Appendices

Appendix A
Sources of Data

Annual Survey of Occupational Injuries and Illnesses, BLS

After passage of the Occupational Safety and Health Act of 1970, the responsibility for collecting statistics on occupational injuries and illnesses was delegated to the Bureau of Labor Statistics (BLS). The BLS Annual Survey of Occupational Injuries and Illnesses, done in cooperation with participating State agencies, involves data collection by mail from a sample of approximately 250,000 establishments each calendar year. Nearly all industries in the private sector (employers covered by the Occupational Safety and Health Act of 1970) are included. Annual BLS reports of these data incorporate corresponding data from mine operators, provided to BLS by the Mine Safety and Health Administration (MSHA), and from railroad transportation employers, provided to BLS by the Federal Railroad Administration. National estimates of injury and illness incidence rates by industry are developed from the survey data. Beginning in 1992, the survey was expanded to provide more information on illnesses resulting in days away from work, allowing for more detailed classification of respiratory system diseases. For this report, annual summary data on respiratory illnesses were abstracted from BLS annual reports on occupational injuries and illnesses.

In contrast with injury data, illness data presented in the BLS annual reports are quite limited because employers typically do not recognize and report illnesses, particularly illnesses with a long latency. Also, the survey does not cover all workers since it excludes the self-employed; farm operators with fewer than 11 employees; private households; employees in federal, state, and local government agencies; and independent mining contractors.

For more information refer to annual reports: *Occupational Injuries and Illnesses: Counts, Rates, and Characteristics,* Office of Safety, Health and Working Conditions, U.S. Department of Labor, Bureau of Labor Statistics; and www.bls.gov/iif/home.htm.

Black Lung Benefit Awards, SSA and DOL

Title IV of the Coal Mine Health and Safety Act of 1969 authorizes a benefits program, providing medical payments and cash stipends for miners totally disabled because of pneumoconiosis arising out of employment in underground coal mining, as well as for widows of coal miners whose death resulted from the disease or who were entitled to Black Lung benefits at the time of death. The Social Security Administration (SSA) was assigned initial responsibility for operating the benefits program. The Black Lung Benefits Act of 1972 continued SSA responsibility for payments to miners granted claims before July 1973, assigned the Department of Labor responsibility for claims filed after July 1973, and extended eligibility for benefits to surface coal miners and to surviving children of miners. This latter provision allowed children to receive benefits if both parents were deceased, or if a widow ceased to qualify for benefits through remarriage. (In September 1997, in an effort to enhance customer service to Black Lung program beneficiaries, the responsibility for managing all active SSA Black Lung claims was assigned to DOL.)

For more information refer to annual reports: *Social Security Bulletin, Annual Statistical Supplements*; www.ssa.gov/statistics/Supplement/2000/9d.pdf; annual reports to Congress: *Office of Workers' Compensation Programs*, U.S. Department of Labor, Employment Standards Administration; and www.dol.gov/esa/regs/compliance/owcp/bltable.htm.

Coal Mine Employment Data, MSHA

Initiated in 1970, annual informational reports from the Mine Safety and Health Administration (MSHA) summarize occupational injury and illness experience of United States miners, based on data reported by mine operators. Each operator subject to the Federal Mine Safety and Health Act of 1977 is required to submit annual reports of all injuries and occupational illnesses (see section on Annual

Survey of Occupational Injuries and Illnesses, above), as well as related data, including average number of employees during the year. The MSHA informational reports on coal mining provide annual estimates for size of the mining workforce, including separate figures for underground mines. Similar estimates are provided based on data reported by contractors performing certain work at mining operations.

For more information refer to annual reports: *Injury Experience in Coal Mining,* U.S. Department of Labor, Mine Safety and Health Administration; and www.msha.gov/stats/part50/p50y2k/aetable.htm.

Coal Workers' X-ray Surveillance Program, NIOSH

The Coal Workers' X-ray Surveillance Program (CWXSP) is a NIOSH-administered occupational health program mandated by the Coal Mine Health and Safety Act of 1969. The primary objective of the CWXSP is to screen miners for coal workers' pneumoconiosis (CWP). Since 1970, coal mine operators have been required to offer a chest radiograph to all underground coal miners at the time of hire and again three years later. Subsequently, miners can volunteer for radiographs at approximately five-year intervals. The chest x-rays are taken at no cost to the miners. In addition to the posterior-anterior chest x-ray, other information is collected, including miner identification, age, tenure, and specific job in the mine.

The chest films are read by physicians certified by NIOSH as proficient in use of the International Labour Office (ILO) classification system for radiographs of the pneumoconioses. Each film is read by at least two readers, and a consensus rule is used to reach a final determination for each film. The CWXSP defines CWP as small opacity profusion category of at least 1/0 or large opacities (i.e., larger than one centimeter in diameter). Miners with radiographic evidence of CWP on their chest radiographs are offered the option to work in an area of the mine with a respirable coal mine dust level of 1 mg/m^3 or less and have personal dust exposures monitored at frequent intervals.

The large number of chest x-ray examinations since 1970 provide a means of monitoring the prevalence of CWP among active underground coal miners. However, coal miner participation rates have generally decreased since 1970 to less than 30% of working underground coal miners. Thus, tenure-specific prevalence estimates may be biased due to selective participation. Also, overall crude prevalence estimates may reflect over-representation of newly employed miners. Inferences regarding the entire coal mine work force that are based on CWXSP data should be drawn with caution. Tabulations of CWXSP data presented in this report vary from those presented in some earlier editions of the *Work-Related Lung Disease Surveillance Report* due to revised criteria for categorizing tenure and round.

For more information: Coal Workers' Health Surveillance Program, Surveillance Branch, Division of Respiratory Disease Studies, NIOSH, 1095 Willowdale Road, Morgantown, WV 26505. Phone (304) 285-5724.

Integrated Management Information System, OSHA

The Integrated Management Information System (IMIS) includes most of the industrial hygiene sample data from Occupational Safety and Health Administration (OSHA) compliance inspections and consultation surveys conducted since May 1979. The data are reported by OSHA compliance safety and health officers and OSHA state consultants. Each IMIS record includes sample date, substance code, airborne concentration, sample type and exposure type, occupation, OSHA permissible exposure limit (PEL), and standard industrial classification (see Methods, Appendix B). OSHA consultation data were not included in previous

NIOSH *Work-Related Lung Disease Surveillance Reports*. Therefore, most numbers of samples reported for a given year, or period of years, are greater than reported previously.

For more information: Directorate of Information Technology, Occupational Safety and Health Administration, 200 Constitution Avenue, NW, Washington, DC 20210. Phone (202) 693-1700.

Metal/Nonmetal Mine Data, MSHA

The metal/nonmetal mine data (MNMD) are records of industrial hygiene samples collected by Mine Safety and Health Administration (MSHA) inspectors in non-coal surface and underground mines and mills since 1974. This report presents data since 1979, which represent both personal and area samples. Each MNMD record includes sample date, contaminant code, airborne concentration, occupation, MSHA permissible exposure limit (PEL), percent silica and silica concentration where available, standard industrial classification, and the mine and/or mill at which the sample was obtained. In 1982, Congress temporarily removed the surface stone and sand and gravel industries from MSHA's jurisdiction. During this year the number of respirable dust samples collected are fewer than in other years. The quartz reference standard used for MNMD samples changed in 1988. As a result, the reported percent quartz content, quartz concentrations, and the percentage of samples exceeding the PEL increased in 1988 from 1987. MSHA occasionally revises and updates MNMD files, so the number of records reported for a given year, or period of years, may differ from previous reports.

For more information: Metal and Nonmetal Health Division, Mine Safety and Health Administration, Room 2453, 1100 Wilson Blvd., Arlington, VA 22209. Phone (202) 693-9630.

For more information on the quartz reference standard used for the MNMD samples: Dust Division, Pittsburgh Safety and Health Technology Center, Mine Safety and Health Administration, P.O. Box 18233, Pittsburgh, PA 15236. Phone (412) 386-6858.

Multiple Cause of Death Data, NCHS

The National Center for Health Statistics (NCHS) has made available annual public-use multiple cause of death data files since 1968. These files contain records of all deaths in the United States (approximately two million annually) that are reported to state vital statistics offices. Each death record includes codes for up to 20 conditions listed on the death certificate, including both underlying and contributing causes of death in two fields: the entity axis, which preserves diagnostic detail for all listed conditions and their placement on the death certificate; and the record axis, which reorders the codes, removes redundancies, and (infrequently) combines some associated conditions (see "Detail Record Layout" at www.cdc.gov/nchs/about/major/dvs/mcd/1998mcd.htm). Other data include age, race, sex, and state and county of residence at time of death. In addition, usual industry and occupation codes are available for decedents from some states since 1985. NCHS annually determines that certain quality criteria have been met by usual industry and occupation data from selected states (see Appendix E).

Potential limitations of multiple cause of death data include: under- or over-reporting of conditions on the death certificate by certifying physicians; incomplete or unclassified reporting of usual occupation and industry; and non-specificity of codes.

For more information: Mortality Statistics Branch, Division of Vital Statistics, National Center for Health Statistics, Centers for Disease Control and Prevention, 6525 Belcrest Road, Room 820, Hyattsville, Maryland 20782. Phone (301) 458-4666; and www.cdc.gov/nchs/products/elec_prods/subject/mortmcd.htm. Also refer to the annual reports: *Vital Statistics of the United States, Vol. II Mortality* (Parts A and B), Public Health

Service, National Center for Health Statistics; and www.cdc.gov/nchs/products/pubs/pubd/vsus/vsus.htm.

For more information on usual industry and occupation codes: see "Technical Appendix for 1995" at www.cdc.gov/nchs/about/major/dvs/mcd/1998mcd.htm.

