred.

The process of classifying and categorizing information and industry influences data interpretation. An underlying assumption is that occupation or industry titles are reasonable indicators of occupational exposures and risks. Broad occupation or industry categories may obscure the detection of increased mortality due to specific exposures among particular occupations or narrowly defined industrial sectors. Similarly, a specific exposure or occupational risk may cause increased mortality and not be recognized because the job titles or industrial setting are grouped to reflect the classification system rather than exposure potential.

The choice of the death certificate also presents other limitations. Although surveillance for the underlying cause of mortality will identify work-related disease that is sufficiently serious to result in death, information about contributing causes of death will not be available. For example, the contributing conditions "chronic lung disease" or "neurologic problems" may be either excluded or only partially evaluated. Efforts to have multiple conditions reported on the death certificate may partially address this problem.[21] The completeness and accuracy of the diagnosis for underlying and contributing conditions are also important, but the examining physician often does not recognize many specific work-related diseases (e.g., silicosis and asbestosis) that may contribute to the cause of death.

Surveillance of occupational mortality by state health departments has several advantages as a component of a national program for surveillance of occupational disease. First, mortality surveillance is an efficient use of information routinely collected and processed at state and local levels. The cost is modest to ensure good reporting, processing, and analysis of this information. Second, analysis and evaluation of mortality differentials by occupation and industry provide an index of health status for employed segments of the population. More importantly, detailed evaluation of these differentials permits the monitoring of known occupational conditions and the identification of increased cause-specific mortality for specific industry and occupation groups. The latter may lead to field investigation and then to efforts for controlling potential exposures or occupational risks.

Efforts are needed to improve the usefulness of information produced from a surveillance system for occupational mortality. Quality-assurance activities within the vital statistics programs should be expanded to ensure the specificity and quality of the industry and occupation information. We also need improved methods to evaluate better and interpret the occupational mortality data, and information on the

TABLE 1—Standardized Proportional Mortality Ratios by Cause of Death and Occupation, Upstate New York Males 1980–82

Cause of Death	Occupation	Observed	Expected	SPMR
Cancer: lip, oral cavity and pharynx	Laborers, except construction	30	15.58	1.9249
	Management related occupations	12	9.03	1.3289
Cancer: esophagus	Machinists	12	6.95	1.7274
	Construction laborers	13	7.75	1.6764
	Carpenters	10	5.99	1.6691
	Janitors and cleaners	21	13.90	1.5113
	Laborers, except construction	19	12.68	1.4980
	Management related occupations	10	7.77	1.2866
Cancer: stomach	Supervisors: production occupations	19	10.79	1.7614
	Machinists	13	9.16	1.4188
	Carpenters	10	7.82	1.2791
	Supervisors and proprietors, sales	13	11.25	1.1558
	Janitors and cleaners	20	18.09	1.1059
Cancer: colon	Mathematical and computer scientists	10	2.24	4.4593
	Postsecondary teachers	10	4.23	2.3640
	Managers: marketing, advertising, public relations	12	6.53	1.8372
	Electrical and electronic engineers	11	6.57	1.6749
	Police and detectives, public service	16	9.60	1.6664
	Management related occupations	36	24.85	1.4489
	Taxi drivers and chauffeurs	10	7.49	1.3351
	Electricians	16	12.07	1.3254
	General office clerks	11	8.54	1.2885
	Supervisors: production occupations	34	26.67	1.2749
	Machinists	26	22.33	1.1643
Cancer: pancreas	Supervisors: production occupations	30	15.97	1.8789
	Management related occupations	21	14.77	1.4222
	Machinists	18	13.71	1.3668
	Supervisors and proprietors, sales	21	16.48	1.2746
	Sales representatives, mining manufacturing and wholesale	10	7.87	1.2704
	Janitors and cleaners	29	26.45	1.0965
Cancer: larynx	Janitors and cleaners	10	8.16	1.2254
Cancer: trachea, bronchus and lung	Crane and tower operators	18	9.87	1.8240
	Separating, filtering and clarifying machine operators	11	6.46	1.7034
	Groundskeepers and gardeners, except farm	36	22.67	1.5883
	Railroad conductors and yardmasters	11	7.31	1.5044
	Plumbers, pipefitters and steamfitters	63	42.16	1.4944
	Furnace, kiln and oven operators except food	18	12.05	1.4943
	Brickmasons and stonemasons	29	20.62	1.4067
	Mail carriers, postal service	38	27.04	1.4051
	Barbers	11	7.91	1.3901
	Carpenters	94	75.52	1.2448
	Supervisors: production occupations	127	105.95	1.1986
	Truck drivers, heavy	197	164.37	1.1985
Cancer: bone, connective tissue, skin	Elementary school teachers	10	2.50	4.0014
	Students	12	6.47	1.8539
	Management related occupations	12	8.75	1.3709
Cancer: other genitourinary organs	Supervisors and proprietors, sales	15	10.80	1.3893
	Management related occupations	13	9.78	1.3291
Cancer: bladder	Janitors and cleaners	21	10.27	2.0452
	Supervisors and proprietors, sales	10	6.28	1.5922
Cancer: kidney	Supervisors, production occupations	11	7.40	1.4874
	Truck drivers, heavy	13	11.52	1.1285
Cancer: other and unspecified sites	Secondary school teachers	10	3.29	3.0387
	Sales representatives, mining manufacturing and wholesale	23	11.68	1.9684
	Taxi drivers and chauffeurs	11	6.94	1.5846
	Students	11	7.19	1.5298
	Supervisors and proprietors, sales	34	24.72	1.3753
	Supervisors: production occupations	29	23.06	1.2578
	Automobile mechanics	15	12.23	1.2264
	Plumbers, pipefitters and steamfitters	11	9.49	1.1586
Hodgkin's disease	Students	16	5.48	2.9223
Myeloid leukemia	Truck drivers, heavy	15	7.83	1.9166

