Silicosis Surveillance in California, 2019–2024: Tracking an Epidemic

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Objectives. To characterize the nature, burden, and trends of silicosis among California workers, including workers with engineered stone exposures.

Methods. We conducted multisource public health surveillance and generated descriptive statistics, compared engineered stone cases to cases with other silica exposures, and examined the utility of various data sources for silicosis surveillance.

Results. We received 1817 reports of possible silicosis for 648 individuals from 2019 to 2024 and confirmed 296 (46%) cases, including 243 (82%) associated with engineered stone exposures. Engineered stone cases were more likely to be younger, men, Latino, and from Los Angeles County than were non–engineered stone cases. Of engineered stone cases, at least 15 (6%) were known to have died, and 60 (25%) were referred for lung transplant, including 30 (12%) who received transplants. There was limited overlap between reporting mechanisms.

Conclusions. Multisource surveillance was effective for identifying a large number of individuals with silicosis, including people exposed to engineered stone. Outcomes were severe, and many patients had advanced disease. Results illustrate that worker screening and silica exposure mitigation are essential to prevent morbidity and mortality in the engineered stone countertop fabrication industry. (*Am J Public Health*. 2025;115(11):1913–1921. https://doi.org/10.2105/AJPH.2025.308225)

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Silicosis is a progressive, irreversible, fibrotic lung disease that results from the inhalation of respirable crystalline silica particles in the workplace. Silicosis is often disabling and can lead to respiratory failure and death, and there is no cure for severe disease other than lung transplantation. Silicosis is not a new disease, having been recognized by Hippocrates more than 2000 years ago, but the work and exposure contexts where it occurs have evolved along with industrial processes.[1] Silica occurs naturally in the earth's crust and is present in varying concentrations in nearly all rock. Silicosis has historically been recognized in a typically chronic form in older workers with decades of low to moderate exposure to dusty work environments involving natural stone, such as mining, foundries, sandblasting, tunneling, and construction.[2] More recently, silicosis has been recognized in the United States and around the world as associated with the fabrication of engineered stone (quartz) countertops. These cases typically involve considerably shorter periods of exposure among much younger workers with an accelerated form of disease.[2–7]

Engineered stone is manufactured by mixing crushed high-silica-content quartz with resins to create a composite material that can contain more than 90% silica, or more than 3 times the silica content of most natural stone.[8] Engineered stone has increased in popularity in the United States because of its cost, durability, and wide range of available colors and designs and is now the most commonly used material for countertops nationwide.[9]

Studies have shown that when engineered stone countertop material is cut, ground, or polished during fabrication, high levels of crystalline silica dust are generated that exceed regulatory limits set by the US Department of Labor Occupational Safety and Health Administration.[10–12] Efforts to prevent dust exposure, including engineering controls such as wet cutting methods for dust suppression and personal protective equipment, are complex and often not adequately protective.[11–13] Because of the difficulty in reducing dust to a level that would protect workers, Australia banned engineered stone containing more than 1% silica as of July 2024.[13] In response to the heightened silica exposure risk posed by engineered stone fabrication, the California Division of Occupational Safety and Health, California's workplace regulatory agency, has modified the existing silica standard to require specific exposure controls and medical monitoring for workers exposed to respirable crystalline silica while fabricating or finishing engineered stone.[14]

The first person in the United States known to have developed silicosis from engineered stone exposure was identified in Texas in 2014.[15] We began conducting case-based public health surveillance of silicosis in California in 2019 after a review of hospital discharge data identified a man aged 37 years who died from silicosis associated with engineered stone silica exposure.[4,5,16] In 2023, we reported the demographics, occupational history, and clinical features of the first 52 cases of engineered stone silicosis identified in California.[5,17] Surveillance efforts have since been significantly expanded. We update public health surveillance findings to further characterize the nature and extent of silicosis statewide, including a comparison of engineered stone worker characteristics with those of workers with other silica exposures.