National Health Interview Survey, NCHS

The National Center for Health Statistics (NCHS) makes available public-use data from the National Health Interview Survey (NHIS), an annual health survey that has been conducted since 1960. NHIS is a cross-sectional household interview survey on the health of the civilian non-institutionalized population of the United States. The main objective of the NHIS is to monitor the health of the United States population through the collection and analysis of data on a broad range of health topics. NHIS data are collected annually from approximately 40,000 households and include about 100,000 persons. The households selected for interview in the NHIS are a probability sample representative of the target population. The annual response rate of the NHIS is near 90% of the eligible households in the sample.

For more information: Division of Health Interview Statistics, National Center for Health Statistics, 6525 Belcrest Road, Hyattsville, MD 20782; and www.cdc.gov/nchs/nhis.htm.

National Hospital Discharge Survey, NCHS

Estimated numbers of hospital discharges presented in this report have been abstracted from National Hospital Discharge Survey (NHDS) reports published by the National Center for Health Statistics (NCHS). The NHDS, conducted yearly by NCHS, collects data on the use of short-stay non-Federal hospitals in the United States. Federal, military, and Department of Veterans Affairs hospitals were excluded in the survey. In recent years, data have been abstracted from approximately 300,000 records from about 500 hospitals. Each discharge record includes information on patient age, race, sex, ethnicity (since 1985), marital status, length of stay, source of payment (since 1977), diagnoses and surgical procedures, hospital size, ownership, and region of the United States.

Only hospitals with six or more beds for patient use and those in which the average length of stay for all patients is less than 30 days are included in the survey. One limitation of NHDS data is that they represent number of discharges, not number of patients. In addition, information is available only nationally and by region, but not by state. The NHDS relies on the completeness of hospital medical records, and findings can be influenced by diagnostic practices.

For more information: *National Hospital Discharge Survey: Annual Summary with Detailed Diagnosis and Procedure Data,* Division of Health Care Statistics, National Center for Health Statistics (www.cdc.gov/nchs/about/major/hdasd/nhdsdes.htm).

Occupational and Environmental Disease Surveillance Database, AOEC

A database for occupational and environmental diseases and chronic injuries has been developed by the Association of Occupational and Environmental Clinics (AOEC). For inclusion in the database, a case must have at least one diagnosed condition that, in the physician's judgment, is more likely than not to be related to occupational or environmental exposure. Twenty-four AOEC member clinics contributed cases for the period 1991-2000. Six clinics participated over the entire 10-year period and contributed 80% of the cases. An additional seven clinics contributed over 125 cases each and submitted 14% of the cases. While not necessarily representative of all patients with work-related conditions, these case reports provide insight into the types of occupational conditions being treated by occupational medicine specialists, as well as into the types of exposures that are causing or exacerbating these diseases.

For more information: Association of Occupational and Environmental Clinics, 1010 Vermont Ave., NW, #513, Washington, DC 20005. Phone (202) 347-4976; and www.aoec.org.

Population Data Estimates, BoC and CDC
National population estimates used in this report are based on national and state level data from the United States Bureau of the Census (BoC). All population estimates used to compute rates in this report have been those obtainable through the CDC computer system. BoC decennial census population data were used for 1970, 1980, and 1990. In all other years prior to 1990, estimates from intercensal Demo Detail files were used. Estimates from postcensal Demo Detail files were used for 1991-1995. Since 1996, comparable postcensal population estimates prepared by the BoC were used. [Note: Comparing population statistics from Demo-Detail and BoC postcensal estimates for each year from 1990 through 1995, we observed a maximum annual difference of less than 0.05 percent, and a difference of 0.01 percent or less in a majority of years. State-specific differences for the same years were less than one percent for all states, with very rare exceptions.]

For more information: *1990 Census of the Population, General Population Characteristics,* U.S. Bureau of the Census, Series 1900, CP-1; and www.census.gov/prod/www/abs/decenial.html. For more information on population estimates: http://eire.census.gov/popest/estimates.php.

Respirable Coal Mine Dust Data, MSHA
The data consist of respirable coal mine dust measurements collected by MSHA inspectors and mine operators at surface and underground coal mines and preparation plants since 1974. Each record includes sample date, duration, and airborne concentration, as well as occupation and the mine or preparation plant at which the sample was obtained.

For more information: Information Resource Center, Mine Safety and Health Administration, P.O. Box 25367, Denver, CO 80225. Phone (303) 231-5475.

Respirable Coal Mine Quartz Dust Data, MSHA
The data consist of respirable quartz measurements collected by MSHA inspectors and mine operators at surface and underground coal mines and preparation plants since 1982. Each record includes sample date, duration, percent quartz, and airborne concentration, as well as occupation and the mine or preparation plant at which the sample was obtained.

For more information: Dust Division, Pittsburgh Safety and Health Technology Center, Mine Safety and Health Administration, P.O. Box 18233, Pittsburgh, PA 15236. Phone (412) 386-6858.

Sentinel Event Notification Systems for Occupational Risks (SENSOR), NIOSH
Since 1987, NIOSH has awarded cooperative agreements to various state health departments to develop models for state-based and condition-specific surveillance and preventive intervention. Two of the conditions for which states have been funded through the SENSOR program are silicosis and work-related asthma. States and years funded for these two conditions are shown in Table A-1.

SENSOR Silicosis. A total of three states (MI, NJ, OH) maintained silicosis surveillance programs during the 10-year period covered by the SENSOR tables included in this report (1989-1998). All three states identified potential cases using a variety of sources: review of state death certificate data, case reports from physicians, review of hospital discharge data or direct hospital reporting to the state health department. In addition, Michigan and Ohio review workers' compensation records.

In all three states, demographic, work history, and medical information used for case confirmation and

description was obtained through a combination of the initial case ascertainment source, a review of medical records, and follow-up telephone interview with the reported cases or their surviving next of kin. For SENSOR surveillance purposes, silicosis case confirmation requires a history of occupational exposure to airborne silica dust and either: (a) a chest radiograph interpreted as characteristic of silicosis, or (b) lung histopathology characteristic of silicosis (see Appendix G).

For more information: Maxfield R, Alo C, Reilly MJ, et al. Surveillance for silicosis, 1993–Illinois, Michigan, New Jersey, North Carolina, Ohio, Texas, and Wisconsin. *MMWR Surveill Summ* 1997/46 (SS-1); 13-28 (www.cdc.gov/mmwr/preview/mmwrhtml/00046046.htm).

SENSOR Work-Related Asthma (WRA). A total of four states (CA, MA, MI, NJ) maintained WRA surveillance programs during the seven-year period covered by the SENSOR tables included in this report (1993-1999). Physician case reports represented the primary ascertainment source in all four states. Massachusetts, Michigan, and New Jersey actively solicited physicians for case reports, whereas California identified potential cases by reviewing data from Doctor's First Reports (DFR) of Occupational Injury or Illness, a longstanding statewide physician reporting system linked to physician reimbursement for medical services. In addition, Michigan and New Jersey actively solicited hospital reports and reviewed hospital discharge records for potential WRA cases. In 1993, Massachusetts also began supplementing case ascertainment with review of state-wide hospital discharge data.

In all four states, surveillance staff collected demographic, work history, and medical information used for case confirmation, classification, and description through a combination of the initial case ascertainment source, a review of medical records, and follow-up telephone interview with reported cases. For SENSOR surveillance purposes, WRA surveillance case confirmation requires a healthcare professional's diagnosis of asthma (or a related diagnosis consistent with asthma) and an association between symptoms of asthma and work. Confirmed WRA cases are classified according to established criteria (see Appendix G). To facilitate consistency in agent coding across states, putative causes of WRA are coded using the Association of Occupational and Environmental Clinics (AOEC) exposure coding scheme (www.aoec.org/aoeccode.htm), which flags "known asthma inducers."

For more information: Jajosky RA, Harrison R, Reinisch F, et al. Surveillance of work-related asthma in selected U.S. states using surveillance guidelines for state health departments–California, Massachusetts, Michigan, and New Jersey, 1993-1995. *MMWR Surveill Summ* 1999/48 (SS-3); 1-20 (www.cdc.gov/mmwr/preview/mmwrhtml/ss4803a1.htm).

Table A-1. States with SENSOR Silicosis (S) and/or Work-Related Asthma (A) Surveillance and Intervention Programs, 1988-2002

State	Oct. 1988 - Sept. 1992	Oct. 1992 - Sept. 1997	Oct. 1997 - Sept. 2002
CA		A	A
CO	A		
IL		S	
MA	A	A	A
MI	A, S	A, S	A, S*
NJ	A, S	A, S	A*, S
NY	A		
NC		S	
OH	S	S	S
TX		S	
WI	A, S	S	

*Not funded by NIOSH for this condition during this period but continued to collaborate with NIOSH.

Appendix B
Methods

MORTALITY

Number of Deaths

In this report, the number of deaths for each occupational respiratory condition is the number of decedents for which the condition was coded as either underlying or contributing cause of death. For the years 1968-1998, these numbers were tabulated from the record axis of the NCHS multiple cause of death data files. Beginning with the 1999 data, these numbers were tabulated from the entity axis and the underlying cause of death of the multiple cause of death data files. (This change was made to permit more complete ascertainment of the diseases of interest.) In the current report, a small number of deaths in 1999 with underlying cause code J65 (pneumoconiosis associated with tuberculosis) were included in the underlying cause of death tabulations of each specific type of pneumoconiosis. Similarly, deaths in 1999 with underlying cause code J92.0 (pleural plaque with asbestos) were included in asbestosis underlying cause of death tabulations. Cause of death codes are defined as shown in Appendix C: International Classification of Diseases (ICD) Codes. The number of deaths by condition are reported both annually and for selected time periods. Reported deaths are restricted to United States residents, 15 years or older, based on state of residence at death. Race was classified as white, black, and all others.

