EDITORIAL

Engineered Stone–Associated Silicosis—A Lethal Variant of an Ancient Disease

Jeremy T. Hua, MD, MPH; Cecile S. Rose, MD, MPH; Carrie A. Redlich, MD, MPH

Silicosis is a progressive and irreversible chronic lung disease caused by inhalation of respirable crystalline silica. Although one of the oldest recognized occupational diseases and fully preventable, silicosis is not a disease of the past. Silicosis remains an important cause of chronic respiratory disease worldwide. Silica is one of the most abundant natural minerals, and inhalation of respirable crystalline silica (hereafter "silica") can occur in a wide range of industries, including construction, mining, quarrying, manufacturing, and the production and finishing of stone products, such as kitchen and bathroom countertops.

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Engineered stone (also known as artificial or synthetic stone, quartz agglomerate, quartz, or by specific trade names) is an alternative to natural stone and synthetic countertops that is growing in popularity. Over the past decade, outbreaks of severe silicosis have been reported in a number of high-income countries among workers who produce, cut, grind, polish, and install countertops made of engineered stone.[1-3] Engineered stone, a hard composite material produced by binding high silica-content crushed stone with resins and pigments, typically contains over 90% silica, a much higher silica content than natural stone, such as marble (less than 5%) or granite (less than 40%).

Despite the rapid growth in demand for engineered stone countertops, published reports of silicosis cases from the US have been limited.[3] Most clinicians, workers, and consumers are unaware of the serious hazards related to engineered stone. In this issue of *JAMA Internal Medicine*, Fazio and colleagues[4] report a California-based case series of 52 engineered stone countertop fabricators with recently diagnosed silicosis. Eight of the cases have been reported previously.[3,5] This large case series raises far-reaching concerns about the use of engineered stone products and the effectiveness of regulatory efforts to prevent silicosis.

Similar to previous reports of silicosis in engineered stone workers,[1,3,6] the patients in the study by Fazio et al[4] were relatively young (median age, 45 years), and many had severe disease. Twenty patients (38%) had advanced silicosis (progressive massive fibrosis with moderate to severely reduced lung function) despite a median of only 15 years of exposure. Ten (19%) had died at the time of the report. Such severe disease in younger workers is rarely seen with "traditional" silicosis in other industries, such as construction and quarrying.

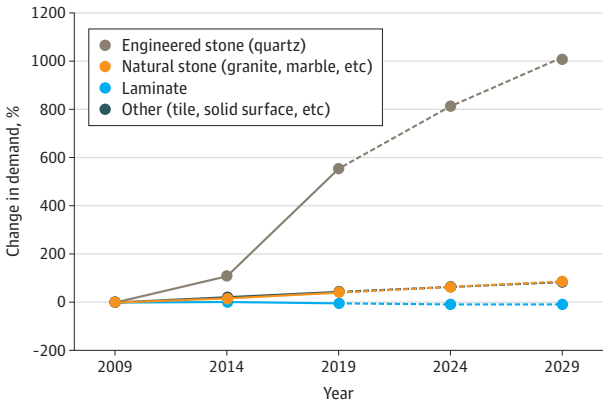
The case series[4] also highlights the challenges in diagnosing engineered stone–associated silicosis, particularly without an occupational history. It is troubling that diagnosis was frequently delayed. Over half the cases were initially diagnosed with other diseases, most commonly with pneumonia or mycobacterial lung infections, diseases that are causally linked to silicosis. Similar to other reports,[2,6] autoimmune disease (12%) and autoimmune serologies (antinuclear antibody, 58%; rheumatoid factor, 25%) were common, and they may have contributed to delays in reaching the diagnosis. Chest computed tomography scan findings showed diverse patterns, with a high prevalence of mediastinal/hilar adenopathy (over 80%) and ground glass opacities (37%). The variable chest imaging reflects the broad spectrum of engineered stone–associated silicosis (including simple silicosis, progressive massive fibrosis, and acute silico-proteinosis), further adding to the challenge of diagnosis. The delays in diagnosis also likely reflect limited clinician awareness of occupational diseases, as well as limited job information in most medical records. Although work is a key social determinant of health, patients are rarely asked about their employment histories.

The findings of Fazio et al[4] prompt several key questions. How many undiagnosed cases are there among the approximately 100 000 engineered stone workers in over 8600 fabrication establishments across the US?[3] What is the prognosis for these workers? What is the most effective way to address this resurgence of severe silicosis?

Answering these questions is particularly urgent because engineered stone countertops have skyrocketed in popularity in the US (**Figure**).[7] Industry experts anticipate that engineered stone products will overtake all other countertop options by 2024, a remarkable increase for a product that had a less than 5% share of the US market just 15 years ago.[7] This shift is due to interrelated factors: a more durable, stain resistant product; an endless choice of shapes, colors, and patterns; declining prices as manufacturing expands in lower-income countries; and limited government oversight.