underlying and contributing condition should be evaluated.

Using data from the National Occupational Hazard Survey, NIOSH is developing a job exposure matrix to help identify or impute exposures to industries and occupations. A job exposure matrix should prove useful in the preliminary interpretation of occupational mortality data by providing information on potential exposures, physical hazards, and the use of technology to reduce the risk of worker exposure. The matrix may also help classify decedents for directed studies of cause-specific mortality and specific exposure (see Chapter VII in this monograph) and should enable analysis to define groups better for exposure potential.

Cancer Registries

Cancer registries, particularly population-based cancer registries, represent another source of information for occupational disease surveillance. A registry stores information on all cancer cases diagnosed and reported in a given geopolitically defined area. Typically, the registries contain detailed information on the particular cancer (morphology and histology), cancer patient demographics (age, race, sex, residence, etc.), and the end results (treatment, recurrence, survival).

Although I & O information has not been collected consistently for cancer patients, cancer registries have demonstrated a potential for the surveillance and identification of occupational cancer.[22,23] Without occupational information, cancer registries may be used to "screen" occupationally or industrially defined cohorts for risks of site-specific cancer.[23] Screening contrasts with the usual practice of using these registries as case sources for case-comparison studies of possible occupation-related risks. The latter approach has proven useful for evaluating potential risks of occupational cancer, although such studies require more resources than do traditional screening activities.

The findings of case-control studies of occupational cancer have led to increased interest in improving the availability and quality of occupational information in cancer registries. NIOSH has supported statewide cancer registries in Maine, Massachusetts, and Pennsylvania for collecting and processing occupational information on cancer patients. Connecticut officials have recently decided to routinely collect information on smoking, occupation, and industry for all cases reported to the Connecticut Cancer Registry.[24] However, most cancer registries lack information on the employment histories of patients and on many cancer risk factors (e.g., smoking, alcohol consumption). Although the absence of risk-factor information may not pose significant problems for the purpose of occupational cancer surveillance, the absence of information on employment history represents a major current deficiency for the use of cancer registries.

