Protecting Vulnerable Workers: Cal/OSHA's Response to the Silicosis Epidemic in Engineered Stone Fabrication

Mike Wilson, PhD, MPH, CIH
Senior Safety Engineer
Cal/OSHA Research and Standards

mwilson@dir.ca.gov

STATE OF CALIFORNIA
CAL OSHA
DEPARTMENT OF INDUSTRIAL RELATIONS

California's Silicosis Epidemic in the Artificial Stone Industry

- Current status of silicosis
- Hazards of artificial stone
- Cal/OSHA's response
- Silicosis Technical Committee: Next steps

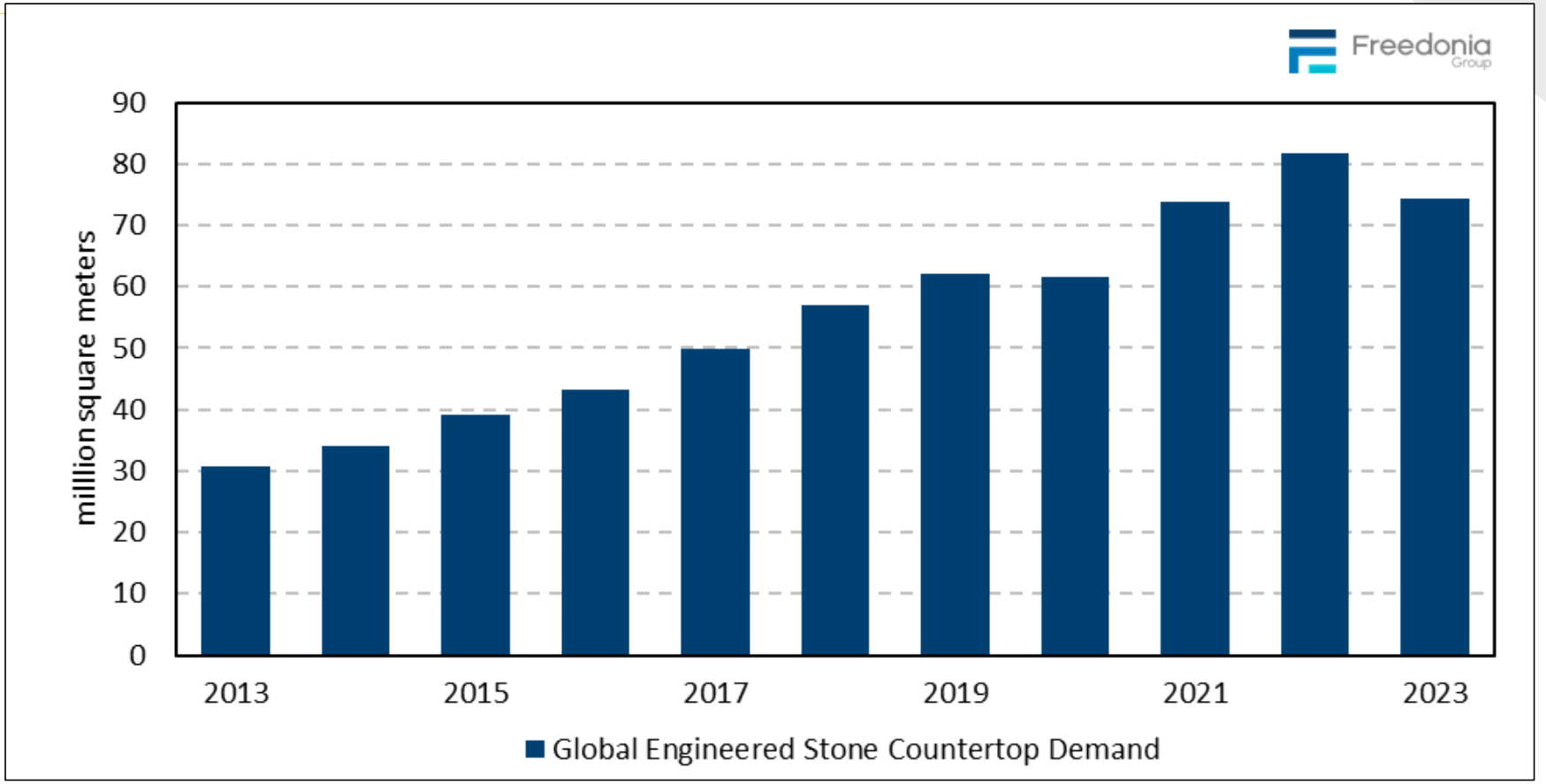
California's Silicosis Epidemic in the Artificial Stone Industry

- **Current status of silicosis**
- Hazards of artificial stone
- Cal/OSHA's response
- Silicosis Technical Committee: Next steps

