



What Physicians Need to Know About Occupational Silicosis and Silica Exposure Sources

Division of Environmental and Occupational Health

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Certain Workers Are At Risk of Developing Silicosis

Crystalline silica is found in many common materials, such as those listed in the box to the right. When these materials are made into a fine dust in work activities such as those listed in the box on page 2, the inhalation and deposition of these fine particles can produce silicosis over time.

Workers in many industries and occupations are at risk, including:

- Construction, especially bridge, tunnel, and elevated highway
- Wrecking and demolition
- Concrete work
- Surface mining and quarrying
- Underground mining
- Stone cutting
- Milling stone
- Agriculture
- Foundry
- Ceramics, clay, pottery
- Vitreous enameling of china plumbing fixtures
- Glass manufacturing
- Manufacturing of concrete products and brick
- Manufacturing of soaps and detergents
- Shipyards, railroads

Other employees who do not work directly with materials containing silica may be exposed as *bystanders* if they are in the area when crystalline silica containing materials are being used.

Materials Containing Crystalline Silica

- Granite and marble
- Quartz and quartzite
- Sand, gravel, and sandstone
- Slate and Traprock
- Many abrasives used for abrasive blasting
- Concrete, concrete block, cement
- Brick and refractory brick
- Mortar
- Gunitite
- Soil, especially sandy soil
- Asphalt containing rock or stone



Silica dust exposure to worker jack hammering concrete pavement to weaken bridge for demolition.

Definition and Clinical Features

Silicosis is a diffuse, nodular, interstitial pulmonary fibrosis caused by a tissue reaction to inhaled crystalline silica dust. It can take the **acute** form under conditions of intense exposure but usually takes the **chronic** form, requiring several to many years to develop. People who have silicosis have increased susceptibility to infections such as tuberculosis, complicating the patient's prognosis. There is also increasing evidence that crystalline silica causes cancer and that individuals with silicosis are at increased risk of developing lung cancer.

Except in its acute form, silicosis begins with few, if any, symptoms. When clinical symptoms of silicosis are present, they could include cough and shortness of breath of increasing severity. On physical examination, breath sounds may be normal or distant and, with increased severity, there may be signs of right heart failure. Evidence of pathological response to silica exposure exists well before symptoms occur.

Chronic reactions, occurring after 10 or more years from first exposure, involve nodular lesions, (bilateral, multiple, rounded opacities) often more prominent in the upper lobes. In this **simple** stage of silicosis, nodules are usually small (1 cm or less). There may be little effect on pulmonary function at this stage.

Work Activities Associated With Silica Exposure

- Drilling, cutting, sawing, grinding, chipping, jack hammering
- Crushing, screening, sorting
- Loading, hauling, dumping, bagging
- Dry sweeping or pressurized air blowing
- Abrasive blasting
- Clean-up/maintenance



Construction worker exposure to silica dust during interstate highway repair.

Complicated silicosis or progressive massive fibrosis (PMF) also usually develops in the upper lobes but the nodules go on to consolidate and exceed 1 cm and encompass blood vessels and airways. Lung function may be severely compromised, often with a mixed restrictive/obstructive pattern, but either pure restriction or obstruction may be seen.

Clinical Signs of Silicosis

Simple

- mild restrictive and/or obstructive defects
- small, rounded opacities on x-ray

Accelerated

- diffuse, small rounded opacities on x-ray
- more severe restrictive and/or obstructive defects

Advanced

- increased profusion of small opacities and development of large opacities on x-ray
- more severe restrictive and/or obstructive defects
- cor pulmonale

Acute

- diffuse perihilar alveolar filling process with ground glass opacities on x-ray

Acute reactions may appear within a few weeks to two years after the onset of massive exposure. The distinguishing feature of acute silicosis is intraalveolar deposits, similar to those seen with alveolar proteinosis. In contrast to the nodular fibrosis seen in the chronic form, diffuse interstitial fibrosis is not found. Silicosis developing in less than 10 years, the **accelerated** form, has been described most often in sandblasters. In these cases, diffuse fibrosis is likely to develop and may be located throughout all lobes of the lung.

Progression of disease and radiographic findings can continue even after exposure has ended.

Recommended Medical Surveillance

The following are recommended by the New Jersey Department of Health and Senior Services as a baseline before exposure, then periodically as noted:

1. Occupational history to determine years of exposure -- update annually. Inquire about the materials used, tasks performed, occupations, and industries in which employed, including those listed in the boxes on pages 1 and 2.