Crude Mortality Rates

To compute annual cause-specific crude mortality rates, the total number of decedents, 15 years and older, with a specified condition coded as either underlying or contributing cause in a given year was divided by the population, 15 years and older, of the same geopolitical unit in the same year. Race- and sex-specific rates were computed from the appropriate subsets of the data. Crude mortality rates were computed at the national and state level for the multi-year period 1990-1999, and at the county level for the multi-year period 1985-1999. For each time period, the average annual number of decedents, 15 years and older, with a specified condition coded as either underlying or contributing cause was divided by the mid-year population (1995, 1992, respectively), 15 years and older, of the same geopolitical unit.

Age-Adjusted Mortality Rates

Age-adjusted mortality rates presented in this report were based on deaths with the condition of interest mentioned as either underlying or contributing cause of death. Rates were calculated annually for each specified condition from 1968 through 1999, as well as for selected periods. For a given year, the age-adjusted rates represent the rates that would have been observed if the age-specific rates for specified age groups had occurred in a population with the same age distribution as that of the standard population. To conform with current NCHS guidelines, the U.S. Year 2000 Standard Population was used as the standard. (All earlier editions of the *Work-Related Lung Disease Surveillance Report* have used the 1940 standard population.) The specific age intervals used were 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84, and 85 years and older. Rates for the entire United States population and for each sex-race group were age-adjusted separately, using the same standard population.

Age-adjusted rates were computed by the direct method. First, the annual age-specific rates for the population of interest were calculated. The product of the age-specific rates and the number in the comparable age-specific group in the standard population equals the expected number of deaths per million population for each age group. The total expected numbers of deaths were then obtained by summing over all age groups. The total expected number of deaths was divided by the sum of the standard population and the resulting quotient was multiplied by 1,000,000 to produce the age-adjusted rate (per million).

Age-adjusted rates were computed at the national and state level for the multi-year period 1990-1999.

Rates also were computed at the county level either for two 15-year periods and one 30-year period (1970-1984, 1985-1999, and 1970-1999), or for a single 20-year period (1980-1999), depending on whether or not the condition of interest was discretely classified during those time periods (see Appendix C). Rates for malignant mesothelioma were computed for 1999 only. For each time period (1970-1984, 1970-1999, 1980-1999, 1985-1999, and 1990-1999), age-specific rates first were computed by dividing the average annual number of deaths in each age group by the corresponding age-grouped, mid-year population (1977, 1985, 1990, 1992, and 1995, respectively) in the comparable geopolitical unit. Age-adjusted rates then were computed as described above.

Years of Potential Life Lost (YPLL)

YPLL were based on deaths with the condition of interest mentioned as either underlying or contributing cause of death. They were calculated using the method described by the Centers for Disease Control (CDC) (*MMWR Surveill Summ* 1986/35(2S); www.cdc.gov/mmwr/preview/mmwrhtml/00001773.htm). YPLL were calculated both to age 65 and to life expectancy. YPLL to age 65 may be considered as a loss of years from a traditional working life, while YPLL to life expectancy may be considered as a loss of years from the overall life span. To compute YPLL to life expectancy, the number of deaths in each race/sex age group (the same age intervals used for computing age-adjusted rates) first was multiplied by the difference between the mid-point of the age group and life-expectancy for that race/sex age-group. Life tables published annually by NCHS (www.cdc.gov/nchs/products/pubs/pubd/lftbls/life/1966.htm) were used to determine race/sex life-expectancies for white/male, white/female, black/male, and black/female. The overall U.S. population life-expectancy was used for other/male and other/female. To compute YPLL to age 65, the number of deaths in age groups 15-24 through 55-64 was multiplied by the difference between 65 years and the mid-point of each age group (e.g., 65 minus 20 years for the 15-24 age group). These age-specific YPLLs then were summed over all age groups to obtain total YPLLs (to life expectancy, and to age 65) for each race/sex/year from 1990 to 1999.

State-specific YPLLs (to life expectancy) per death also were calculated for the period 1990-1999. To calculate this index, the total number of all race/sex deaths in each age group was multiplied by the corresponding U.S. population life-expectancy, then summed over all age groups to obtain the total YPLL, and then divided by the total number of deaths for each state during this time period.

Rank Order

For each state, a rank order is presented for each of several mortality measures. Depending on the specific mortality measures, a rank order of "1" indicates the greatest number of deaths, highest mortality rate, or highest YPLL among all states in the U.S.

Most Frequently Recorded Industries/Occupations

In this report, the ten most frequently recorded Bureau of Census industries (CIC) and occupations (COC) with at least two decedents have generally been listed for specified causes of death (from selected states and years in Appendix E). Where more than one industry/occupation was tied for tenth place, all those that were tied were listed.

Proportionate Mortality Ratio (PMR)

The data used for PMR analyses are a subset of the NCHS multiple cause of death files for which usual industry and occupation codes are available and meet quality criteria set by NCHS (see Appendix E for a list of states and years for which data qualified).

The PMR is defined as the observed number of deaths with the condition of interest (mentioned as either underlying or contributing) in a specified industry/occupation (from selected states and years

in Appendix E), divided by the expected number of deaths with that condition. The expected number of deaths is the total number of deaths in the Bureau of Census industry (CIC) or occupation (COC) of interest multiplied by a proportion defined as the number of cause-specific deaths for the condition of interest in all industries/occupations, divided by the total number of deaths in all industries/occupations. The PMRs in this report have been internally adjusted by five-year age groups (i.e., 15-19, 20-24, … 110-114, and 115 years and over), sex, and race (i.e., white, black, and all other). (PMRs presented in the 1999 *Work-Related Lung Disease Surveillance Report* were internally adjusted for age only, using the age groupings 15-34, 35-54, 55-74, and 75 years and over.) Confidence intervals were calculated assuming Poisson distribution of the data.

A PMR greater than 1.0 indicates that there were more deaths associated with the condition in a specified occupation or industry than expected. This report includes only those industries/occupations with five or more decedents with the condition of interest and a lower 95% confidence limit exceeding 1.0.

MORBIDITY

Prevalence (Asthma, COPD, and Smoking)

The prevalence of asthma, chronic obstructive pulmonary disease (COPD), and cigarette smoking was based on the 2000 NHIS data collected from adult (18 years and older) household interview survey. Asthma was defined as a "yes" response to the question, "Have you ever been told by a doctor or other health professional that you had asthma?" COPD was defined as a "yes" response to either of the following questions: (1) "Have you ever been told by a doctor or other health professional that you had chronic bronchitis?" or (2) "Have you ever been told by a doctor or other health professional that you had emphysema?" Cigarette smoking status was classified as three groups: nonsmokers, current smokers, and former smokers. Nonsmokers were defined as those who smoked less than 100 cigarettes during their entire life. Former smokers were defined as those who smoked at least 100 cigarettes in their entire life and do not currently smoke. Information on current occupation and industry was coded according to the revised 1995 Standard Industrial and Occupational Classification. These detailed occupation and industry codes were collapsed in the NHIS public-use data set (available at www.cdc.gov/nchs/about/major/hdasd/nhdsdes.htm).

Prevalence rates for asthma and COPD were estimated (using sample weights and adjustment for non-responses) by gender, smoking status, industry, and occupation as regrouped by NCHS in the NHIS data files. The prevalence of cigarette smoking was estimated by gender, industry, and occupation. Survey Data Analysis (SUDAAN®) software was used to estimate variances, enabling calculation of 95% confidence intervals for asthma, COPD, and smoking prevalence rates. Lower 95% confidence limits less than zero were converted to 0.0 and upper 95% confidence limits greater than 100 were converted to 100.0.

Prevalence (CWP)

Prevalence of CWP, presented by tenure and time period, was based solely on "final determinations" (consensus values) of ILO category 1/0 or higher of chest radiographs taken for the Coal Workers' X-ray Surveillance Program (CWXSP). Administrative and regulatory guidelines have varied over the life of the program. From 1970 through 1981, the program was administered in structured rounds. After a change in procedure in 1981, examinations have been arranged on a continual basis. For this report, CWXSP data collected after 1981 are grouped into 5-year periods (referred to as "rounds"), which roughly correspond to cycles during which all working underground coal miners could elect to receive a chest x-ray. In cases where more than one chest x-ray was available for a single participant in the same round–usually due

to a change in employer–the final determination for the most recent chest x-ray was used. Tenure in underground coal mining was based on summation of years in various mining occupations, as reported by the miner at the time of x-ray.

Incidence Rates (Occupational Respiratory Illnesses)

Estimated numbers of work-related respiratory illness (with days away from work) and incidence rates of occupational respiratory conditions due to toxic agents were generally abstracted from the BLS annual reports of occupational injuries and illnesses, 1992-2000. Where data were not directly abstracted from BLS reports, incidence rates for occupational respiratory illnesses (with days away from work) were computed by dividing the BLS-estimated annual number of incident cases in the industry by the BLS-estimated industry-specific employment for the corresponding year. The resulting quotients were multiplied by 100,000 to yield rates per 100,000 workers.

Association of Occupational and Environmental Clinics (AOEC) Diagnoses

In this report, the frequency distributions of work-related respiratory conditions diagnosed in AOEC clinics and respiratory hazards associated with respiratory diagnoses were tabulated by AOEC from the AOEC database.