Artificial Stone Showcase

Photo by Mike Wilson, Cal/OSHA

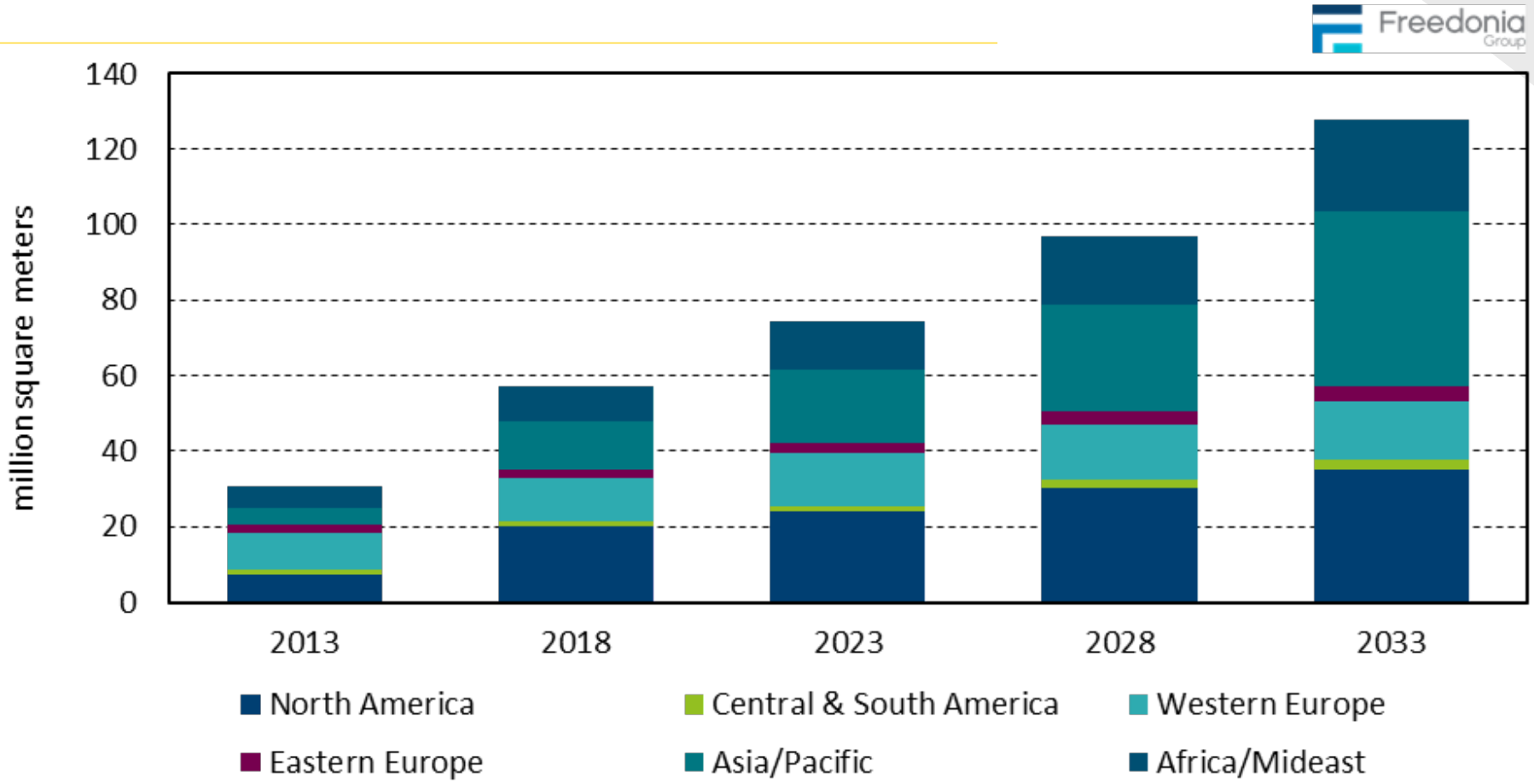
Global Artificial Stone Demand, 2013-2023



"Global demand for artificial stone countertops is projected to increase 5.4% per year to 97 million square meters in 2028."

https://www.freedoniagroup.com/industry-study/global-engineered-stone-countertops.

Projected 10-year Global Artificial Stone Demand



The highest growth over the next 10 years is expected in the North American and Asia/Pacific markets.

https://www.freedoniagroup.com/industry-study/global-engineered-stone-countertops.

