The National Occupational Health Survey of Mining

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Introduction

Surveillance for occupational safety and health problems has historically lagged behind that for infectious diseases. Adequate surveillance methods are essential in assessing the scope of health problems and in assigning priorities for intervention strategies; therefore, in recent years the National Institute for Occupational Safety and Health (NIOSH) has placed heavy emphasis on upgrading occupational health surveillance. Since direct surveillance of exposed workers has been shown to be a useful way to assess the prevalence of disease and to monitor trends, in 1984 NIOSH began an extensive survey of potential occupational exposures found at mine sites in the United States.

The National Occupational Health Survey of Mining (NOHSM) is similar to the National Occupational Hazard Survey that NIOSH conducted during 1972-1974 and the follow-up National Occupational Exposure Survey conducted during 1981-1982, both of which, however, involved only general-industry worksites. NOHSM not only will identify potential exposures related to occupational lung diseases, which head the NIOSH list of 10 leading work-related diseases and injuries (*1*), but also will identify potential exposures that may lead to other conditions on the list. The present plans for NOHSM call for five segments of mine surveys, to last approximately 1 year each, with an expected completion date of 1989. This report describes the purposes of NOHSM and the methods used. Results will be published in subsequent articles, as they become available.

NOHSM was developed in response to the U.S. Federal Mine Safety and Health Amendment Act of 1977, which requires the Secretary of Health, Education, and Welfare (now Health and Human Services) to "determine for each toxic material or harmful physical agent . . . used or found in a mine . . . whether such material or agent is potentially toxic at the concentrations in which it is used or found in a mine." As the lead federal agency for research in occupational safety and health, NIOSH was assigned responsibility for making this determination. To comply with the 1977 Act, NIOSH began in 1978 a review of information collected by several agencies (primarily the Mine Safety and Health Administration [MSHA]) on potentially toxic substances that exist on U.S. mine properties. It issued a report in 1979 showing a ". . . paucity of exposure data for certain agents, and the absence of comprehensive information on the many substances used or found in mines." As a result, NIOSH began planning for an in-depth survey of all substances found on mine properties. The study design was developed in the period 1980-1983, and NOHSM was approved for field work in March 1984.

Data from NOHSM will be used primarily to supply MSHA with information for 1) setting regulatory priorities and writing improved health standards, 2) improving compliance with existing standards, and 3) identifying research needs and priorities. NIOSH will also use the data to set priorities for its mining-related research and to provide supporting information for specific mining-related NIOSH projects. Other interested parties, including government agen-

cies, universities, labor unions, and individual workers, are expected to request ingredient information for trade-name products found in the mining industry, along with supporting information for research efforts, compensation claims, and the instruction of students. With the exception of trade secrets, NIOSH will provide the data requested.

Survey Design and Sample Selection

The mining industry consists of specific mines and mills that produce commodities (e.g., asbestos, coal, potash) or carry out processes (e.g., crushing, breaking). NIOSH accepts the commodity or process designation that MSHA has established for each mine or mill. NOHSM will consist of a series of segments, each approximately 1 year in duration, with a different set of commodities to be studied in each segment. The five segments now planned will enable researchers to estimate 1) the number of miners potentially exposed to health hazards, 2) the number of mines with health hazards and with various occupational health facilities, and 3) the number of such health hazards and health facilities, arranged by Standard Industrial Classification and by other domains to be selected after the survey is completed.

Mines to be surveyed as a part of NOHSM are selected from a list of all mines that report quarterly to MSHA. Selection is based on average yearly employment, Standard Industrial Classification code, geographic area, and current activity in the mining of specified commodities. The 72 commodities to be studied in NOHSM are divided into 103 geographic strata based on differences in mineral composition and mining methods. Commodities surveyed in the first segment are listed in Table 1; those being surveyed in the second segment are shown in Table 2.

TABLE 1. Commodities* surveyed in the first segment of the National Occupational Health Survey of Mining

Aluminum/alumina	Metal ores†
Aplite	Nonmetal minerals†
Asbestos	Perlite
Beryl	Potash
Boron minerals	Rare earths
Gemstones	Salt (evaporated)
Gilsonite	Salt (rock)
Gypsum	Sandstone (crushed and broken)
Leonardite	Silver
Lode, placer gold	Sodium compounds
Magnesite	Trona
Mercury	Vermiculite

*Commodity terminology of the Mine Safety and Health Administration

†Not elsewhere classified

TABLE 2. Commodities* being surveyed in the second segment of the National Occupational Health Survey of Mining