METHODS

We identified silicosis cases through a combination of mechanisms:

1. Annual review of statewide hospital data (patient discharge and emergency department);
2. Voluntary direct health care provider reporting (physicians, tuberculosis [TB] controllers, and other local health department staff, pulmonary function laboratory technicians, and a transplant center);
3. Electronic case reporting (ECR) through the Reportable Conditions Knowledge Management System;
4. Worker screening as a result of case follow-up at a worksite; and
5. Voluntary direct reporting from other sources, including legal service providers.

After discovery of the index case in 2019, we examined hospital discharge data going back to 2006 to identify more silicosis cases and conducted screening at worksites associated with the index case. We have added additional data sources over time, including ECR and health care and legal service provider reporting in 2022.[18] We identified cases in hospital and ECR data using the *ICD-10* (*International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* [Geneva, Switzerland: World Health Organization; 1992]) code for silicosis (J62.X). Some individuals were reported multiple times through multiple mechanisms or by only a single mechanism, which we considered "uniquely reported."

We recorded all reports in a relational database, with individual patients deduplicated.

Once we identified a report of silicosis, we obtained, reviewed, and abstracted medical records to ascertain additional case information and attempt to confirm the case. We confirmed cases using the National Institute for Occupational Safety and Health case definition for silicosis: history of occupational exposure to airborne silica dust and either imaging or pathology results interpreted as consistent with silicosis, as documented in medical records.[19] Those with engineered stone–associated silicosis met the confirmed case definition and additionally had a history of occupational exposure to engineered stone.

We recorded demographic data, occupational history, clinical information, and outcome data for all potential cases from initial reports and medical records. We calculated the ages at diagnosis, transplant, and death by subtracting date of birth from year of diagnosis, transplant date, and date of death, respectively. We calculated the interval from diagnosis to death by subtracting year of diagnosis from date of death. We defined outcome as the last patient disposition known to us based on reporting sources and medical records. Transplant status similarly reflects our most recent information, with mutually exclusive categories of transplanted, awaiting transplant, and denied transplant. We performed χ^2 analysis and generated descriptive statistics using SAS version 9.4 (SAS Institute, Cary, NC).

RESULTS

From January 2019 through December 2024, we received 1817 reports of silicosis for 648 individuals, including 313 (48%) with engineered stone exposures. Among the 648 reported individuals, we were able to confirm that 296 (46%) had silicosis. We determined an additional 73 (11%) not to be silicosis; 279 (43%) were missing essential information required for case confirmation. Among the 296 confirmed cases, 243 (82%) were associated with engineered stone exposure during countertop fabrication.

Table 1 shows that patients confirmed with silicosis were more likely to be men (99% vs 90%), to be Latino

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TABLE 1— Demographic Characteristics of All Silicosis Cases Reported: California, 2019–2024

	All Potential Silicosis	Confirmed Silicosis	Confirmed Silicosis, Engineered Stone	Confirmed Silicosis, Non-Engineered Stone
Total, no. (%)	648	296 (46)	243 (38)	53 (8)
Male, no. (%)	584 (90)	292 (99)	242 (99.6)	50 (94)
Age, y, median (IQR)	50 (41–66)	47 (41–55)	46 (40–51)	65 (54–80)
Latino, no. (%)	435 (71)	262 (89)	237 (98)	25 (47)
Los Angeles County, no. (%)	247 (38)	150 (51)	138 (57)	12 (23)

Note. IQR = interquartile range.

(89% vs 71%), and to be from Los Angeles County (51% vs 38%) compared with all patients reported. Non–engineered stone workers with confirmed silicosis were older (median = 65 years; interquartile range [IQR] = 54–80) than were engineered stone workers with confirmed silicosis (median = 46 years; IQR = 40–51). Workers with confirmed engineered stone–associated silicosis were significantly more likely to be men (99.6% vs 94.0%; $P < .01$), to be Latino (98% vs 47%; $P < .001$), and to be from Los Angeles County (57% vs 23%; $P < .001$) than were workers with confirmed non–engineered stone–associated silicosis. The most commonly reported sources of silica exposure among workers with non–engineered stone silicosis were sandblasting, mining, cement work, glass manufacturing, brick manufacturing, and stone and tile cutting. Other occupations reported included dental technician, foundry worker, sculptor, and diatomaceous earth worker.