Artificial Stone Workplace

Photos provided to Cal/OSHA courtesy of Dr. Jane Fazio, UCLA

Dry grinding to create bullnose edge

Photo: https://fedvrs.us/cutting-and-polishing-granite-countertops/

Dry edging

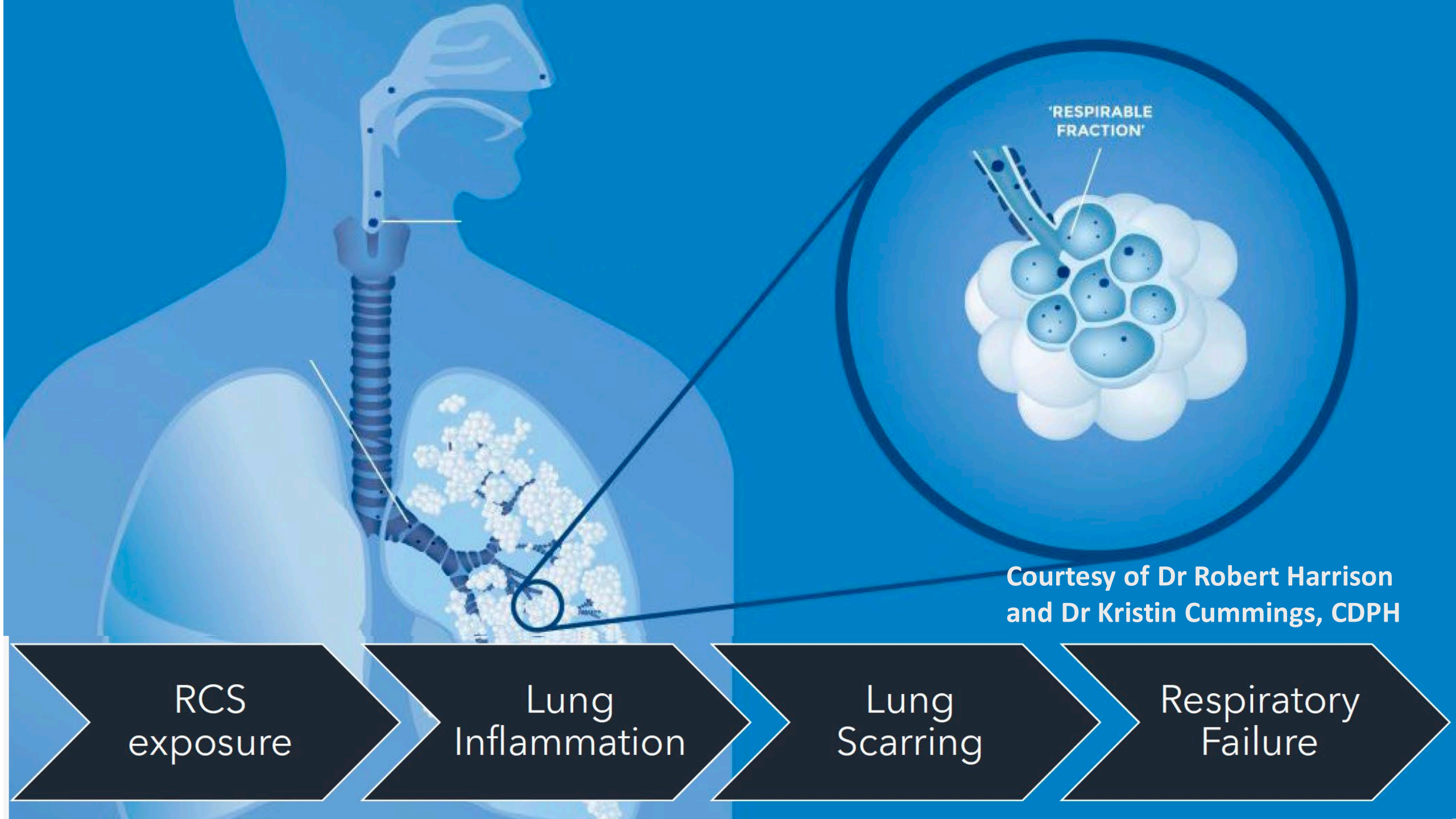
Photo: https://fedvrs.us/cutting-and-polishing-granite-countertops/

Dry polishing

Photo: https://fedvrs.us/cutting-and-polishing-granite-countertops/

California's Silicosis Epidemic in the Artificial Stone Industry

- Current status of silicosis
- **Hazards of artificial stone**
- Cal/OSHA's response
- Silicosis Technical Committee: Next steps


'RESPIRABLE FRACTION'
Courtesy of Dr Robert Harrison and Dr Kristin Cummings, CDPH
RCS exposure
Lung Inflammation
Lung Scarring
Respiratory Failure

Unique Hazards of Artificial Stone

- Very high silica content (93% or greater)
- Grinding and polishing produces high concentrations of fine RCS particles (<1µm) and ultrafine particles (<0.1µm).
  - Large reactive surface area
  - Enter the deep lung
- Particles have irregular shapes, sharp edges, fractures
  - Increases the rate of cell lysis that leads to lung scarring.
- Volatile organic compounds (from resins) also emitted during cutting.

Silicosis

Silicosis is a severe, incurable, and progressive lung disease caused by inhaling crystalline silica dust, leading to permanent lung damage, disability, and frequently death.

Artificial stone silicosis is uniquely aggressive.

Routine chest radiography in a study for lumbar pain in 45 y/o male, showing multiple bilateral pulmonary calcified micronodules.
History of sand-work for five years.
https://radiopaedia.org/cases/silicosis-with-progressive-massive-fibrosis-6

Hazards of Artificial Stone (1)

2020, Wu et. al.

- 18 patients with artificial stone-associated silicosis
  - Median exposure duration of 6 years.
  - 22% experience rapid deterioration in 6 to 12 months
  - 40% required lung transplant
  - 28% died
- 63 patients with natural stone-associated silicosis
  - Median exposure duration of 30 years
  - 3% required lung transplant
  - No deaths

Wu N, et al. Artificial stone-associated silicosis in China: A prospective comparison with natural stone-associated silicosis. *Respirology* (2020) 25, 518–524. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7187561/.

Hazards of Artificial Stone (2)

2020, León-Jiménez, et. al.

- 106 workers with confirmed silicosis resulting from exposure to artificial stone dust
- All removed from exposure
- 35 workers (33%) with simple pneumoconiosis advanced to progressive massive fibrosis over a mean of 4 years
- Compared to granite workers and former coal miners, where 10% advanced to PMF over a mean of 22 years

León-Jiménez A, et al. Artificial stone silicosis: rapid progression after exposure cessation. *Chest* (2020);158(3):1060-1068. https://pubmed.ncbi.nlm.nih.gov/32563682/.

Hazards of Artificial Stone (3)

2023, Hoy et. al.