Coal (bituminous)	Slate, crushed and broken
Clay	Slate, dimension
Granite, crushed and broken	Stone, crushed and broken†
Granite, dimension	Stone, dimension†
Manganese	

*Commodity terminology of the Mine Safety and Health Administration

†Not elsewhere classified

Mines are selected according to two categories: 1) self-representing units for which the data collected will apply only to the individual mine and 2) probability samples for which the data may be projected to other similar mine sites. A site is designated as a self-representing unit if it 1) is one of the three largest mines or mills in the stratum, 2) has large employment relative to the rest of the stratum, or 3) is one of only a small number of mines in that stratum. Probability samples are selected to represent a given percentage of each stratum, with the probability of selection being proportional to the number of workers. Objective rules govern the selection process for probability samples to ensure that the samples are representative.

Field Protocol

Field activities for NOHSM are carried out by a team of six surveyors; normally each site visit is conducted by one surveyor. The initial six surveyors included three mining engineers, one mineral-processing engineer, and two industrial hygienists; the current team is composed of four mining engineers, one chemical engineer, and one industrial hygienist. Surveyors travel 100% of their duty time, and an office-support staff of three full-time and several part-time employees is based at the Appalachian Laboratory for Occupational Safety and Health (ALOSH) in Morgantown, West Virginia.

After each site is selected from the MSHA list, its management is contacted by telephone to verify that the mine is active and that the commodity designation is correct. A letter of notification of selection for NOHSM is then sent to the management of the mine and to the official miners' representative who is registered with MSHA. The survey is usually scheduled 1-2 months after notification. Surveyors are responsible for scheduling the surveys, and whenever possible they do this at a time mutually agreeable to NIOSH and to the mine management. Once a starting date has been established, NIOSH sends letters announcing plans for the survey to the management at the mine site, any corporate headquarters, the miners' representative, MSHA, the Bureau of Mines, appropriate state agencies, and the NIOSH Regional Offices.

Each site survey includes a questionnaire and walk-through observations. The questionnaire, which takes about 30 minutes to complete, is designed to record information on a company's occupational health practices and to include related descriptive information. The walk-through survey takes place in two phases: an inventory and a worksite survey. For the inventory, the surveyor examines centralized storage areas on the property and identifies every health-related trade-name product and generic chemical present. This includes potentially hazardous products such as mill reagents, fuels, lubricants, paints, cleaning agents, and welding rods. The surveyor must record the exact name of each product as labeled and the supplier's name and address, as well as the mine management's best estimate of the amount of the product used during the preceding 12 months. Products found on the site but not used during this period are recorded as having zero usage. For the worksite survey, the surveyor observes every worksite on the mine property and all activities of the workers to determine any health-related potential exposures. In addition to recording the toxic agents suggested above, the surveyor also records potential exposures to welding and combustion products, metals, dusts, excessive noise, musculoskeletal overloads, and a variety of ergonomic factors. For each potential exposure, the surveyor must determine its relative duration, the controls intended for that agent, and the associated number of employees by sex. This is strictly an observational exercise, and the term "potential exposure" is used to indicate that an agent is present but that NIOSH has not documented its level with any environmental monitoring technique.

After each survey, the surveyor codes the observations in a precise format and sends the coded data to ALOSH for computer processing and the generation of reports. At ALOSH, each set of survey data received from the field is keyed to magnetic tape, which is electronically edited to be sure that the data have been properly formatted. The computer editing also checks the chemicals mentioned in the survey data against a glossary of acceptable chemical names. Any chemical that does not match is referred to a chemist who determines whether the entry is a new chemical, a synonym for an acceptable chemical name, or a trade name that was improperly reported as a generic chemical.

Reporting the NOHSM Data

NIOSH is required by regulation to provide reports to each facility that it surveys. For NOHSM, NIOSH reports to each facility on the responses to the questionnaire and on the inventory of substances found on the property. The mine operator reviews this report for technical errors and for the inadvertent inclusion of confidential information. Later, when trade-name substances identified during the NOHSM surveys have been resolved into their associated chemical ingredients, the ingredients of trade-name substances that have not been declared trade secrets by their manufacturers will be available to the public.

After a commodity has been surveyed, NIOSH prepares a report that describes certain occupational health-related aspects of that commodity. The information is divided into several categories of potential exposures: chemicals with and without MSHA regulations and/or NIOSH-recommended exposure limits, trade-name products, physical agents, musculoskeletal overload conditions, and potential exposures from welding. The information is then presented in tabular form for each of these categories, giving the number of workers potentially exposed (both observed and predicted), the percentage of workers potentially exposed, the predicted annual usage of the product, the occupations of the workers exposed, and the locations in the facilities where exposure may occur.