EXPOSURE

Occupational Exposure Limits

Permissible Exposure Limits. OSHA and MSHA each enforce regulations that establish the legal limits of workplace exposures to pneumoconiotic agents. These legal limits are described in this report as permissible exposure limits (PELs), although the regulations sometimes use the term "standard" or "exposure limit." The current legal limits may be found in the U.S. Code of Federal Regulations (CFR), as follows:

OSHA	
general industry	construction industry
29 CFR 1910.1000	29 CFR 1926.55
29 CFR 1910.1001	29 CFR 1926.1101
29 CFR 1910.1043	

MSHA	
coal mine industry	non-coal mining industry
30 CFR 70.100	30 CFR 56.5001
30 CFR 70.101	30 CFR 57.5001
30 CFR 71.100	
30 CFR 71.101	
30 CFR 71.700	
30 CFR 75.321	
30 CFR 90.100	
30 CFR 90.101	

Although OSHA has PELs for the maritime industry [29 CFR 1915], very few samples have been collected and are not reported here.

The OSHA PELs for several pneumoconiotic agents were changed on March 1, 1989, but a legal challenge to the modified OSHA PELs was upheld, and the modified OSHA PELs reverted to the previous OSHA PELs on March 23, 1993. Therefore, data for respirable quartz, selected pneumoconiotic agents, and all pneumoconiotic agents are reported for the three time periods: 1979 to 1988; 1989 to 1992; and 1993 to 1999. Some pneumoconiotic agents had a substance-specific OSHA PEL only from March 1, 1989 to March 22, 1993, including: aluminum as welding fumes, respirable dust of natural graphite, mica containing less than 1% crystalline silica, tin oxide, inorganic compounds of tin oxide, fused respirable silica dust, fibrous talc not containing tremolite, talc not containing asbestos, insoluble tungsten & compounds, and welding fumes (total particulate).

The MSHA metal/nonmetal mining PELs for pneumoconiotic agents were adopted from the 1973 edition of the American Conference of Governmental Industrial Hygienists (ACGIH®)

publication entitled "*TLV®s Threshold Limit Values for Chemical Substances in Workroom Air Adopted by ACGIH for 1973*." MSHA has not adopted a PEL for the pneumoconiotic agents: tin oxide dust/fume; inorganic dusts of tin; insoluble tungsten dusts/fumes; and welding fumes (total particulate). In this report a MSHA PEL of 10 milligrams per cubic meter (mg/m^3) is used for welding fumes (total particulate) through 1993, but since then it has been MSHA policy not to collect samples for welding fumes.

OSHA and MSHA do not have PELs specific for any form of crystalline silica. The PELs apply to respirable dust containing crystalline silica, and the allowable exposure to respirable dust is reduced as the crystalline silica content increases. The formulas for allowable exposure vary with the agency and the industry. In metal/nonmetal mining, the MSHA PEL is the same as the OSHA PEL for respirable dust containing at least 1% quartz:

$$OSHA\ PEL = \frac{10\ mg/m^3}{\%\ Quartz + 2}$$

However, OSHA adopted a PEL of 0.1 mg/m^3 for quartz that was enforced from March 1, 1989 through March 22, 1993.

Since December 1972, the MSHA PEL for respirable coal mine dust has been 2 mg/m^3 MRE[1] unless the quartz concentration of the respirable coal mine dust at the mine exceeds 5%. When the quartz content of the respirable dust exceeds 5% in a coal mine sample, the MSHA PEL is reduced based on the following formula:

$$MSHA\ PEL = \frac{10\ mg/m^3\ MRE}{\%\ Quartz}$$

The OSHA PEL of 2 fibers per cubic centimeter (f/cc) for asbestos was reduced to 0.2 f/cc on July 21, 1986, and to 0.1 f/cc on October 11, 1994. Therefore, asbestos exposures are reported for three time periods: 1979 to 1986; 1987 to 1994; and 1994 to 1999. The MSHA PEL for asbestos has not changed from 2 f/cc since it was adopted.

The OSHA PELs for cotton dust (raw) vary by processing operation. They are:

- 1 mg/m^3 for the cotton waste processing operations of waste recycling (sorting, blending, cleaning, and willowing) and garneting;
- 0.75 mg/m^3 for textile slashing and weaving operations;
- 0.50 mg/m^3 for textile mill waste house operations or for dust from "lower grade washed cotton" used during yarn manufacturing; and
- 0.20 mg/m^3 for yarn manufacturing and cotton washing operations.

Reporting of cotton dust data began when the process-specific OSHA PELs became effective on March 27, 1980.

Recommended Exposure Limits. NIOSH develops and periodically revises recommended exposure limits (RELs) for hazardous substances or conditions in the workplace. The RELs are then published and transmitted to OSHA and MSHA for use in promulgating legal standards. The RELs for mineral dusts and chemical hazards, including pneumoconiotic agents, are published in the NIOSH *Pocket Guide to Chemical Hazards* (NIOSH Pub. No. 97-140). The REL for coal mine dust was adopted in September 1995, while RELs for the other pneumoconiotic agents in this report were adopted before 1979, which is the first year OSHA and MSHA data are reported. The REL for beryllium and compounds is based on cancer, rather

[1] The MRE designation refers to the Mining Research Establishment of the National Coal Board, London, England. MSHA's PELs for respirable coal mine dust and respirable coal mine dust containing quartz are based on sampling criteria developed by MRE, but OSHA's are based on different sampling criteria. To clearly indicate the difference, the MSHA PELs and sample results are designated by "MRE" in this report.

than pneumoconiotic effects. NIOSH has no full-shift RELs for the following pneumoconiotic agents: aluminum oxide; emery; synthetic graphite; rouge; fused respirable silica dust; titanium dioxide; and welding fumes (total particulate).

Data Selection

MSHA coal mine dust samples included in this report met all of the following criteria:

(1) obtained in the United States or one of its territories;
(2) designated by MSHA as valid;
(3) coded as "designated occupation," "non-designated occupation," "designated work position," "non-designated work position" with valid occupation codes, or "designated area" other than "intake air."

MSHA Coal Mine Quartz. MSHA coal mine quartz samples included in this report met all of the following criteria:

(1) obtained in the United States or one of its territories;
(2) designated by MSHA as valid;
(3) sample duration greater than zero;
(4) quartz concentration greater than or equal to zero;
(5) coded as "designated occupation," "non-designated occupation," "designated work position," "non-designated work position" with valid occupation codes, or "designated area" other than "intake air."

MSHA Metal/Nonmetal Mine Data (MNMD). MSHA metal/nonmetal mine data (MNMD) included in this report met the following criteria:

(1) obtained in the United States or one of its territories;
(2) not duplicated by another record, as determined by a comparison of all data fields.

NIOSH staff edited the MNMD provided by MSHA to remove duplicate records and records with internal inconsistencies, similarly to the methods previously used by the U.S. Bureau of Mines for data presented in earlier *Work-Related Lung Disease Surveillance Reports*.

OSHA Integrated Management Information System (IMIS). IMIS samples included in this report met all of the following criteria:

(1) the state code was one of the 50 U.S. states, Washington, DC, American Samoa, Guam, Puerto Rico, or the U.S. Virgin Islands;
(2) the sample type was "area" or "personal" (excludes: "bulk," "wipe," "screen," "blood," and "urine" samples);
(3) the exposure type was "time-weighted average," or "not detected" (excludes: "ceiling," "peak," "dose," "sound reading," "not analyzed," and "not valid");
(4) the indicated OSHA PEL and units were applicable to the contaminant indicated by the substance code for the recorded date of sampling.

Data Analysis for MSHA and OSHA Samples

The reported number of samples for an agent was the total number of samples meeting the above criteria. The percent of samples exceeding the PEL for an agent category was calculated as the number of samples in that category with measured exposures exceeding the PEL enforced at the time the sample was collected, divided by the total number of samples for the agent, and finally multiplying by 100. The percent of samples exceeding the REL for an agent was calculated as the number of samples in that category with measured exposure exceeding the REL, divided by the total number of samples for the agent, and multiplying by 100.

Exposures are commonly log normally distributed, rather than normally distributed. For this reason we present geometric means of the exposure. To calculate a geometric mean exposure, samples less than the minimum quantifiable concentration (MQC) were assigned a value, either the (MQC/2)

or ($MQC/2^{1/2}$), depending on the distribution of samples that were quantifiable.[2] The analytical methods used to calculate the MQC for selected pneumoconiotic agents are presented in Table F-2 of Appendix F. The calculation assumes a sample duration of 6 hours for cotton dust, and 7 hours for other agents.

The OSHA and MSHA asbestos MQCs changed during the 1979 to 1999 period; therefore, appropriate MQCs were used for each time period.

OSHA analyzed cotton dust or welding fumes (total particulate) samples by using their standard operating procedure (SOP) for nuisance dusts. The limit of detection of 10 micrograms was determined by the sensitivity of the balance. Results for cotton dust samples below the MQC, 4.3% of all cotton dust samples, could not be assigned to a specific cotton dust processing operation and were not included in Figure 4-4 and Table 4-11.

The MSHA respirable coal mine quartz data are based on analyses of respirable coal mine dust samples. However, the quartz content could not be reliably identified for most of these samples. Therefore, in Section 2, the percent of respirable coal mine dust samples exceeding the MSHA PEL were calculated using the MSHA PEL of 2 mg/m^3 MRE for respirable coal mine dust containing no more than 5% quartz.

In Section 3 the geometric means of exposure to quartz are reported for OSHA samples. However, the reported percentage greater than the PEL (% > PEL) compares only the respirable dust samples containing at least 1% quartz to the PEL for respirable dust containing at least 1% quartz. The exception is from March 1, 1989 through March 22, 1993, when OSHA enforced a PEL of 0.1 mg/m^3 for respirable quartz. During this period the percentage greater than the PEL (% > PEL) compares the exposure to quartz to 0.1 mg/m^3.