- 402 of 544 (74%) workers exposed to artificial stone >50% of work time; dry processing was common.
- 117 of 402 workers (29%) diagnosed with confirmed silicosis.
- Median exposure duration 12 years.
- Most cases did not experience coughing or shortness of breath. Medical surveillance therefore key.

Hoy RF, et al. Prevalence and risk factors for silicosis among a large cohort of stone benchtop industry workers. Occup Environ Med (2023) 1-8. https://oem.bmj.com/content/oemed/80/8/439.full.pdf.

Hazards of Artificial Stone (4)

2023, Ramkissoon, et. al.

- VOCs released from resins in binding agents during fabrication tasks.
- Phthalic anhydride, styrene, benzene, ethylbenzene, toluene
- Phthalic anhydride made up 26-85% of total VOC content
- Phthalic anhydride and styrene are respiratory irritants
- Others are carcinogens

Ramkissoon C, et al. Engineered Stone Fabrication Work Releases Volatile Organic Compounds Classified as Lung Irritants. *Annals of Work Exposures and Health* (2023); 67(2) 288–293. https://pubmed.ncbi.nlm.nih.gov/36239208/.

Hazards of Artificial Stone (5)

2022, Ramkissoon, et. al.

- Artificial stone: 80% of mass of dust particles consisted of RCS.
- Natural stone: 17% of mass of dust particles consisted of RCS.
- 90% of dust particles in both artificial and natural stone ranged from 0.19 to 0.83 µm, so they penetrate into deep lung.
- AS particles: sharp edges, spikes and fractures, compared to natural stone.
- More likely to cause cell damage, leading to lung tissue scarring.

Ramkissoon C, et al. Characterization of dust emissions from machined engineered stones to understand the hazard for accelerated silicosis. *Nature Portfolio* 12:42351 (2022). https://www.nature.com/articles/s41598-022-08378-8.

Photo: Trevor Stamp, as reported in *Public Health Watch*, Dec 2, 2022.

Juan Gonzalez Morin developed silicosis after cutting and grinding artificial stone countertops for $14 an hour from 2013 to 2022 in the LA area. “Many of us continue working in this field out of necessity, and many continue because of ignorance…”

Gonzalez died in April 2023 at age 37.

Jim Morris, Leslie Berestein Rojas (Dec 2022) *Public Health Watch.* https://publichealthwatch.org/2022/12/02/lung-disease-silica-countertops-southern-california/

Photo: Leslie Berestein Rojas, as reported in *Public Health Watch*, Dec 2, 2022.

Gustavo Reyes Gonzalez, age 32 and a father of three, spoke to the Board in 2023. He had a severe case of silicosis from cutting countertops. He says he used water to suppress the dust and wore high-quality masks, but the fine silica dust still entered his lungs.

Reyes received a lung transplant in 2024 that could extend his life up to ten years.

Jim Morris, Leslie Berestein Rojas (Dec 2022) *Public Health Watch.* https://publichealthwatch.org/2022/12/02/lung-disease-silica-countertops-southern-california/

Photo: Leigh Day, as reported in the UK Daily Mail, Nov 6, 2024.

After 10 years of working in artificial stone fabrication, Marek Marzec, a 48-year-old father of three who lives in London with his three children, was diagnosed with silicosis in 2024. He was not eligible for lung transplant. On Nov 6, 2024 he called for "urgent safety changes to prevent others from dying after simply doing their job."

Mr. Marzec died Nov 30, 2024.

Eve Simmons (Nov 6 ,2024) *UK Daily Mail.* https://www.dailymail.co.uk/health/article-14048007/New-concerns-quartz-worktop-silicosis-warning-ban-dying.html

Dr. Jane Fazio and Dr. Nader Kamangar, UCLA Olive View. Photo: Trevor Stamp, as reported in *Public Health Watch*, Dec 2, 2022.

Jane Fazio, MD, MPH "I have numerous other patients in their 30s on the lung-transplant list, waiting and waiting for one of those precious organs to become available and become a match for them. But they don't come available that often. A lot of them will probably die waiting."

Jim Morris, Leslie Berestein Rojas (Dec 2023) California Issues Emergency Rule to Address Silicosis Epidemic. *Public Health Watch.* https://publichealthwatch.org/2022/12/02/lung-disease-silica-countertops-southern-california/