NIOSH has supported two research grants to evaluate the collection of occupational information through population-based cancer registries. It is premature to comment on the progress yet, particularly when we contrast this experience with comparable efforts to develop a state-based surveillance system for occupational mortality. Nevertheless, cancer registries should be considered and developed as an added resource in a nationwide program for occupational disease surveillance.[25]

Workers' Compensation Systems

An evaluation of workers' compensation laws carried out by the National Industrial Conference Board in 1987 recommended that "states should promptly undertake . . . the establishment of a permanent, scientific, uniform system of compensation statistics."[26] Despite the recognized need for a system to organize compensation data and the existence of workers' compensation systems in all 50 states and the District of Columbia, it was not until 1976 that the Bureau of Labor Statistics (BLS) began collecting data on occupational injury and disease from these sources.[27,28] The Supplementary Data System (SDS) of the BLS was designed to collect these data. By 1983, 30 state labor departments were providing uniform sets of information on occupational injuries and illnesses in conformity with SDS reporting requirements.[28]

From the onset SDS faced formidable challenges because the compensation coverage and reporting requirements varied widely from state to state. These vast differences have severely restricted the use of this data set for generating national statistics. Some states submit only closed compensation cases (claims adjudicated in favor of the claimant); other states submit all claims filed whether they are awarded or not, and still others require a minimum number of lost workdays before reporting the claim to SDS.[28] The potential impact of these differential reporting requirements can be seen in the contrast between Kentucky, which reports all claims and had 888 claims for anthracosis in 1980, and neighboring Virginia, which reports only closed cases and had 10 claims for anthracosis or pneumoconiosis in 1980.

Another limitation to the use of data from compensation systems stems from variations in physician reporting practices,[29,30] which in turn stem from underrecognition of these conditions by the medical community[31] and the long latency of many chronic diseases. The effect of all these limitations is more pronounced in the area of occupational diseases because disease claims are more frequently contested than are injury claims.[26,32]

Despite these limitations, compensation systems do contain substantial information useful in identifying worksites with current health hazards. Workers' compensation claims contain not only demographic information from the claimants but also their industry/occupation, the nature of the illness, the source of the problem, the number of lost workdays, and the name and address of the plant where the illness occurred.[33] In 1985, 31 states maintained compensation records in a machine-readable format.[34] Health departments in eight of the states reportedly analyze workers' compensation data independent of any analysis done by the labor departments.

Based on workers' compensation claims for occupational diseases, the State of Washington initiated a successful program of plant inspections in 1977.[35] Similar efforts have been made in Ohio to follow up compensation reports of lead poisoning and cumulative trauma disorders.[33,36] Studies of the epidemiology of electrocutions and electrical injuries in Virginia,‡ logging fatalities in Washington,[37] cold injuries,[38] dermatitis, and work-related violent crime injuries in Ohio[39,40] have all used workers' compensation claims.

When workers' compensation data have been focused on diseases or conditions that are easily recognized and occur without long latency, they have proven useful in identifying worksites appropriate for follow-up actions. Changes in the type of data collected in these programs, better access to the

‡Jones JE, Armstrong CW, Wooland CD, Miller GB: Fatal occupational electrical injuries in Virginia, 1977–1985. Submitted for publication.

data, follow-up investigations, and effective control measures will increase the value of these data for surveillance and for preventive purposes. Workers' compensation data can complement mortality and cancer-registry surveillance by identifying occupational diseases with shorter latencies that are not usually identified in the latter two surveillance systems.

Hospital Discharge Records

Hospital discharge records represent another source of information for the surveillance of occupational disease. Discharge data have been used to identify potential occupational health problems among Minnesota agricultural workers;[41] associate unusual patterns of musculoskeletal disease[42] and leukemia[43] among lumber and wood-product workers; and evaluate the occurrence of selected sentinel health events (occupational) (e.g., extrinsic allergic alveolitis, coal workers' pneumoconiosis, asbestosis, and silicosis) in New Jersey[44] and Rhode Island.[45] No comparable use of these data nationally has been demonstrated.

Discharge data have many advantages as a potential source of information on occupational disease: the information is computerized in many states; the system can be used in state health departments for surveillance of selected chronic occupational diseases; and the system may permit follow-back of cases for detailed investigations.

Although the disadvantages of hospital discharge data are many, they may not be prohibitive for surveillance purposes. Like most information accessed through hospitals, they may contain selection biases for both the disease(s) and the patients admitted for treatment. A patient's discharge abstract is not designed for research purposes, and thus additional medical and risk-factor information may be lacking. Although in many states the information is computerized, the act of processing the data may produce quality problems (completeness, incomparable coding practices), and may inject unnecessary delays between the date of diagnosis and the availability of the data for surveillance purposes.