Engineered Stone Cases

Table 2 summarizes characteristics of confirmed engineered stone cases. Of the 105 workers with confirmed engineered stone silicosis in which country of origin was known, 69 (66%) were from Mexico, 20 (19%) from El Salvador, 7 (7%) from Guatemala, 4 (4%) from elsewhere in Latin America, 3 (3%) from countries outside Latin America, and 2 (2%) from the United States. Of the 114 confirmed engineered stone patients in which insurance status was known, 73 (64%) were covered under Medi-Cal, California's Medicaid program, 17 (15%) were uninsured or self-pay, 16 (14%) had private coverage, and 8 (7%) were covered by workers' compensation. The number of years of silica exposure was available for 166 (64%) workers with engineered stone silicosis, with a median of 19 years (IQR = 15–23), and

TABLE 2— Characteristics and Outcomes of Confirmed Engineered Stone–Associated Silicosis Cases: California, 2019–2024

Characteristic/Outcome (No. With Data Available)	No. (%) or Median (IQR)
Country of birth (105)	
Mexico	69 (66)
El Salvador	20 (19)
Guatemala	7 (7)
Other Latin America	4 (4)
Other	5 (5)
Years exposed (166)	19 (15–23)
Health insurance (114)	
Medi-Cal	73 (64)
Uninsured or self-pay	17 (15)
Private insurance	16 (14)
Workers' compensation	8 (7)
Outcomes (243)	
Death from silicosis	15 (6)
Age at death, y	46 (41–52)
Median interval from diagnosis to death in years	2
Referred for lung transplant	60 (25)
Transplanted (3 deceased)	30 (12)
Awaiting transplant (2 deceased)	24 (10)
Denied transplant (5 deceased)	6 (2)
Age at transplant, y	46 (38–51)

Note. IQR = interquartile range. Study population size was n = 243.

24 patients reporting 10 years of exposure or less. Among the 44 confirmed engineered stone patients with any information about TB, recognition of silicosis was delayed for 19 because of an initial diagnosis of TB, including 9 patients who received TB treatment before infection was ruled out and a silicosis diagnosis was made. We identified 5 confirmed engineered stone patients with silicotuberculosis.

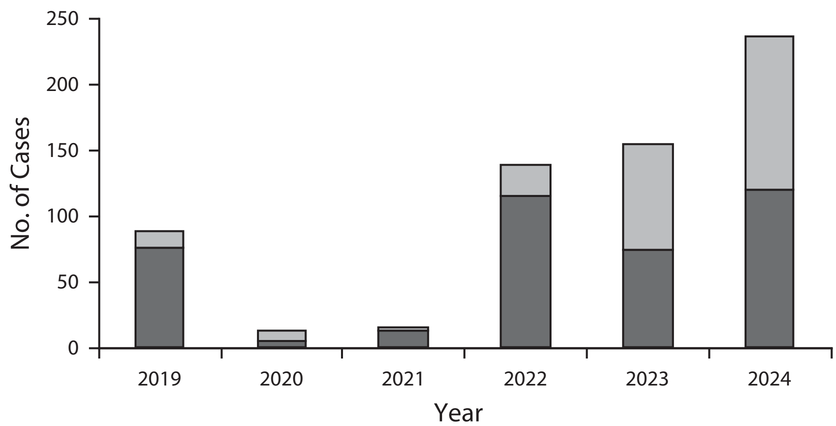
We found that 60 (25%) of the 243 confirmed engineered stone patients were referred for lung transplant and 15 (6%) died as a result of their silicosis. Of the 60 transplant referrals, 30 (50%) received a transplant, 24 (40%) were waiting or being evaluated for transplant, and 6 (10%) were denied transplant. Ten (17%) of the 60 patients referred for transplant died (3 post-transplant, 2 while waiting, and 5 after denial). Patients who received transplants had a median age of 46 years at the time of transplant (IQR = 38–51) and 8 were younger than 40 years. Patients who died had a median age of 46 years at death (IQR = 41–52), including 3 who died before 40 years. The median interval from diagnosis to death was 2 years.