California Silicosis Cases Since 2019 Reported by CDPH

425
Confirmed ES Silicosis Cases

23
Deaths

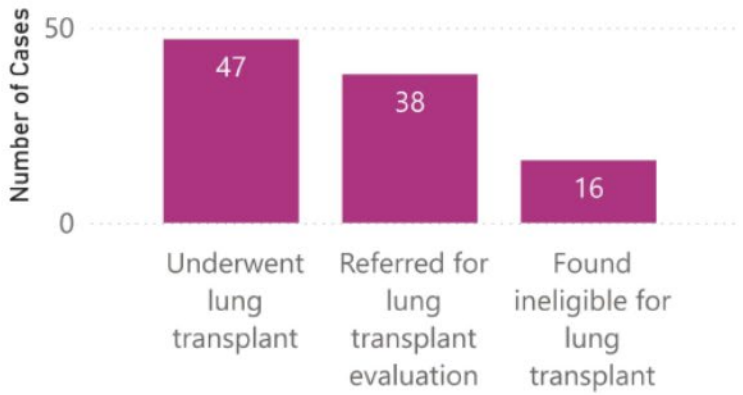
46
Median Age at Diagnosis

47
Median Age at Death

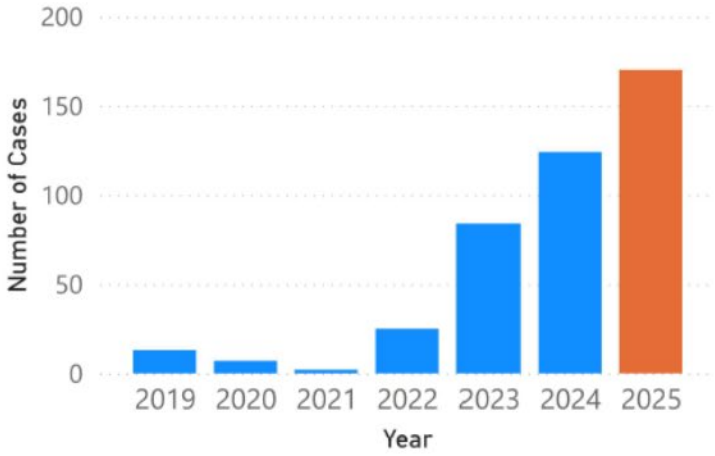
99.8%
Percent of all cases male

98%
Percent of all cases Latino

Last known transplant status for confirmed ES Silicosis cases

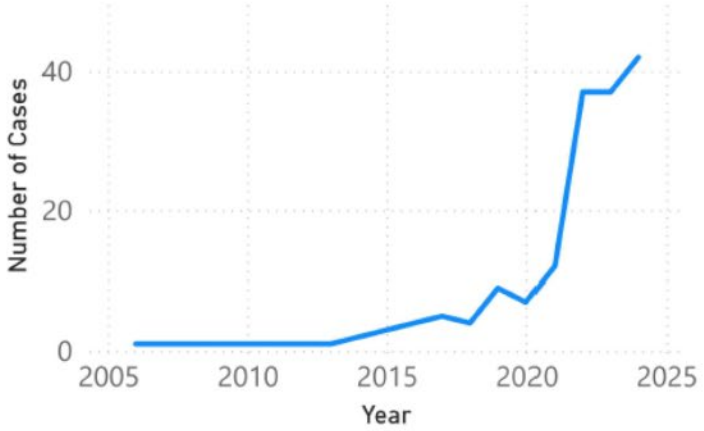


Year confirmed ES Silicosis cases identified by CDPH



Cases identified in 2025 are expected to increase

Year of diagnosis* for confirmed ES Silicosis cases



*Known years of diagnosis are displayed through 2024; data for more recent years are incomplete due to reporting lags. Diagnosis year is missing for some cases.

2019-2022:

- 13% of silicosis cases covered by workers' compensation.
- 58% covered by Medi-Cal.
- 98% of workers from Mexico or Central America (Fazio et al, JAMA Intern Med 2023).

California's Silicosis Epidemic in the Artificial Stone Industry

- Current status of silicosis
- Hazards of artificial stone
- **Cal/OSHA's response**
- Silicosis Technical Committee: Next steps

Cal/OSHA Silicosis Projections

- Given a global silicosis rate of 12% to 21% in the industry, and
- A silicosis fatality rate of 19% among these cases after a median of 15 years exposure,
- Cal/OSHA estimates that among the 5000 workers in California…

Photo: Federal OSHA

Cal/OSHA Silicosis Projections

- Between 600 (12%) and 1050 (21%) of these 5,000 workers could develop silicosis.
- Between 114 and 200 (19%) of these workers with silicosis could die of pulmonary fibrosis and respiratory failure, absent a lung transplant.

