

Silica Exposure, Silicosis, and the New Occupational Safety and Health Administration Silica Standard

What Pulmonologists Need to Know

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Silicosis, a progressive fibrotic lung disease caused by inhalation of respirable crystalline silica particles, remains an important and preventable occupational lung disease in the United States and worldwide (1, 2). In this month's issue of the *AnnalsATS*, Reilly and colleagues (pp. 1404–1410) present data from the State of Michigan's occupational health surveillance program on more than 1,000 confirmed cases of silicosis from 1988 to 2016 (3). The findings presented highlight several important features regarding silicosis in the United States, as well as the new 2016 Occupational Safety and Health Administration (OSHA) silica standard and the need for pulmonologists to be knowledgeable about the risks of silica exposure and silica-related lung diseases. The majority of silicosis cases reported had more advanced disease: 22% had progressive massive fibrosis on imaging, 17% reported ever having tuberculosis, and 76% of ever- and 72% of never-smokers had either a restrictive or obstructive pattern on spirometry.

Yet most (65%) had not applied for workers' compensation, and of those confirmed cases that died during the study period, only 8% of the death certificates

recorded a diagnosis of silicosis, suggesting substantial underrecognition of the disease. Further, over time, the fraction of confirmed cases that applied for workers' compensation and had death certificate documentation of the disease both declined, suggesting even greater underrecognition in most recent years (3). This may reflect clinicians' decreased awareness of the risks of silica exposure and limited attention to the patient's occupational and environmental history.

Reilly and colleagues also highlight the changing work settings in which silica exposures and risks increasingly exist (3). Although overall silicosis incidence rates in Michigan have fallen over time, more recently diagnosed cases were more likely to be related to construction and mining, rather than manufacturing. Worldwide, construction, demolition, and renovation workers, including road and tunnel workers, are the largest occupational group exposed to silica (4). Compared with manufacturing, construction work settings pose unique challenges in terms of controlling silica exposures and surveilling exposed workers, and thus, they are the focus of the new OSHA silica standard. Also relevant to the new OSHA standard was the finding that the majority of workplaces inspected (34/55; 62%) had silica exposures above the new OSHA 50 $\mu\text{g}/\text{m}^3$ permissible exposure limit, and only 11% of inspected companies screened their workers for silicosis (3).

Beyond Michigan, silicosis and other silica-related lung diseases continue to occur throughout the United States and worldwide. Crystalline silica is contained in rocks, sand, and soil, and any activities that generate respirable size particles, such as cutting, drilling, sandblasting,

manufacturing, or producing objects that contain crystalline silica can lead to silica exposure. In addition to construction workers, industries with potential for high silica exposures include mining, quarrying, sandblasting, foundries, glass, and other manufacturing processes (1, 5). The resurgence of high rates of severely debilitating lung disease in coal workers is associated with exposure to coal mine dust with high concentrations of silica (6, 7). In addition, outbreaks of silicosis have recently occurred in newer industries, such as the production of engineered stone countertops, worn denim jeans, and oil from hydraulic fracturing (fracking) (8–10).

In the United States, it is estimated that 1–2% of workers (>2 million workers), are exposed to respirable silica, most in construction trades, including new construction, demolition, renovation work, and road and tunnel construction (11). Such workers are also frequently exposed to other respirable hazards such as mineral dusts, fumes, gases, and particulates. Substantial knowledge exists on how to control these exposures, including substitution, engineering controls, wet dust suppression, and the use of personal protective equipment (respirators) for short duration tasks (1, 11). However, as documented by Reilly and colleagues, despite this knowledge and existing OSHA regulations, respirable silica exposures and silica-related diseases have persisted (3).

In addition to silicosis, silica exposure increases the risk for chronic obstructive pulmonary disease (COPD), regardless of smoking history, as well as the risk for tuberculosis, renal disease, autoimmune disease, and lung cancer (1, 11). Respirable

crystalline silica is a known human carcinogen (1, 11, 12).

The diagnosis of silicosis can usually be made on the basis of the patient's clinical presentation, occupational history, and typical chest radiological findings. Spirometry can be normal or show an obstructive or restrictive pattern. Occupational COPD can exist without silicosis findings on chest imaging (13, 14). A thorough occupational history, high level of suspicion, and knowledge about the spectrum of silica-associated diseases are essential for diagnosis. Physicians may be unaware of their patient's silica exposure, as occupational and environmental exposure histories are not routinely obtained (3), and silicosis has been misdiagnosed as idiopathic pulmonary fibrosis (15).

In June 2018, OSHA implemented the new silica standard, which lowers the permissible exposure limit for occupational respirable silica exposure from 100 $\mu\text{g}/\text{m}^3$ to 50 $\mu\text{g}/\text{m}^3$, and also for the first time mandates medical surveillance of

workers with exposures above the permissible exposure limit (16). Surveillance should include a medical examination and occupational questionnaire, chest radiograph with B read interpretation, tuberculosis screening, and spirometry, with referral of affected workers to a pulmonologist or occupational medicine physician for further evaluation of possible silica-related respiratory disease (16).

The new OSHA silica standard is anticipated to identify cases of silicosis earlier and, over time, reduce silica-related mortality (16). If appropriately implemented, pulmonologists and other clinicians throughout the United States will likely be seeing more patients referred with silica exposure and concern for silicosis. Pulmonologists should familiarize themselves with the new OSHA silica standard, how to assess occupational silica exposures, and recognize and manage silicosis and other silica-related diseases, such as COPD, tuberculosis, and rheumatological conditions. In addition

to the care of the individual patient, pulmonologists should also become familiar with related socioeconomic and public health issues, including the workers' compensation statutes and occupational health surveillance reporting requirements in their state. Such systems typically use a more probable than not degree of diagnostic certainty (greater than 50% likelihood) that work exposures contributed to the patient's lung disease, and are essential to both patient care and monitoring the effectiveness of controls to reduce silica exposures.

Reilly and colleagues remind us that although silicosis rates have declined, silicosis persists in the United States. Under the new OSHA silica standard, pulmonologists and clinicians will likely play a greater role in the recognition and management of silica-related lung diseases. ■

Author disclosures are available with the text of this article at www.atsjournals.org.

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