Industries with Elevated PMRs and Most Frequently Recorded on Death Certificates

This report includes number of samples, geometric mean exposures, and percent of samples exceeding the PEL or REL by selected industries for exposure agents related to elevated occupational lung disease mortality. For asbestosis, CWP, silicosis, byssinosis, and all pneumoconiosis, separate tables present data for the ten most frequently recorded industries with five or more decedents and significantly elevated PMRs.

STATE AND COUNTY DESIGNATIONS

The "number of states" displayed on maps in this report sums to 51 because the District of Columbia is included.

Counties in this report are coded according to the 1990 Federal Information Processing Standards (FIPS) Codes system. A small number of counties or county equivalents have split, merged with, or separated from surrounding or adjacent subdivisions (see Appendix H). Readers should be cautious in assessing geographic patterns and temporal trends for subdivisions that have split or merged.

INDUSTRY/OCCUPATION CODES AND TITLES

Since 1993, the 1990 Bureau of Census (BoC) Index of Industries and Occupations classification system (see "Technical Appendix for 1995" at www.cdc.gov/nchs/about/major/dvs/mcd/1998mcd.htm) has been used for coding death certificate information on the NCHS multiple cause of death data files. Most codes and titles in the 1990 system do not differ from the 1980 system. All tables

[2] Hornung, R., Reed, L. 1990. Estimation of average concentration in the presence of nondetectable values. Applied Occupational and Environmental Hygiene 5:46-51.

reporting BoC industry (CIC) and occupation (COC) codes and titles that are presented in the mortality and exposure sections of this report, except those listed in Appendix D, follow the 1980 BoC classification system.

Industry/occupation titles ranked by estimated prevalence of asthma, COPD, and smoking, which are presented in the morbidity sections of this report, had been classified according to the 1995 Standard Industrial Classification (SIC) System and then regrouped by NCHS. Incidence rates of the pneumoconioses (including siderosis) and respiratory conditions due to toxic agents follow the 1987 SIC System. Tables summarizing temporal patterns of geometric means in selected exposure sections (i.e., asbestos, silica, and pneumoconiotic agents) of this report also group industries by the 1987 SIC System.

The primary industries associated with silicosis and work-related asthma cases in the SENSOR sections of this report are grouped by the 1987 SIC System; however, the primary occupations (COC) are grouped by the 1990 BoC classification system.

Appendix C
International Classification of Diseases (ICD) Codes

Condition (as defined for this report)	ICD-8 (1968-1978)		ICD-9 (1979-1998)		ICD-10 (1999)	
	Rubrics	Codes	Rubrics	Codes	Rubrics	Codes
Asbestosis	**Asbestosis**	**515.2**	**Asbestosis**	**501**	**Pneumoconiosis due to asbestos and other mineral fibers** Asbestosis	**J61***
Coal Workers' Pneumoconiosis	**Anthracosilicosis** Anthracosis Coal miners' lung	**515.1**	**Coal workers' pneumoconiosis** Anthracosilicosis Anthracosis Black lung disease Coal workers' lung Miners' asthma	**500**	**Coal workers' pneumoconiosis** Anthracosilicosis Anthracosis Coal workers' lung	**J60***
Silicosis	**Silicosis** Calcicosis Chalicosis	**515.0**	**Pneumoconiosis due to other silica or silicates** Pneumoconiosis due to talc Silicotic fibrosis (massive) of lung Silicosis (simple) / (complicated)	**502**	**Pneumoconiosis due to dust containing silica** Silicotic fibrosis (massive) of lung Pneumoconiosis due to talc dust Pneumoconiosis due to other dust containing silica	**J62***
	Silicotuberculosis Colliers' phthisis Grinders' phthisis Miners' phthisis Stonemasons' phthisis	**010**	*No discrete ICD-9 code*		*No discrete ICD-10 code*	
Byssinosis	*No discrete ICD-8 code*		**Pneumonopathy due to inhalation of other dust** Byssinosis Cannabinosis Flax-dressers' disease	**504**	**Airway disease due to specific organic dust** Byssinosis Flax-dresser's disease Cannabinosis Airway disease due to other specific organic dusts	**J66**
Unspecified/Other Pneumoconioses	**Pneumoconiosis due to inhalation of other inorganic dust** Aluminosis (of lung) Bauxite fibrosis (of lung) Berylliosis Graphite fibrosis (of lung)	**516.0**	**Pneumoconiosis due to other inorganic dust** Aluminosis (of lung) Bauxite fibrosis (of lung) Berylliosis Graphite fibrosis (of lung) Siderosis Stannosis	**503**	**Pneumoconiosis due to other inorganic dusts** Aluminosis (of lung) Bauxite fibrosis (of lung) Berylliosis Graphite fibrosis (of lung) Siderosis Stannosis Pneumoconiosis due to other specified inorganic dusts	**J63***
	Other pneumoconiosis, including unspecified Pneumoconiosis: n.o.s. due to: silicates n.e.c. talc	**515.9**	**Pneumoconiosis, unspecified**	**505**	**Unspecified pneumoconiosis**	**J64***

See footnotes at end of table.

Condition (as defined for this report)	ICD-9 (1979-1998)		ICD-10 (1999)	
	Rubrics	**Codes**	**Rubrics**	**Codes**
Malignant Mesothelioma	*No discrete ICD-9 code*		**Mesothelioma** Mesothelioma of pleura Mesothelioma of peritoneum Mesothelioma of pericardium** Mesothelioma of other sites Mesothelioma, unspecified	**C45**
Hypersensitivity Pneumonitis	**Extrinsic allergic alveolitis** Farmers' lung Bagassosis Bird-Fanciers' lung Suberosis Malt workers' lung Mushroom workers' lung Maple bark-strippers' lung Ventilation pneumonitis Other specified allergic alveolitis and pneumonitis Unspecified allergic alveolitis and pneumonitis	**495**	**Hypersensitivity pneumonitis due to organic dust** Farmer's lung Bagassosis Bird fancier's lung Suberosis Maltworker's lung Mushroom-worker's lung Maple-bark-stripper's lung Air-conditioner and humidifier lung Hypersensitivity pneumonitis due to other organic dusts Hypersensitivity pneumonitis due to unspecified organic dust	**J67**
Asthma	**Asthma** Extrinsic asthma Intrinsic asthma Asthma, unspecified	**493**	**Asthma** Predominantly allergic asthma Nonallergic asthma Mixed asthma Asthma, unspecified **Status asthmaticus** Acute severe asthma	**J45** **J46**
Chronic Obstructive Pulmonary Disease	*No data included in this report*		**Bronchitis, not specified as acute or chronic** Bronchitis: n.o.s. catarrhal with tracheitis n.o.s. Tracheobronchitis n.o.s. **Simple and mucopurulent chronic bronchitis** Simple chronic bronchitis Mucopurulent chronic bronchitis Mixed simple and mucopurulent chronic bronchitis **Unspecified chronic bronchitis** **Emphysema** MacLeod's syndrome Panlobular emphysema Centrilobular emphysema Other emphysema Emphysema, unspecified **Other chronic obstructive pulmonary disease** Chronic obstructive pulmonary disease with acute lower respiratory infection Chronic obstructive pulmonary disease with acute exacerbation, unspecified Other specified chronic obstructive pulmonary disease Chronic obstructive pulmonary disease, unspecified **Bronchiectasis**	**J40** **J41** **J42** **J43** **J44** **J47**

See footnotes at end of table.

Condition (as defined for this report)	ICD-9 (1979-1998)		ICD-10 (1999)	
	Rubrics	**Codes**	**Rubrics**	**Codes**
Respiratory Tuberculosis	**Primary tuberculous infection**	**010**	**Respiratory tuberculosis, bacteriologically and histologically confirmed**	**A15**
	Primary tuberculous infection		Tuberculosis of lung, confirmed by sputum microscopy with or without culture	
	Tuberculous pleurisy in primary progressive		Tuberculosis of lung, confirmed by culture only	
	Other primary progressive tuberculosis		Tuberculosis of lung, confirmed histologically	
	Primary tuberculous infection, unspecified		Tuberculosis of lung, confirmed by unspecified means	
	Pulmonary tuberculosis	**011**	Tuberculosis of intrathoracic lymph nodes, confirmed bacteriologically and histologically	
	Tuberculosis of lung, infiltrative		Tuberculosis of larynx, traches and bronchus, confirmed bacteriologically and histologically	
	Tuberculosis of lung, nodular		Tuberculous pleurisy, confirmed bacteriologically and histologically	
	Tuberculosis of lung with cavitation		Primary respiratory tuberculosis, confirmed bacteriologically and histologically	
	Tuberculosis of bronchus		Other respiratory tuberculosis, confirmed bacteriologically and histologically	
	Tuberculous fibrosis of lung		Respiratory tuberculosis unspecified, confirmed bacteriologically and histologically	
	Tuberculous bronchiectasis			
	Tuberculous pneumonia [any form]		**Respiratory tuberculosis, not confirmed bacteriologically or histologically**	**A16**
	Tuberculous pneumothorax		Tuberculosis of lung, bacteriologically and histologically negative	
	Other specified pulmonary tuberculosis		Tuberculosis of lung, bacteriological and histological examination not done	
	Pulmonary tuberculosis, unspecified		Tuberculosis of lung, without mention of bacteriological or histological confirmation	
	Other respiratory tuberculosis	**012**	Tuberculosis of intrathoracic lymph nodes, without mention of bacteriological or histological confirmation	
	Tuberculous pleurisy		Tuberculosis of larynx, trachea, and bronchus, without mention of bacteriological or histological confirmation	
	Tuberculosis of intrathoracic lymph nodes		Tuberculous pleurisy, without mention of bacteriological or histological confirmation	
	Isolated tracheal or bronchial tuberculosis		Primary respiratory tuberculosis without mention of bacteriological or histological confirmation	
	Tuberculous laryngitis		Other respiratory tuberculosis, without mention of bacteriological or histological confirmation	
	Other specified respiratory tuberculosis		Respiratory tuberculosis unspecified, without mention of bacteriological or histological confirmation	
	Miliary tuberculosis	**018**		
	Acute miliary tuberculosis		**Miliary tuberculosis**	**A19**
	Other specified miliary tuberculosis		Acute miliary tuberculosis of a single specified site	
	Miliary tuberculosis, unspecified		Acute miliary tuberculosis of multiple sites	
			Acute miliary tuberculosis, unspecified	
	Late effects of tuberculosis		Other miliary tuberculosis	
	Late effects of respiratory or unspecified tuberculosis	137.0	Miliary tuberculosis, unspecified	
			Sequelae of tuberculosis	
			Sequelae of respiratory and unspecified tuberculosis	B90.9

See footnotes at end of table.