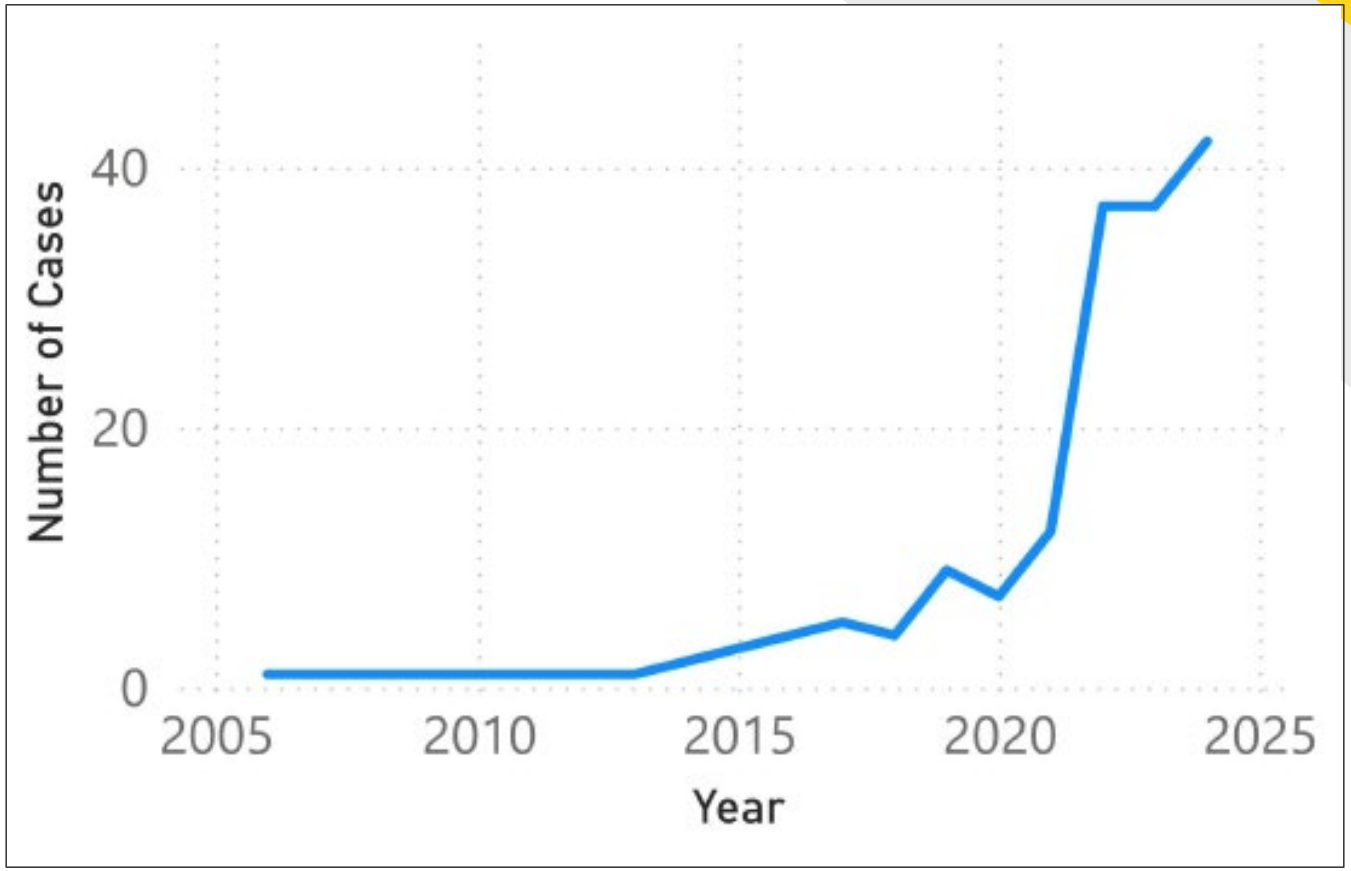
Photos: OSHA and CDC

Cal/OSHA's Response (Part 1)

2017	Silica Regulation (5204) adopted from federal OSHA
2019-2020	Enforcement: Silica Special Emphasis Program 106 inspections, 72% not compliant with Silica Regulation
Dec 2023	WOEMA petition 597 Feb 2023. Emergency Temporary Standard (ETS) in effect by December – HETT approach, wet methods, PAPR, wet or HEPA cleanup, OPU etc.
Feb 2025	Permanent Silica Regulation in effect – strengthened ETS requirements – Medical surveillance and removal

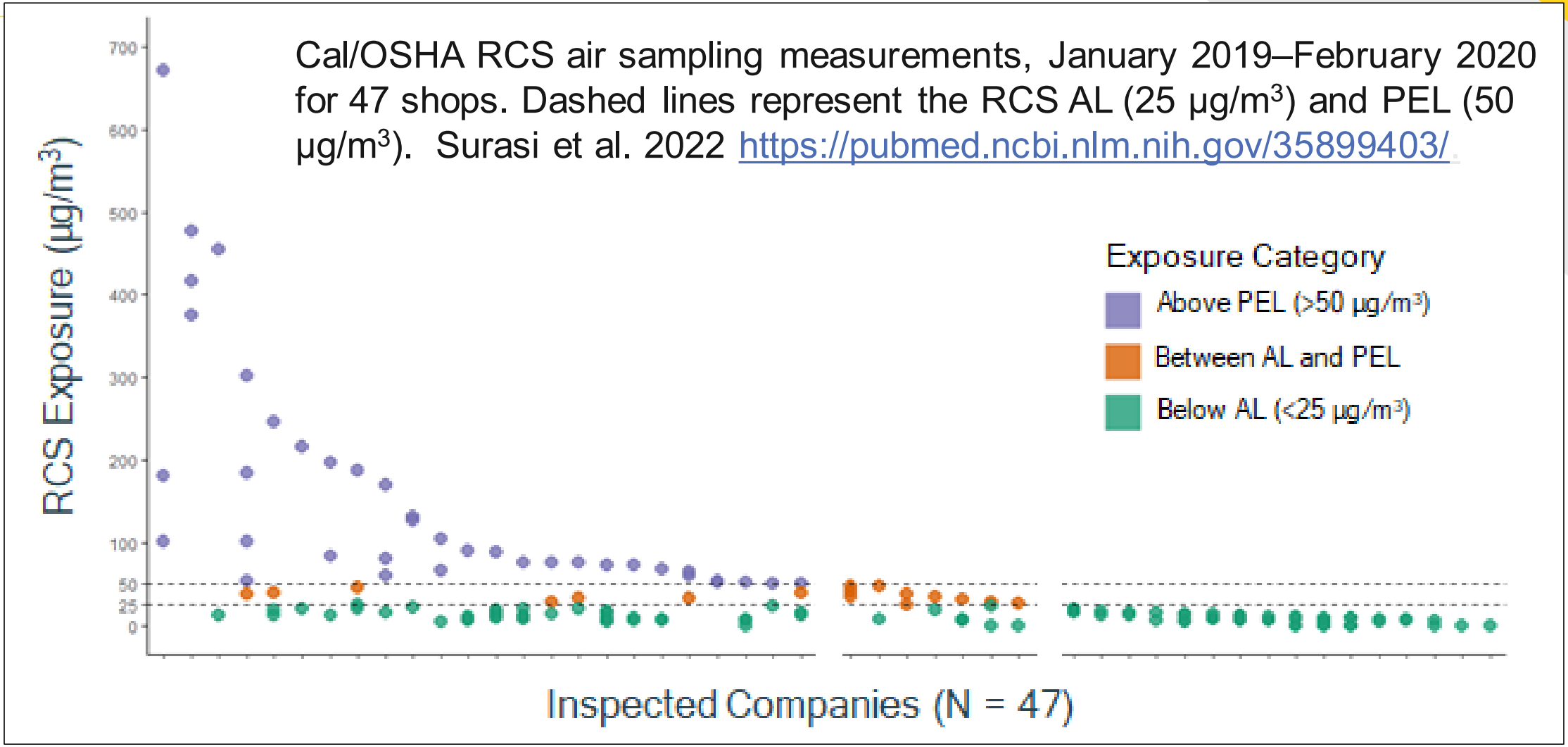
First SEP, 2019-2020: Widespread Non-compliance