Reporting

Figure 1 illustrates the trend in silicosis case identification in California over time among those with confirmed engineered stone–associated silicosis and all other reported cases. Comparing the total number of cases from 2019 to 2021 before ECR and direct reporting by health care and legal services providers were added as data sources to the total number of cases in 2022 to 2024 shows that reporting of engineered stone cases increased 9-fold, whereas reporting of all other cases increased nearly 2.5-fold. Year of diagnosis was missing for 91 (37%) of 243 confirmed engineered stone cases, but among the 152 with data, 22 (15%) were diagnosed before 2019, when reporting began, and as early as 2006.

Among all individuals reported, 511 (79%) of 648 were uniquely reported through a single mechanism, whereas 145 (60%) of 243 confirmed engineered stone cases were uniquely reported through a single mechanism. Health care and legal service providers uniquely reported 106 (73%) of the 145 uniquely reported engineered stone cases, whereas hospital data and ECR were the largest sources for all other uniquely reported individuals (310/511 [61%]). Confirmed engineered stone cases were more likely to be reported by multiple reporting mechanisms compared with all cases (40% vs 21%).

Although the median was 1 report received per individual, the mean was 2.8, because some individuals were reported multiple times by multiple reporting sources, for multiple medical encounters, or both. Some individuals were reported by up to 4 different mechanisms. Reporting sources varied in volume and the ability to identify confirmed, engineered stone, and



	2019	2020	2021	2022	2023	2024
Confirmed ES cases	13	7	2	24	80	117
All other reported cases	76	5	12	116	75	121

FIGURE 1— Silicosis Cases by Year Identified by California Department of Public Health: 2019–2024

Note. ES = engineered stone.

uniquely reported cases. Table 3 illustrates that across all 1817 reports received, 917 (50%) were received through ECR, 532 (29%) from hospital data, 161 (9%) from provider reports, 160 (9%) from legal services, and 46 (3%) from employee screening. We received 947 reports for confirmed engineered stone cases, with reports more likely to come from ECR, health care providers, and legal services than all other cases reported. Nearly 60% of all reports received for confirmed engineered stone cases were through ECR.

DISCUSSION

Since 2019, the California multisource silicosis surveillance system has processed 1817 reports for 648 individuals, of whom 243 were confirmed with engineered stone–associated silicosis. This is 1 of the largest case series of engineered stone silicosis reported worldwide and is especially noteworthy because nearly all cases were found through ongoing passive data collection, as opposed to active screening of engineered stone workers. Although the addition of case-finding mechanisms in the past 3 years has nearly tripled the number of all reported silicosis cases regardless of exposure, the number of confirmed engineered stone cases has increased 9-fold. This result illustrates the value of multisource surveillance and that without it, many cases may be unidentified; the burden of disease is likely underestimated because of reliance on physician reporting and can be better estimated by enhancing surveillance methods.

Historically, silicosis has been documented primarily in male-dominated industries. All but 4 of the 296 individuals with confirmed silicosis in our data set were men. Many of the reported cases that were determined not to have silicosis were women (23%), most commonly because of misdiagnosis or incorrect diagnosis codes in medical records. However, our surveillance data did identify 3 women with confirmed non–engineered stone–associated silicosis and 1 woman with confirmed engineered stone–associated silicosis. We have identified 2 additional women with potential engineered stone–associated silicosis but have not yet been able to confirm their diagnoses. To our knowledge, these are among the few women with engineered stone–associated silicosis reported worldwide.

Workers with confirmed non–engineered stone silicosis were significantly older and less likely to be Latino, compared with workers with confirmed engineered stone silicosis. Non–engineered stone patients worked in a variety of industries and occupations, including sandblasting, mining, glass product manufacturing, cement mixing and cutting, foundry work, and sand, rock, and brick work. Silica exposures are well documented in these work contexts, and historically workers in these environments develop chronic silicosis after decades of exposure.[2,20] We identified non–engineered stone patients across the state proportionate to state population distribution. This differs from engineered stone patients, 57% of whom resided in Los Angeles County, where 27% of the state population lives[21] but where there are high concentrations of engineered stone fabrication shops, and where several health care providers care for many silicosis patients and regularly report cases to the surveillance system.