2. Medical exam emphasizing the respiratory system -- annually.

3. Chest x-ray to look for evidence of abnormality. Posteroanterior 14" x 17" or 14" x 14", classified according to the 1980 *Guidelines for the Use of ILO International Classification of Radiographs of Pneumococcosis* by a certified class "B" reader, is recommended. The ILO system has the distinct advantage of a standardized set of comparison x-ray films. Names of B-readers are available from NIOSH. Information on how to contact NIOSH is given at the end of this bulletin. The above box gives recommendations for the frequency of x-rays. **NOTE** the potential for excessive x-rays if the employee has also worked with asbestos or other hazards for which OSHA may require employers to provide x-rays.

4. Pulmonary Function Tests (PFT) to look for evidence of respiratory impairment. Should include FEV1 (forced expiratory volume in 1 second), FVC (forced vital capacity), and DLCO (diffusion capacity of the lungs) -- annually. All PFT should use equipment and follow recommendations issued by the ATS (American Thoracic Society) and be administered by a technician who has successfully completed NIOSH-certified training.

5. A baseline PPD skin test for tuberculosis because people who have silicosis have increased susceptibility. Repeat annually if there is x-ray evidence of silicosis (1/0 or greater profusion category using the ILO classification) or 25 years or longer exposure.

Frequency of Chest X-rays for Silicosis

- Every 3-5 years with normal x-ray, low exposure, and less than 20 years exposure.
- Every 1-3 years with normal x-ray, high exposure, or greater than 20 years exposure.
- Annually with x-ray evidence of silicosis (ILO 1/0 or greater or ILO results A, B, or C large opacities), massive exposure, or positive PPD test.
- See **NOTE** in item 3.

Reporting Guidelines

Physicians, radiologists, pathologists and other health care professionals should report cases of silicosis to the health department in their state so that it can be determined whether silica exposures are being controlled at the workplaces where the patient has been employed. **Such reporting is mandatory in many states, including New Jersey. In NJ, call 800-772-0062 to report cases or for reporting forms.**

If the state has no occupational health program, cases of concern should be discussed with NIOSH (National Institute for Occupational Safety and Health) or the local OSHA (Occupational Safety and Health Administration) or MSHA (Mine Safety and Health Administration) office. Information on how to contact these agencies is given at the end of this bulletin.

The following elements define a case of silicosis for reporting purposes:

- A physician's provisional or working diagnosis of silicosis, **OR**
- Chest x-ray or other imaging technique interpreted as consistent with silicosis, **OR**
- Pathologic findings consistent with silicosis.

Because silicosis is sometimes confused with sarcoidosis, asbestosis, coal miner's pneumoconiosis, or other pneumoconiosis it is important that all chest x-rays be reviewed by a B-reader.

Medical Management of Silicosis

There is no known medical treatment to reverse silicosis, therefore prevention is critically important. Removal from exposure may decrease the rate of disease progression. Corticosteroids are not useful to reduce the progression of the disease. Appropriate treatment for heart failure and tuberculosis should be begun if these complications exist. All individuals should be strongly advised to stop smoking and offered smoking cessation information and support. Regular follow-up exams to assess progression and possibly to screen for lung cancer should be scheduled. Individuals who develop silicosis should be given the option of transfer to silica-free jobs. In order for this to be a realistic alternative, the individual should be able to maintain the same rate of pay and benefits without loss of seniority.

For Additional Information

NIOSH: e-mail -- pubstaft@niosdt1.em.cdc.gov.

1-800-35-NIOSH (1-800-356-4674) or 513-533-8328, fax 513-533-8573,

Internet site -- <http://www.cdc.gov/niosh/silicpag.html>

- CDC/NIOSH Alert, **Request for Assistance in Preventing Silicosis and Deaths in Rock Drillers**, DHHS (NIOSH) Publication No. 92-107, August 1992.
- CDC/NIOSH Alert, **Request for Assistance in Preventing Silicosis and Death in Construction Workers**, DHSS (NIOSH) Publication No. 96-112, May 1996.
- CDC/NIOSH Alert, **Request for Assistance in Preventing Silicosis and Deaths from Sandblasting**, DHHS (NIOSH) Publication No. 92-102, August 1992.
- Lists of certified B-readers by state, approved pulmonary function technician courses, state health department contacts for reporting purposes.

MSHA: Call headquarters for the number of your local office: **703-235-8307**

Internet site -- <http://www.msha.gov> has a directory of all offices.

OSHA: Internet site -- <http://www.osha.gov> has a directory of all offices. Or, call the national office for the number of your local office: **202-219-8151**.

ATS (American Thoracic Society): Adverse Effects of Crystalline Silica Exposure. *American Journal Respiratory and Critical Care Medicine*, 1997; 155:761-765. Standardization of Spirometry - 1994 update. *American Journal Respiratory and Critical Care Medicine*, 1995; 152: 1107-1136.