- 72% of countertop employers in violation of section 5204.
- 5% of workers received required medical exam.
- 45% of workers reported using wet methods.

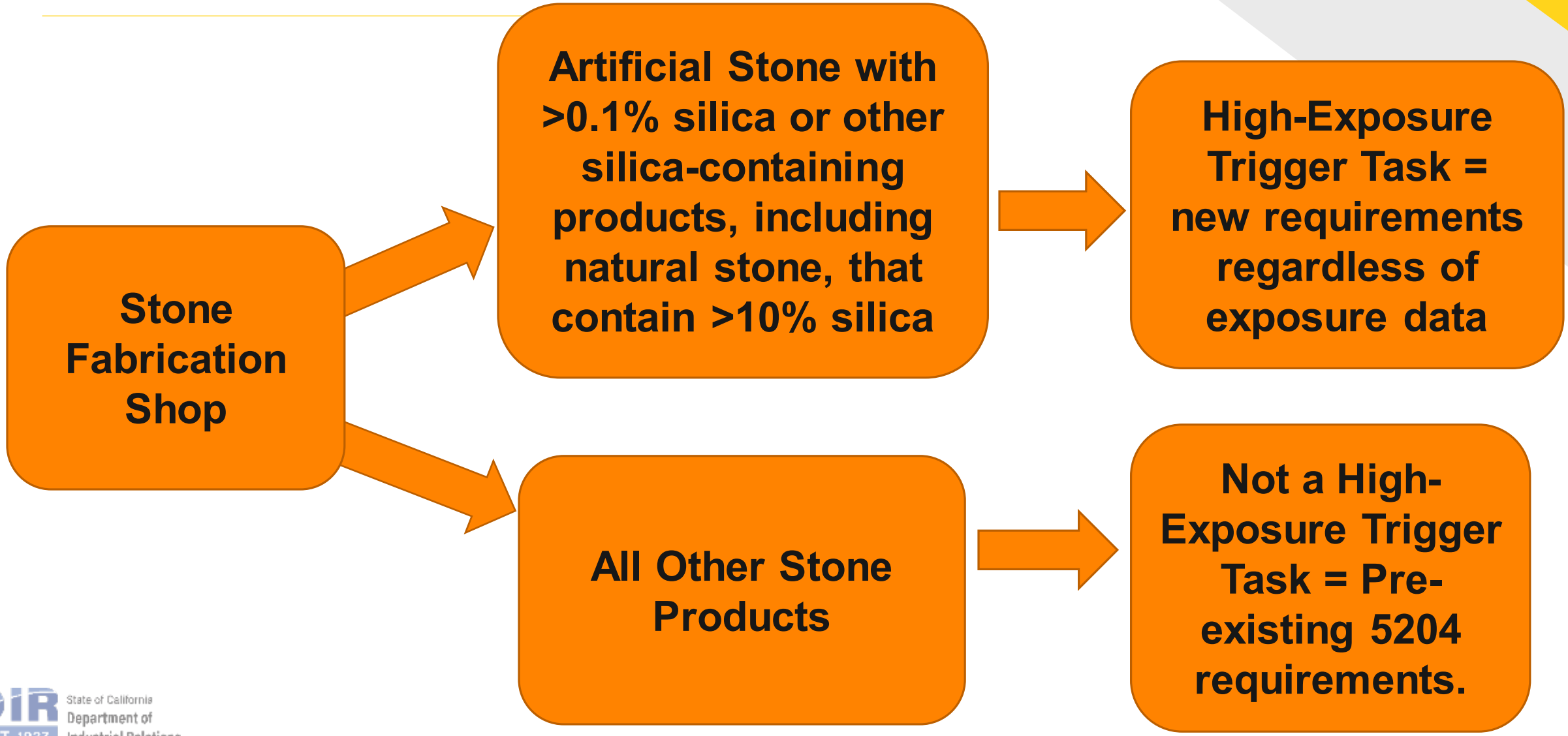


Surasi K, et al. (2022). *Am J Ind Med*. 65:701-707. https://pubmed.ncbi.nlm.nih.gov/35899403/.