Consistent with other publications on engineered stone silicosis, engineered stone silicosis patients in our data were primarily immigrants with a relatively short duration of exposure.[22–25] Although the median duration of exposure was 19 years, the range was from 1 to 39 years, with 24 patients (14% of those with data) reporting 10 years of exposure or less. Studies have demonstrated the relationship between exposure and disease[26,27] as well as the high levels of silica dust generated during engineered stone countertop fabrication,[10–12] illustrating the critical need

TABLE 3— Reports by Reporting Source for All Silicosis Cases Compared With Confirmed Engineered Stone–Associated Silicosis Cases: California, 2019–2024

Reporting Mechanism	All Reports, No. (%)	Reports for Confirmed Engineered Stone–Associated Cases, No. (%)
Total	1817 (100)	947 (52)[a]
Electronic case reporting	917 (50)	562 (59)
Hospital data	532 (29)	112 (12)
Health care provider	161 (9)	138 (15)
Legal	160 (9)	125 (13)
Active employee screening	46 (3)	10 (1)
Other	1 (0)	0 (0)

Note. The table represents reports, not individuals.
[a]This is a row percentage; the other percentages shown are column percentages.

to reduce exposures in the engineered stone fabrication industry. Although outcome reporting may not be timely given that it is captured in a surveillance system focused on reports at diagnosis, our surveillance data captured 15 deaths and 30 transplants, demonstrating the severe consequences of advanced disease in this young worker population. Transplant referral was made for a quarter of all confirmed engineered stone silicosis patients, and the youngest patient to receive a transplant was younger than 30 years. The median age at death was 46 years, with a median interval from diagnosis to death of 2 years, suggesting rapid disease progression and late diagnosis of disease.

These findings emphasize the importance of screening workers for disease and controlling workplace hazards. The California Division of Occupational Safety and Health's revised respirable crystalline silica standard contains new requirements, including that employers must conduct regular air monitoring, provide new protections for workers engaged in high-risk tasks, provide employee training, and test all high-risk workers for silicosis using more sensitive low-dose chest computed tomography scans as opposed to radiographs.[14] Employers also must report any confirmed silicosis cases to our surveillance system and the California Division of Occupational Safety and Health within 24 hours. These approaches may have an important impact on prevention, although enforcement of workplace standards can be challenging because the enforcing agency has limited resources and capacity.

Although silicosis is an occupational disease, only 7% of confirmed engineered stone cases with insurance information had medical care paid through workers' compensation. Instead, 79% of individuals with engineered stone–associated silicosis received publicly funded care or were uninsured. There is anecdotal information that many California engineered stone workers, although functioning as employees, are instead working as independent contractors,[5] which could affect their eligibility for workers' compensation. This results in cost shifting from employers' workers compensation insurance carriers to primarily publicly funded care and may dissuade workers from seeking care if they are not adequately covered by insurance. In general, the largely immigrant population of workers who are affected by engineered stone silicosis faces many barriers to health care and safe work environments.[28]

Early diagnosis is critical. The primary treatment of silicosis is limiting exposure in the workplace. Reducing exposures not only protects workers who have already been identified with silicosis from further exposure and may slow disease progression[29] but also decreases disease risk for other workers in the same work environment. Past studies in California have shown that worker medical screening and implementation of exposure controls in countertop fabrication shops are lacking.[10,30] Clinicians should routinely ask about work exposures and report any suspected cases of silicosis to their local or state health jurisdiction. Previous studies have demonstrated that delays in identification can result in more severe disease and poorer outcomes.[17]

It is well established that silicosis increases the risk of TB[31,32] and that TB and silicosis can be difficult to distinguish, both clinically and radiologically.[33] Because the patients we describe with engineered stone silicosis are young immigrant men from countries where TB is endemic, TB may be high in the differential diagnosis. We have previously documented delays in silicosis diagnosis because of initial diagnoses of TB.[5] Our current data include 5 confirmed engineered stone cases of silicotuberculosis as well as 19 engineered stone cases with silicosis diagnoses that were delayed because of first being diagnosed with TB, which was subsequently ruled out. Of those 19 cases, 9 cases were treated for TB before the silicosis diagnosis was recognized. Workers with silica exposures should be screened for both silicosis and TB, and clinicians should monitor those with silicosis for TB because of the increased risk posed by silicosis.