Condition (as defined for this report)	ICD-9 (1979-1998)		ICD-10 (1999)	
	Rubrics	**Codes**	**Rubrics**	**Codes**
Respiratory Conditions due to Chemical Fumes and Vapors	**Respiratory conditions due to chemical fumes and vapors** Bronchitis and pneumonitis due to fumes and vapors Acute pulmonary edema due to fumes and vapors Upper respiratory inflammation due to fumes and vapors Other acute and subacute respiratory conditions due to fumes and vapors Chronic respiratory conditions due to fumes and vapors Unspecified respiratory conditions due to fumes and vapors	**506**	**Respiratory conditions due to inhalation of chemicals, gases, fumes, and vapors** Bronchitis and pneumonitis due to chemicals, gases, fumes, and vapors Acute pulmonary edema due to chemicals, gases, fumes, and vapors Upper respiratory inflammation due to chemicals, gases, fumes, and vapors, n.e.c. Other acute and subacute respiratory conditions due to chemicals, gases, fumes, and vapors Chronic respiratory conditions due to chemicals, gases, fumes, and vapors Other respiratory conditions due to chemicals, gases, fumes, and vapors Unspecified respiratory condition due to chemicals, gases, fumes, and vapors	**J68**
Lung Cancer	*No data included in this report*		**Malignant neoplasm of trachea** **Malignant neoplasm of bronchus and lung** Main bronchus Upper lobe, bronchus or lung Middle lobe, bronchus or lung Lower lobe, bronchus or lung Overlapping lesion of bronchus and lung Bronchus or lung, unspecified	**C33** **C34**
Other Interstitial Pulmonary Diseases	*No data included in this report*		**Other Interstitial Pulmonary Diseases** Alveolar and parietoalveolar conditions Other interstitial pulmonary diseases with fibrosis Other specified interstitial pulmonary diseases Interstitial pulmonary diseases, unspecified	**J84**

n.o.s. - not otherwise specified n.e.c. - not elsewhere classified

* A small number of deaths with underlying cause equal to ICD-10 code J65 or J92.0 are included in underlying cause of death tabulations. See methods for more detailed explanation.

** In this report, mesothelioma of the pericardium is grouped into mesothelioma of other sites.

SOURCES: U.S. Department of Health, Education, and Welfare: Eighth Revision International Classification of Diseases, Volume 1.
U.S. Department of Health and Human Services: International Classification of Diseases 9th Revision, Volume 1.
World Health Organization: International Statistical Classification of Diseases and Related Health Problems 10th Revision, Volume 1.

Appendix D

Changes in Bureau of Census Industry and Occupation Codes and Titles

1980		1990	
Code	**Title**	**Code**	**Title**
Industry: 1980 codes merged into 1990 codes			
382	Not specified professional equipment (manufacturing)	**392**	Not specified manufacturing industries
392	Not specified manufacturing industries		
510	Sporting goods, toys and hobby goods	**532**	Miscellaneous wholesale, durable goods
522	Not specified electrical and hardware (wholesale trade)		
532	Miscellaneous wholesale, durable goods		
730	Commercial research, development, and testing labs	**891**	Research, development and testing services
891	Noncommercial educational and scientific research		
Industry: 1980 title changed to 1990 title			
042	Crude petroleum and natural gas extraction	**042**	Oil and gas extraction
102	Canned and preserved fruits and vegetables	**102**	Canned, frozen and preserved fruits and vegetables
141	Floor coverings, except hard surface	**141**	Carpets and rugs
281	Cutlery, handtools, and other hardware	**281**	Cutlery, handtools, and general hardware
322	Electronic computing equipment	**322**	Computers and related equipment
372	Optical and health services supplies	**372**	Medical, dental, optical instruments and supplies
440	Radio and television broadcasting	**440**	Radio and television broadcasting and cable
441	Telephone (wire and radio)	**441**	Telephone communications
672	Fuel and ice dealers	**672**	Fuel dealers
701	Savings and loan associations	**701**	Savings institutions, including credit unions
712	Real estate, including real estate-insurance-law offices	**712**	Real estate, including real estate-insurance offices
751	Automotive repair shops	**751**	Automotive repair and related services
812	Offices of physicians	**812**	Offices and clinics of physicians
820	Offices of dentists	**820**	Offices and clinics of dentists
821	Offices of chiropractors	**821**	Offices and clinics of chiropractors
822	Offices of optometrists	**822**	Offices and clinics of optometrists
830	Offices of health practitioners, n.e.c.	**830**	Offices and clinics of health practitioners, n.e.c.
851	Business, trade, and vocational schools	**851**	Vocational schools
961	Homemaker, student, unemployed, volunteer	**961**	Non-paid worker or non-worker or own home/at home
Occupation: 1980 codes merged into 1990 codes			
349	Telegraphers	**353**	Communications equipment operators, n.e.c.
353	Communications equipment operators, n.e.c.		
368	Weighers, measurers, and checkers	**368**	Weighers, measurers, checkers, and samplers
369	Samplers		
436	Cooks, except short-order	**436**	Cooks
437	Short-order cooks		
673	Apparel and fabric patternmakers	**674**	Miscellaneous precision apparel and fabric workers
674	Miscellaneous precision apparel fabric workers		
794	Hand grinding and polishing occupations	**795**	Miscellaneous hand working occupations
795	Miscellaneous hand working occupations		
804	Truck drivers, heavy	**804**	Truck drivers
805	Truck drivers, light		
Occupation: 1980 title changed to 1990 title			
098	Inhalation therapists	**098**	Respiratory therapists
558	Supervisors, n.e.c.	**558**	Supervisors, construction, n.e.c.
734	Printing machine operators	**734**	Printing press operators

n.e.c. - not elsewhere classified

Appendix E

States (and Years) for which Industry and Occupation Codes from Death Certificates Met NCHS Quality Criteria, 1985-1999

State	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Alaska			X	X											
Colorado	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Georgia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hawaii									X	X		X		X	X
Idaho				X	X	X	X	X	X	X	X	X	X	X	X
Indiana		X	X	X	X	X	X	X	X		X			X	X
Kansas	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Kentucky	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Maine	X	X	X	X	X	X	X	X	X	X	X	X		X	
Missouri	X	X													
Nebraska	X														X
Nevada	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
New Hampshire	X	X	X	X	X	X	X	X	X	X	X	X		X	X
New Jersey				X	X	X	X	X	X	X	X	X	X	X	X
New Mexico		X	X	X	X	X	X	X	X	X	X	X	X	X	X
North Carolina			X	X	X	X	X	X	X	X	X	X	X	X	X
Ohio	X	X	X	X	X	X	X	X	X		X	X	X	X	
Oklahoma	X	X	X	X	X	X	X	X	X						
Rhode Island	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
South Carolina	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tennessee	X	X	X	X											
Utah	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vermont		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Washington					X	X	X	X							
West Virginia				X	X	X	X	X	X	X	X	X	X	X	X
Wisconsin	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Appendix F
Exposure Categories

Table F-1. Pneumoconiotic agent categories for MSHA and OSHA data

Pneumoconiotic Agent Category (as defined for this report)	MSHA Agents in Category	OSHA Agents in Category
Asbestos	Asbestos, fibers > 5 µm in length ($3MgO{\cdot}2SiO_2{\cdot}2H_2O$)	Asbestos [actinolite, anthophyllite, chrysotile, crocidolite, tremolite] Talc, containing fibrous tremolite
Cotton Dust		Cotton dust (raw) Flax dust*
Coal Mine Dust	Respirable coal mine dust, <= 5% quartz	
Quartz	Respirable coal mine dust, > 5% quartz Respirable dust, > 1% quartz Nuisance dust (respirable fraction), < 1% quartz** Unlisted particulate (respirable fraction), < 1% quartz** Respirable dust (not analyzed or below detection limit)**	Respirable crystalline silica (as quartz) Respirable crystalline silica/tripoli (as quartz) Respirable coal dust, > 5% quartz
Other	Aluminum oxide dust (as Al_2O_3) Aluminum oxide fume (as Al_2O_3) Antimony dusts (as Sb) Beryllium dusts (as Be) Beryllium fumes (as Be) Carbon black Cobalt dusts (as Co) Cobalt fumes (as Co) Cristobalite (respirable fraction) Graphite, natural Iron oxide fume (as Fe_2O_3) Mica Silica (Amorphous) Talc, fibers > 5 µm in length ($Mg_3Si_4O_{10}(OH)_2$) Talc, nonfibrous, < 1% quartz Tin oxide dust (as SnO_2) Tin oxide fume (as SnO_2) Tin, inorganic dusts, except SnO_2 (as Sn) Titanium dioxide dust (as TiO_2) Titanium dioxide fume (as TiO_2) Tridymite (respirable fraction) Tungsten fumes (as W) Tungsten, insoluble dusts (as W) Welding fumes (total dust)	Alpha-alumina (total dust) Alpha-alumina (respirable fraction) Aluminum oxide Aluminum (as Al), metal (total dust) Aluminum (as Al), metal (respirable fraction) Aluminum (as Al), welding fumes Antimony and compounds (as Sb) Barium (insoluble compounds) Barium sulfate (total dust) Barium sulfate (respirable fraction) Beryllium and compounds (as Be) Carbon black Cobalt, metal, fume and dust (as Co) Emery (total dust) Emery (respirable fraction) Graphite, natural (respirable fraction) Graphite, synthetic (total dust) Graphite, synthetic (respirable fraction) Iron oxide fume (as Fe_2O_3) Kaolin (total dust) Kaolin (respirable fraction) Magnesite (total dust) Magnesite (respirable fraction)* Mica (< 1% crystalline silica) Rouge (total dust) Rouge (respirable fraction) Silica, amorphous, diatomaceous earth (<1% crystalline silica) Silica, respirable cristobalite Silica, respirable tridymite Silica, fused (respirable fraction) Talc (containing no asbestos) Talc, fibrous non-tremolite Tin, inorganic compounds, except oxide (as Sn) Tin oxide (as Sn) Titanium dioxide (total dust) Tungsten and compounds (insoluble asW) Welding fumes (total dust)