NIOSH also plans to develop its capability of responding to special requests for analyses of NOHSM data. Experience with other data bases has shown that maximum speed and flexibility are essential elements of an efficient analytic and reporting system. Wherever possible, the system of NOHSM information will be combined with other mine-related information to provide a comprehensive reporting system.

Limitations of the NOHSM Data

The following limitations of the NOHSM data must be recognized: 1) The worksite data indicate only potential exposures. Thus, the agent may be observed at one or more sites in the facility, presenting the possibility that workers would be exposed to it. 2) Usage data are based on estimates provided by the mine management and should serve only as guides to the projected magnitude of usage rather than as precise information. Such estimates are expected to vary widely in accuracy. 3) The terminology relating to commodity, occupation, operation, and location was adapted directly from information that MSHA supplied to NIOSH. This terminology is not necessarily applied or accepted by others. 4) Mine operators have the right to specify which information they wish to have protected as trade secrets. For this reason, all NOHSM data that NIOSH reports to the public must be devoid of identifiable trade secrets. 5) NOHSM data are an indication of health-related conditions only at the time of the survey itself. No changes made by mine operators after the survey will be reflected in the data.

Observations from the First Segment

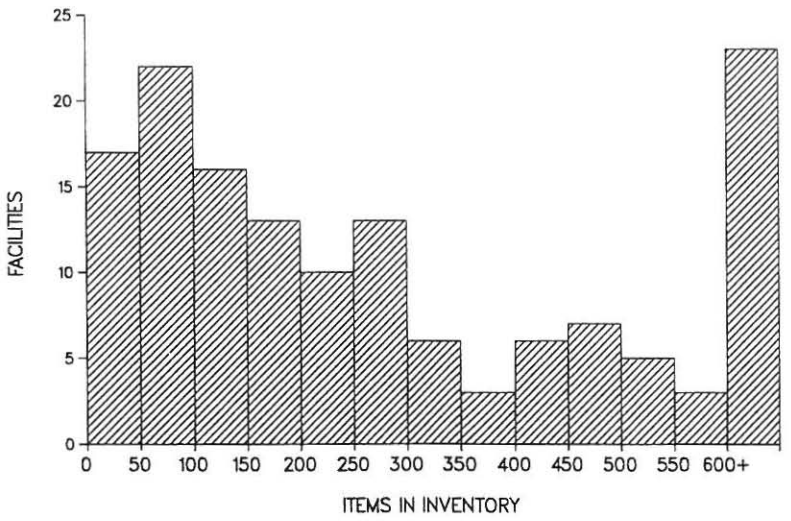
The first segment of NOHSM was concluded in September 1985. By October 28, 1985, 102 site reports either had been approved by the respective mine operators or were being reviewed by them. Although compilation of the findings is not yet complete, some descriptive information is available.

The number of trade-name products and chemical substances inventoried per site varies from fewer than 50 to more than 600 (Figure 1). Further analysis of the data may show this to be a function of the size of the site and/or the complexity of the operation carried out there. The current estimate of 35,000 products inventoried in this segment includes multiple listings of some products if they are found at more than one site; these duplicates are now being identified. An estimated 38% of the products inventoried were reported by mine management as not having been used during the previous 12 months. This high percentage was unexpected and is responsible, in part, for a longer survey time per site than had been predicted; the average survey time was 34 hours, compared with an expected time of 16 hours. Efforts to reduce the time required for surveys include the use of checklists, where feasible, and the omission of some zero-use products.

Follow-Up to NOHSM

Data derived from NOHSM will not completely meet the requirement of the Federal Mine Safety and Health Amendment Act of 1977 that levels of health-related agents be determined. Thus, once NIOSH learns from NOHSM which agents are present, follow-up work must begin that will identify monitoring strategies to yield the associated environmental levels. A complete study, of course, requires that the levels of all toxic agents be measured, including those that may not be visible, such as radon daughters and carbon monoxide.

FIGURE 1. Inventory of potentially hazardous products at mining facilities surveyed, United States, May 1984-September 1985



The Act also requires that information be gathered on a continuing basis. If NOHSM is to be a viable source of data in years to come, NIOSH will need an efficient mechanism for updating the NOHSM information, because it reflects conditions that existed only at the time of the survey.

Reference

1. CDC. Leading work-related diseases and injuries—United States. MMWR 1983;32:24-6, 32.

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