In general, hospital discharge data present an attractive new source of surveillance information. As noted in a recent National Academy of Science (NAS) study, 20 states computerize discharge abstract records, and nine states have access to these data pursuant to state regulations.[26] In conjunction with the efforts to use cancer registries and workers' compensation files as surveillance tools, increased attention should be directed to the availability and use of hospital discharge data.

Other Data Sources

NIOSH has conducted national studies using information from the National Center for Health Statistics (NCHS)[46–50] and the Social Security Administration.[51–54]

NCHS conducts the National Health Interview Survey (NHIS), a continuing, nationwide survey of American households that collects information on personal and demographic characteristics, health, injuries, and the use of medical care. NIOSH used these survey data in the late 1970s to evaluate unusual patterns of disease and disability for relatively large segments of industry.[46] More recently, NIOSH used NHIS supplements to characterize workers' perceptions of occupational risks,[47] to analyze the prevalence and levels of cigarette smoking for specific occupational groups and segments of industry,[48] and to assess the prevalence of hearing-loss symptoms among adult workers potentially exposed to continuous noise in excess of 85 dBA.[50]

NHIS has been useful for describing and identifying unusual patterns of morbidity for selected industries. The NHIS survey supplement has also been useful for monitoring progress toward achieving broad health promotion and disease prevention goals. In contrast to the data sources discussed previously, these evaluations have not been undertaken to initiate case follow-back and intervention, nor do they provide state-specific surveillance data.

Based on the Current Population Survey through 1984, the NHIS sample was designed to produce national estimates for the civilian, noninstitutionalized population. Changes were made in design, many of which enable NCHS to use this sampling frame for other surveys.[55] NIOSH may want to consider the import of these design changes for follow-back studies, possibly using information from NOES to target segments of industry for detailed health surveys.

The NIOSH use of survey data from the Social Security Administration has concentrated on studies of permanent disability. NIOSH has published reports describing patterns of disability in detail for occupation[51,52,54] and industry.[52,53] Until recently, these data have been a largely untapped source of morbidity information, but increased interest has centered on their use for research of stress-related disorders and neurotoxic health effects. As with the NHIS survey data, these disability data sources have not been used for follow-back studies.

Conclusion

The use of existing data sources for surveillance of occupational disease promises to contribute substantially to our recognition and eventual control of occupational diseases in the United States. Increased activity in this area, particularly in occupational mortality surveillance, has demonstrated the utility of surveillance methods implemented at the state level. Increased use and evaluation of other data sources will help expand this surveillance to other conditions.

Several factors must be considered in developing potential data sources. First, efforts to maintain the quality of the data are important. Different data systems emphasize different forms of quality control depending on the type (medical, demographic) or form (hard copy, abstracted, computer file) of the information being processed. Second, improved methods should be developed to link information of specific workplace exposures and the presence of occupational disease. Third, these surveillance systems should not be viewed in isolation. Each should be viewed as part of a system for surveillance of occupational exposure and disease, with each data source complemented by and coordinated with other sources of surveillance information. Different forms of occupational illness may best be identified by different surveillance systems.

Diseases with long latency may be assessed from death certificate or registry sources, and those with shorter latency may be more commonly identified through physician reporting. Similarly, early stages of occupational lung disease may be detected from physician reporting, and later stages may be identified from workers' compensation, hospital discharge, or death certificate sources. More cooperative efforts are needed to understand better the types of occupational diseases identified by different sources of data for occupational disease surveillance.

Finally, these surveillance data should be used to identify and prevent occupational disease. The results of surveillance must be used by groups that conduct detailed field evaluation of occupational health problems because field identification and measurement are necessary first steps in the prevention process.

Prevention programs must be implemented in conjunction with surveillance systems. Our failure to develop better occupational disease surveillance may be due in part to a lack of demand for facility-specific disease data. Current programs for controlling occupational risks should be evaluated with respect to their requirements for medical monitoring and disease reporting. Furthermore, agencies responsible for controlling occupational disease should evaluate the use of surveillance data for targeting workplace inspections.

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