The best prevalence data for engineered stone silicosis come from Australia. Following alarming outbreaks of severe silicosis similar to the cases reported by Fazio et al,[4] the Australian states of Victoria and Queensland implemented mandatory medical surveillance for engineered stone workers.[8] At present, nearly 25% of over 1800 engineered stone workers in Australia who have undergone surveillance have been found to have silicosis, and about 15% of those with silicosis have had progressive massive fibrosis.[8] Although a smaller fraction (15%) had advanced disease compared with the cases reported by Fazio et al (38%),[4] these surveillance findings are disturbing. Since silicosis can progress after the exposure is eliminated, and given the relatively young ages of the workers, both the lifetime

Figure. Change in US Countertop Demand by Surface Material (Compared With 2009 Demand Levels)



Current and projected US countertop demands were calculated based on publicly available countertop sales information from the Freedonia Group,[7] based on square footage of annual countertop sales. The dashed lines represent projected change in demand.

prevalence of the disease and its severity are likely to further increase over time.

Surveillance data from the US are more limited. Unlike Australia, there is no systematic medical surveillance of engineered stone workers, despite the more stringent and comprehensive regulations that the Occupational Safety and Health Administration issued in 2016 to prevent silicosis. These updated silica standards for general industry and construction (29 CFR §1910.1053; 29 CFR §1926.1153) lowered the permissible exposure limit for silica and require employers to provide preemployment and periodic medical surveillance of silica-exposed workers.

The report from Fazio et al[4] provides insights into the challenges of enforcing government silica standards, including medical surveillance for engineered stone workers. The reported cases were almost entirely among Latino immigrants, the majority of whom were uninsured or underinsured and may have had undocumented immigration status. Across the US, more hazardous jobs are frequently performed by immigrant and other vulnerable workers with limited access to medical care and job protections. Many are hired as independent contractors, an employment status that can circumvent employer responsibilities for medical insurance, workplace protections, surveillance, and workers' compensation.

Unlike most states, California has both a strong Department of Public Health and an active Occupational Health Branch with access to multiple information sources, including direct clinician reporting, hospital discharge data, and workplace referral. California is also one of the few states that provides medical insurance for undocumented immigrants. Further, over 70% of the cases in the report by Fazio et al[4] were from Los Angeles County, and the majority were identified by a single astute pulmonary clinician at 1 safety net hospital, with only 8 (15%) identified through workplace medical surveillance. This unique constellation of resources and circumstances facilitated the diagnosis and reporting of these 52 cases of silicosis. Most other US states lack comparable resources, and there is no national reporting system for occupational diseases, including silicosis.

Silicosis is an entirely preventable disease. The large number of cases reported by Fazio et al,[4] in conjunction with other reports documenting severe disease and high silica exposures in the engineered stone industry,[9] demonstrate the inadequacy of current efforts to control silica exposures and protect engineered stone workers. In addition to the high levels of silica dust generated from engineered stone, there may be toxicity related to characteristics of the inhaled dust, such as particle size or composition. Workplace engineering controls and dust suppression methods can reduce airborne silica exposures, along with properly selected and fit-tested respirators. However, there are multiple challenges to implementing such approaches.[4] In the case series, many patients worked in shops with fewer than 10 employees, which is common in the industry. Exposure controls are particularly challenging to implement and monitor in small establishments. In addition, the Occupational Safety and Health Administration is severely underresourced, limiting workplace inspections and enforcement. Current efforts to protect workers from engineered stone–associated silicosis are inadequate.

In addition to primary prevention, there is an urgent need for widespread and systematic medical surveillance of stone fabrication workers, in conjunction with national and state reporting of cases, and appropriate medical care for those identified with disease. Along with increasing awareness among clinicians of this emerging threat, consumers should be informed and aware of the risks that may be inherent in their choice of interior design products. If efforts focused on silica dust control at the workplace and medical surveillance are inadequate in preventing silicosis, elimination of hazardous products and substitution of safer alternatives are the most effective ways to protect workers. In the absence of enhanced primary prevention and medical surveillance, astute clinicians remain the most important resource for vulnerable workers to obtain a correct diagnosis and to receive appropriate medical care.

ARTICLE INFORMATION

Author Affiliations: Division of Environmental and Occupational Health Sciences, National Jewish Health, Denver, Colorado (Hua, Rose); Department of Environmental & Occupational Health, Colorado School of Public Health, Aurora (Hua, Rose); Department of Medicine, Yale Occupational and Environmental Medicine Program, Yale School of Medicine, New Haven, Connecticut (Redlich).

Corresponding Author: Carrie A. Redlich, MD, MPH, Yale Occupational and Environmental Medicine Program, Yale School of Medicine, 367 Cedar St, ESHA 2nd Floor, New Haven, CT 06510 (carrie.redlich@yale.edu).

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