* No data reported for these agents in most recent provisional data.
** See Selected Limitations section.
The following documents were reviewed to identify pneumoconiotic agents: ACGIH® *Documentation of TLV*®s, 6th edition; *Occupational Respiratory Diseases Report*, NIOSH Pub. No. 86-102; *The NIOSH Pocket Guide to Chemical Hazards*, NIOSH Pub No. 97-140; and NIOSH Criteria Documents.

Table F-2. MSHA analytical methods for selected pneumoconiotic agents

Pneumoconiotic Agent Category (as defined for this report)	MSHA Agents in Category	MSHA Analytical Method
Asbestos	Asbestos, fibers > 5 µm in length ($3MgO{\cdot}2SiO_2{\cdot}2H_2O$)	NIOSH 7400
Coal Mine Dust	Respirable coal mine dust, <= 5% quartz	NIOSH 7603/MSHA P7
Quartz	Respirable coal mine dust, > 5% quartz Respirable dust, > 1% quartz Nuisance dust (respirable fraction), < 1% quartz Unlisted particulate (respirable fraction), < 1% quartz Respirable dust (not analyzed or below detection limit)	MSHA coal: MSHA P7/NIOSH 7300 MSHA metal/nonmetal: MSHA P2/NIOSH 7500
Selected Pneumoconiotic Agents	Aluminum oxide dust (as Al_2O_3) Aluminum oxide fume (as Al_2O_3) Beryllium dusts (as Be) Beryllium fumes (as Be) Cobalt dusts (as Co) Cobalt fumes (as Co) Iron oxide fume (as Fe_2O_3) Titanium dioxide dust (as TiO_2) Titanium dioxide fume (as TiO_2)	OSHA 121/125
	Cristobalite (respirable fraction)	MSHA P2/NIOSH 7500
	Welding fumes (total dust)	OSHA 121/125
	Talc, nonfibrous, < 1% quartz	NIOSH 0600 (gravimetric)/MSHA P8 (impinger)

Table F-3. Most commonly used OSHA analytical methods for selected pneumoconiotic agents

Pneumoconiotic Agent Category (as defined for this report)	**OSHA Agents in Category**	**OSHA Compliance Analytical Method** (SLCTC)	**OSHA Consultation Analytical Method** (WOHL)
Asbestos	Asbestos [actinolite, anthophyllite, chrysotile, crocidolite, tremolite] Talc containing fibrous tremolite	ID-160	WOHL method (based on NIOSH 7400 and OSHA ID-160)
Cotton Dust	Cotton dust (raw)	1910.1043 - Appendix A; SOP for nuisance dust	WW001.6.0 (5um PVC filter)
Quartz	Respirable crystalline silica (as quartz) Respirable crystalline silica/tripoli (as quartz) Respirable coal dust, > 5% quartz	ID-142	WOHL method (based on NIOSH 7500 and OSHA ID-142)
Selected Pneumoconiotic Agents	Alpha-alumina (total dust) Aluminum oxide Antimony and compounds (as Sb) Beryllium and compounds (as Be) Cobalt, metal, fume and dust (as Co) Iron oxide fume (as Fe) Tin (Inorganic Compounds, Except oxide as Sn)	ID-125G	WW001.3.1
	Silica, respirable crystalline cristobalite	ID-142	WOHL method (based on NIOSH 7500 and OSHA ID-142)
	Carbon black	ID-196	WC019cb.4.0
	Welding fumes (total particulate)	SOP for nuisance dust	WW001.6.0 (5um PVC filter)

SLCTC - Salt Lake City Technical Center WOHL - Wisconsin Occupational Health Laboratory

Appendix G
Surveillance Guidelines for State Health Departments

Silicosis

Reporting Guidelines

State health departments should encourage physicians, including radiologists and pathologists, as well as other health-care professionals, to report all diagnosed or suspected cases of silicosis. These reports should include persons with:

A. A physician's provisional or working diagnosis of silicosis.
OR
B. A chest radiograph interpreted as consistent with silicosis.
OR
C. Pathologic findings consistent with silicosis.

State health departments should collect appropriate clinical, epidemiologic, and workplace information on reported persons with silicosis as needed to set priorities for workplace investigations.

Surveillance Case Definition

A. History of occupational exposure to airborne silica dust.*****
AND EITHER OR BOTH OF THE FOLLOWING:
B1. Chest radiograph or other imaging technique interpreted as consistent with silicosis.[+]
B2. Pathologic findings characteristic of silicosis.[§]

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* Exposure settings associated with silicosis are well characterized and have been summarized in several reviews. The induction period between initial silica exposure and development of radiographically detectable nodular silicosis is usually >10 years. Shorter induction periods are associated with heavy exposures, and acute silicosis may develop within months following massive silica exposure.

\+ Cases can be classified as nodular or acute. Common radiographic findings of nodular silicosis include multiple, bilateral, and rounded opacities in the upper lung zones; other patterns have been described. Since patients may have mixed dust exposure, irregular opacities may be present or even predominant. To be considered consistent with silicosis, radiographs of nodular silicosis classified by NIOSH-certified "B" readers should have small opacity profusion categories of 1/0 or greater by the International Labour Organization classification system. If the largest opacity is >1 cm in diameter, progressive massive fibrosis [PMF] (also known as 'complicated' silicosis) is present. A bilateral alveolar filling pattern is characteristic of acute silicosis and may be followed by rapid development of bilateral small or large opacities.

§ Characteristic lung tissue pathology in nodular silicosis consists of fibrotic nodules with concentric "onion-skinned" arrangement of collagen fibers, central hyalinization, and a cellular peripheral zone, with lightly birefringent particles seen under polarized light. In acute silicosis, microscopic pathology shows a periodic acid-Schiff positive alveolar exudate (alveolar lipoproteinosis) and a cellular infiltrate in the alveolar walls.

Work-Related Asthma

Reporting Guidelines

State health departments should encourage health-care professionals to report all diagnosed or suspected cases of asthma that are caused by or exacerbated by workplace exposures or conditions. Reported cases should include asthma caused by sensitizers or irritants and should include cases of reactive airways dysfunction syndrome (RADS).

Surveillance Case Definition

A. Healthcare professional's diagnosis consistent with asthma.*****

AND

B. An association between symptoms of asthma and work.[+]

Surveillance Case Classification Criteria (see next page)

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* Asthma is a chronic condition characterized by inflammation of the tracheobronchial tree associated with increased airways responsiveness to a variety of stimuli. Symptoms of asthma include episodic wheezing, chest tightness, cough, and dyspnea, or recurrent attacks of bronchitis with cough and sputum production. The primary physiologic manifestation of airways hyperresponsiveness is variable or reversible airflow obstruction. It is commonly demonstrated by significant changes in the forced expiratory volume in 1 second (FEV_1) or peak expiratory flow rate (PEFR). Airflow changes can occur spontaneously, with treatment, with a precipitating exposure, or with diagnostic maneuvers such as nonspecific inhalation challenge.

\+ Patterns of association can vary and include: (1) symptoms of asthma that develop or worsen after a worker starts a new job or after new materials are introduced on a job (a substantial period can elapse between initial exposure and development of symptoms); (2) symptoms that develop within minutes of specific activities or exposures at work; (3) delayed symptoms that occur several hours after exposure (e.g., during the evenings of workdays); (4) symptoms that occur less frequently or not at all on days away from work and on vacations; (5) symptoms that occur more frequently when the affected worker returns to work; and (6) symptoms that are temporally associated with workplace exposure to an agent with irritant properties. Work-related changes in medication requirements can accompany these symptom patterns.

Work-Related Asthma (continued)

Surveillance Case Classification Criteria (see decision logic on next page)

C1) Increased asthma symptoms or increased use of asthma medication (upon entering an occupational exposure setting) experienced by a person with preexisting asthma who was symptomatic or treated with asthma medication within the two years prior to entering that occupational setting.

C2) New asthma symptoms that develop within 24 hours after a one-time high-level inhalation exposure (at work) to an irritant gas, fume, smoke, or vapor and that persist for at least three months.

C3) Workplace exposure to an agent previously associated with occupational asthma.*****

C4) Work-related changes in serially measured forced expiratory volume in one second (FEV_1) or peak expiratory flow rate (PEFR).+

C5) Work-related changes in bronchial responsiveness as measured by serial nonspecific inhalation challenge testing.§

C6) Positive response to specific inhalation challenge testing¶ with an agent to which the patient has been exposed at work.