Strengths and Limitations

The data in this report are subject to several limitations. The data likely underrepresent total case counts in the state because it is well documented that silicosis, particularly in young engineered stone workers, is underrecognized and underdiagnosed.[34] Voluntary provider reporting was routinely done by 8 clinicians who had awareness and interest in the disease and was focused in 1 geographic area of the state. Low-wage immigrant workers may not have access to care or may not seek care because of fear of retaliation from employers or concerns about immigration status, all of which contribute to underdiagnosis and underrecognition. The medical records we reviewed were usually associated with only the medical encounter that was reported, limiting our knowledge of other care a patient may have received, and we relied primarily on patient self-report regarding their exposure to silica.

It is important to note that for the period we studied, silicosis reporting was not mandatory in California. Therefore, reporting was not done consistently for all cases, as voluntary health care provider and legal services reporting focused specifically on engineered stone cases and contained details about exposures, clinical status, and outcomes. Although hospital data and ECR identified individuals with silicosis statewide without regard to exposure source by using *ICD-10* codes indicating silicosis, medical records were generally more complete and detailed for younger patients with accelerated disease associated with engineered stone exposures, compared with older patients, whose exposures and silicosis diagnosis were many years earlier. As a result of the additional detail and more current histories, engineered stone case records were much more likely to provide the information necessary to meet the case definition for confirmation than were non–engineered stone records. We often identified non–engineered stone patients through diagnosis codes of silicosis in a historical problem list, but their encounters with the health care system were for other, non–silicosis-related medical conditions. More than 40% of all silicosis cases reported were missing essential information required for case confirmation or were still in the process of being confirmed. The age, ethnicity, and geographic distribution of individuals with unconfirmed cases more closely resembled those with confirmed non–engineered stone–associated silicosis than those with engineered stone–associated silicosis.

Our data demonstrate that multisource surveillance generates increased case finding. Case-finding mechanisms varied in timeliness and efficacy and had limited overlap. Nearly 80% of all silicosis cases and 60% of confirmed engineered stone cases were uniquely reported through only 1 reporting mechanism. Voluntary reporting by health care and legal service providers included detail and provided cases that were more easily confirmed, but the scope was limited to their practices and not geographically representative of the entire state. ECR provides real-time reporting of any health care encounter at a participating facility statewide with silicosis in the problem list. Currently, there are 3120 California facilities participating, and we have documented the value of using this mechanism to identify individuals with silicosis.[18] ECR has also been effective for providing updated information on case status and outcome and uniquely reported 20% of all reported silicosis cases.

The utility of ECR for surveillance should expand even more, as several large health care organizations do not yet participate. Hospital data are accessed annually and are therefore not timely, but they are effective for identifying cases with the most severe disease. The reporting mechanisms used for our surveillance system can be adopted by other public health jurisdictions for silicosis surveillance. In addition to accessing hospital and ECR data, media attention and outreach have been effective for raising health care provider awareness and enlisting voluntary provider reporting. Silicosis became a reportable disease in California in July 2025, which is anticipated to increase case finding significantly.

Public Health Implications

Using multisource surveillance in California, we identified an increasing number of accelerated engineered stone–associated cases among mostly young, Latino, immigrant men, as well as many cases of chronic silicosis from more traditional silica exposures. Given the lag time between exposure and diagnosis and extensive ongoing exposures, we expect many more engineered stone cases to be identified in the future. The outcomes for these young workers can be severe and illustrate the importance of identifying disease early and controlling workplace exposures. The addition of surveillance mechanisms, including ECR and voluntary reporting by informed health care and legal service providers, increased case finding significantly and are approaches that can be adapted by jurisdictions nationwide. AJPH

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose.

HUMAN PARTICIPANT PROTECTION

The California Committee for the Protection of Human Subjects approved this project.

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