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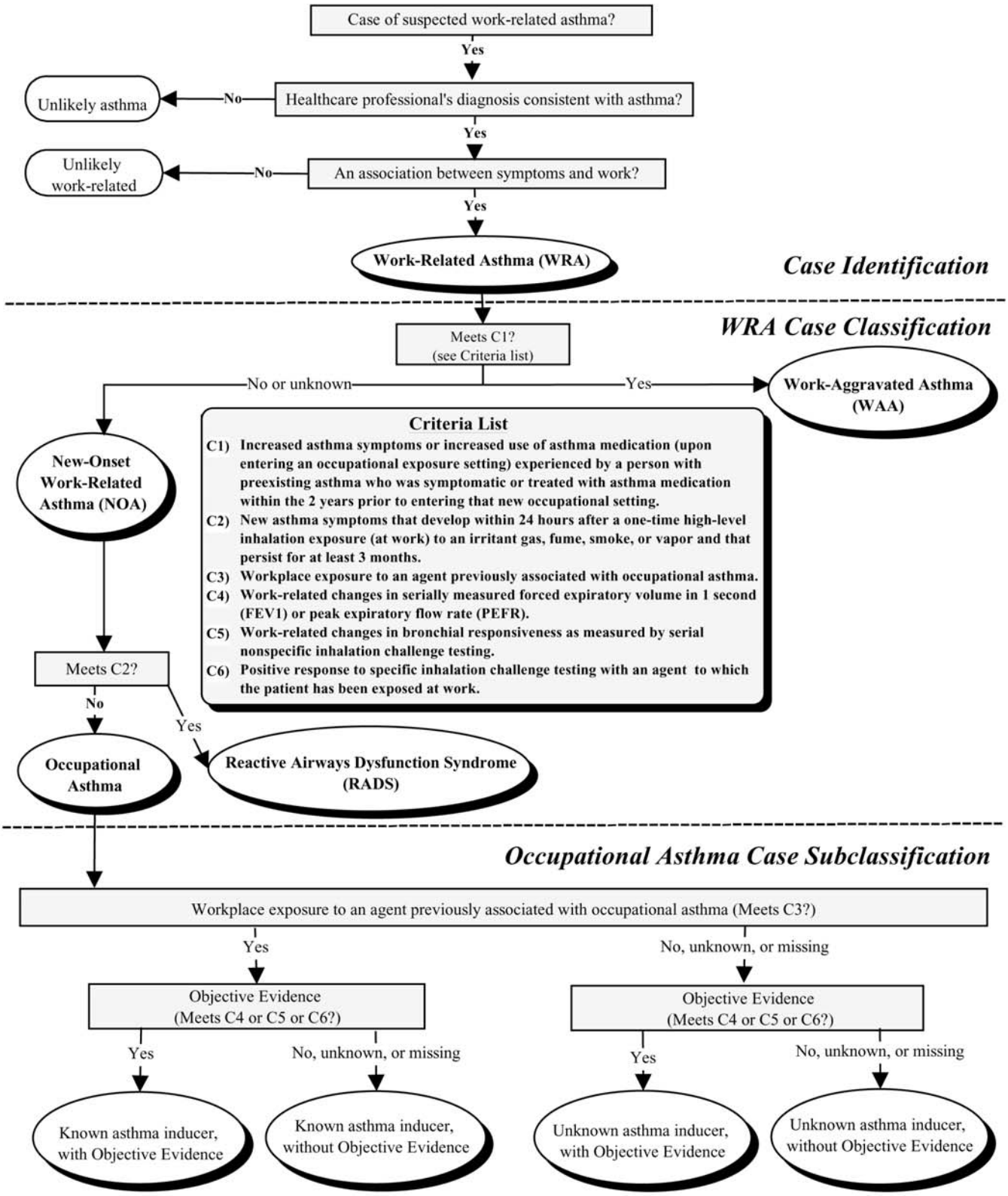
* Many agents can induce occupational asthma via a specific hypersensitivity mechanism. A comprehensive list of these asthma inducers is used for this criterion. Known asthma inducers have been designated with the letter "A" in the Association of Occupational and Environmental Clinics (AOEC) coding scheme (www.aoec.org/aoeccode.htm).

\+ Spirometric measurements (e.g., FEV_1) can be obtained before and after a person's work shift (i.e., cross-shift spirometry). However, many cases of occupational asthma can fail to demonstrate a significant cross-shift reduction in FEV_1, either because of a delayed bronchoconstrictor response or because of intermittent exposure patterns. Cross-shift spirometry testing on multiple days might help confirm the association with work. Alternatively, PEFR can be measured serially throughout the day on multiple days at and away from work using a portable peak flow meter.

§ Changes in bronchial responsiveness can be measured by serial inhalation challenge testing with nonspecific agents (e.g., using methacholine or histamine). Evidence of work-relatedness is manifested by increased bronchial responsiveness (i.e., bronchoconstriction at lower inhaled doses of methacholine or histamine) following work exposures and decreased or normal bronchial responsiveness after a period away from work.

¶ Specific inhalation challenge testing has distinct objectives, including the following: (1) identifying previously unrecognized causes of occupational asthma; (2) confirming a diagnosis of occupational asthma; and (3) identifying the causative agent when more than one allergen is present in the occupational environment and identification of the causative agent is essential for management. Specific inhalation challenge testing is potentially dangerous and should be performed by experienced personnel in a hospital setting where resuscitation facilities are available and frequent observations can be made over sufficient time to monitor for delayed reactions. Specific inhalation challenge testing is usually not necessary for clinical diagnosis of occupational asthma.

Decision Logic for Work-Related Asthma



Appendix H

Split, Merged, or Renamed Counties and County Equivalents

State	Subdivision	County Representation in this Report		
		Same*	Other	
Alaska	Aleutian Islands	-	Aleutians East Borough	1968-1993
	Aleutians West Census Area	1994-1999	**	**
	Anchorage District	-	Anchorage Borough	1968-1981
	Bethel District	-	Bethel Census Area	1968-1981
	Kuskokwim District	-		1968-1981
	Bristol Bay Division	-	Bristol Bay Borough	1968-1981
	Dillingham Census Area	1982-1999		1968-1981
	Lake and Peninsula Borough	1994-1999	Dillingham Census Area	1982-1993
	Southeast Fairbanks Census Area	1982-1999	Fairbanks North Star Borough	1968-1981
	Fairbanks District	-		1968-1981
	Juneau District	-	Juneau Borough	1968-1981
	Kenai-Cook Inlet District	-	Kenai Peninsula Borough	1968-1981
	Seward District	-		1968-1981
	Ketchikan District	-	Ketchikan Gateway Borough	1968-1981
	Kodiak District	-	Kodiak Island Borough	1968-1981
	Palmer-Wasilla District	-	Matanuska-Susitna Borough	1968-1981
	Nome District	-	Nome Census Area	1968-1981
	Barrow District	-	North Slope Borough	1968-1981
	Kobuk District	-	Northwest Arctic Borough	1968-1981
	Kobuk Borough	-		1982-1993
	Outer Ketchikan District	-	Prince of Wales-Outer Ketchikan Census Area	1968-1981
	Prince of Wales District	-		1968-1981
	Sitka District	-	Sitka Borough	1968-1981
	Haines Borough	1982-1999	Skagway-Yakutat-Angoon Census Area	1968-1981
	Lynn Canal-Icy District	-		1968-1981
	Skagway-Yakutat District	-		1968-1981
	Skagway-Hoonah-Angoon Census Area	-		1994-1999
	Yakutat Census Area	-		1994-1999
	Cordova-McCarthy District	-	Valdez-Cordova Census Area	1968-1981
	Valdez-Chitina-Whittier District	-		1968-1981
	Wade Hampton District	-	Wade Hampton Census Area	1968-1981
	Wrangell District	-	Wrangell-Petersburg Census Area	1968-1981
	Upper Yukon District	-	Yukon-Koyukuk Census Area	1968-1981
	Yukon-Koyukuk District	-		1968-1981
	Denali Borough	-		1994-1999
Arizona	La Paz County	1994-1999	Yuma County	1968-1993
Hawaii	Kalawao County	1982-1999	Maui County	1968-1981
New Mexico	Cibola County	1982-1999	Valencia County	1968-1981
New York	Bronx Borough	-	Bronx County	1968-1981
	Brooklyn Borough	-	Kings County	1968-1981
	Manhattan Borough	-	New York County	1968-1981
	Queens Borough	-	Queens County	1968-1981
	Staten Island Borough	-	Richmond County	1968-1981
South Dakota	Washabaugh County	-	Jackson County	1968-1979
Virginia	Waynesboro City	1970-1999	Augusta County	1968-1969
	Portsmouth City	1970-1999	Chesapeake City	1968-1969
	Virginia Beach City	1970-1999		1968-1969
	Winchester City	1970-1999	Frederick County	1968-1969
	South Boston City	1968-1995	Halifax County	1996-1999
	Williamsburg City	1970-1999	James City County	1968-1969
	Manassas City	1982-1999	Prince William County	1968-1981
	Manassas Park City	1982-1999		1968-1981
	Nansemond County	-	Suffolk City	1968-1974
	Nansemond City	-		1970-1981
	Poquoson City	1982-1999	York County	1968-1981

- indicates subdivisions that no longer existed as of the 1990 Census, or were renamed or split after the 1990 Census.
* During the indicated years, population and mortality data are assigned to the subdivision itself.
** All data from Aleutian Islands (1968-1993) were assigned to Aleutians East Borough.
NOTE: The primary political divisions of most states are termed counties. Prior to 1982, Alaskan county equivalents were called districts, divisions, or islands. Since 1982, Alaskan county equivalents were reclassified as boroughs or census areas. Virginia has many county-equivalent cities that are or were independent of any county organization.