Widespread Non-compliance found in the 2019-2020 SEP



Section 5204 (ETS 12/23, Permanent rule 2/25)



Section 5204 (ETS 12/23, Permanent rule 2/25)

- (a) Scope and Application
- (b) Definitions
- (c) Permissible Exposure Limit
- (d) Exposure Assessment
- (e) Regulated Areas
- (f) Methods of Compliance
- (g) Imminent Hazards
- (h) Respiratory Protection
- (i) Housekeeping
- (j) Medical Surveillance
- (k) Medical Removal
- (l) Communication of Hazards
- (m) Reporting of Silicosis and Lung Cancer
- (n) Recordkeeping

Section 5204 (ETS 12/23, Permanent rule 2/25)

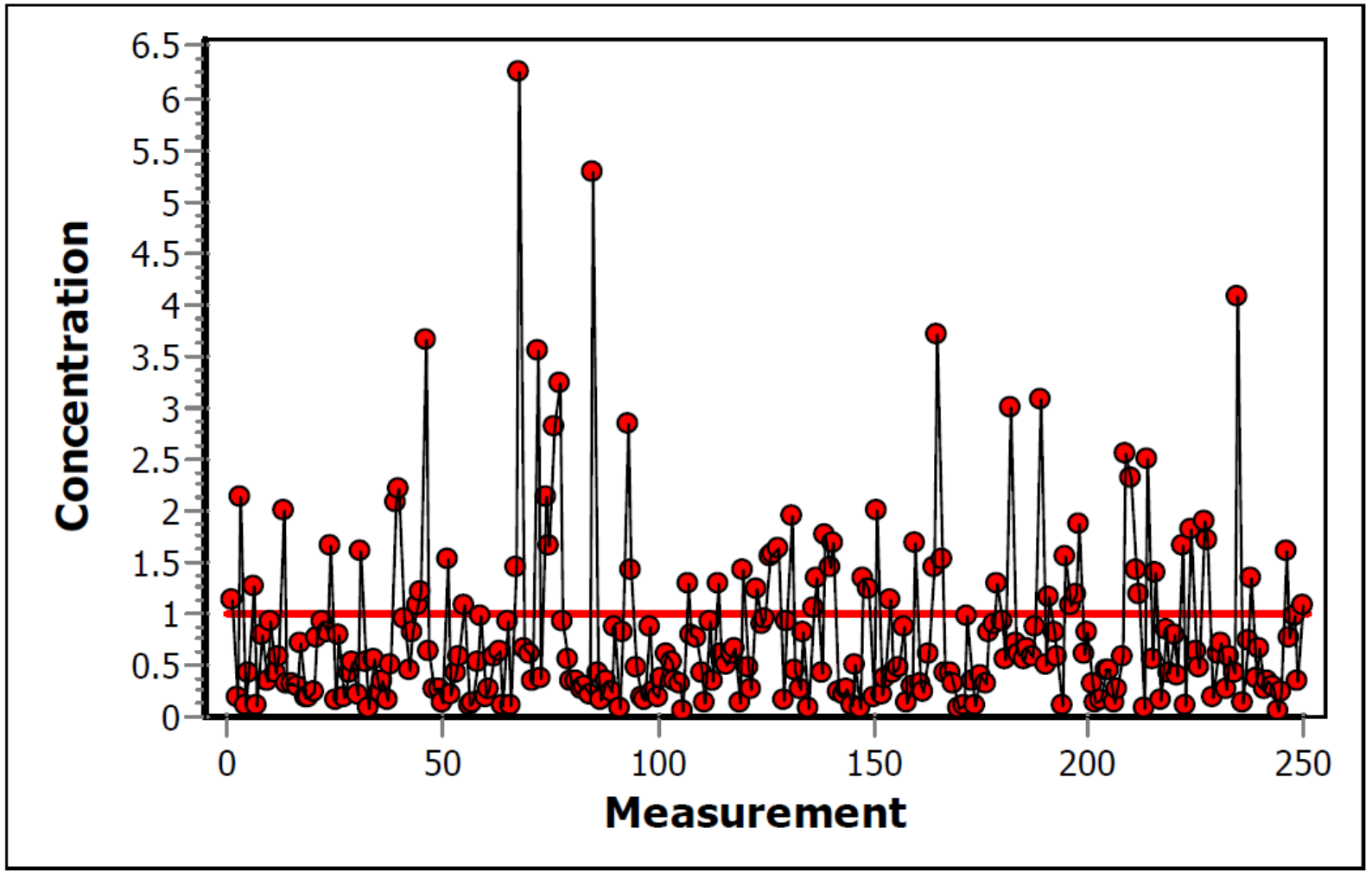
(a) Scope and Application	(b) Definitions	(c) Permissible Exposure Limit	(d) Exposure Assessment
(e) Regulated Areas	(f) Methods of Compliance	(g) Imminent Hazards	(h) Respiratory Protection
(i) Housekeeping	(j) Medical Surveillance	(k) Medical Removal	(l) Communication of Hazards
	(m) Reporting of Silicosis and Lung Cancer	(n) Recordkeeping	

(f) Methods of Compliance

Requirements for High-Exposure Trigger Tasks, regardless of exposure data:

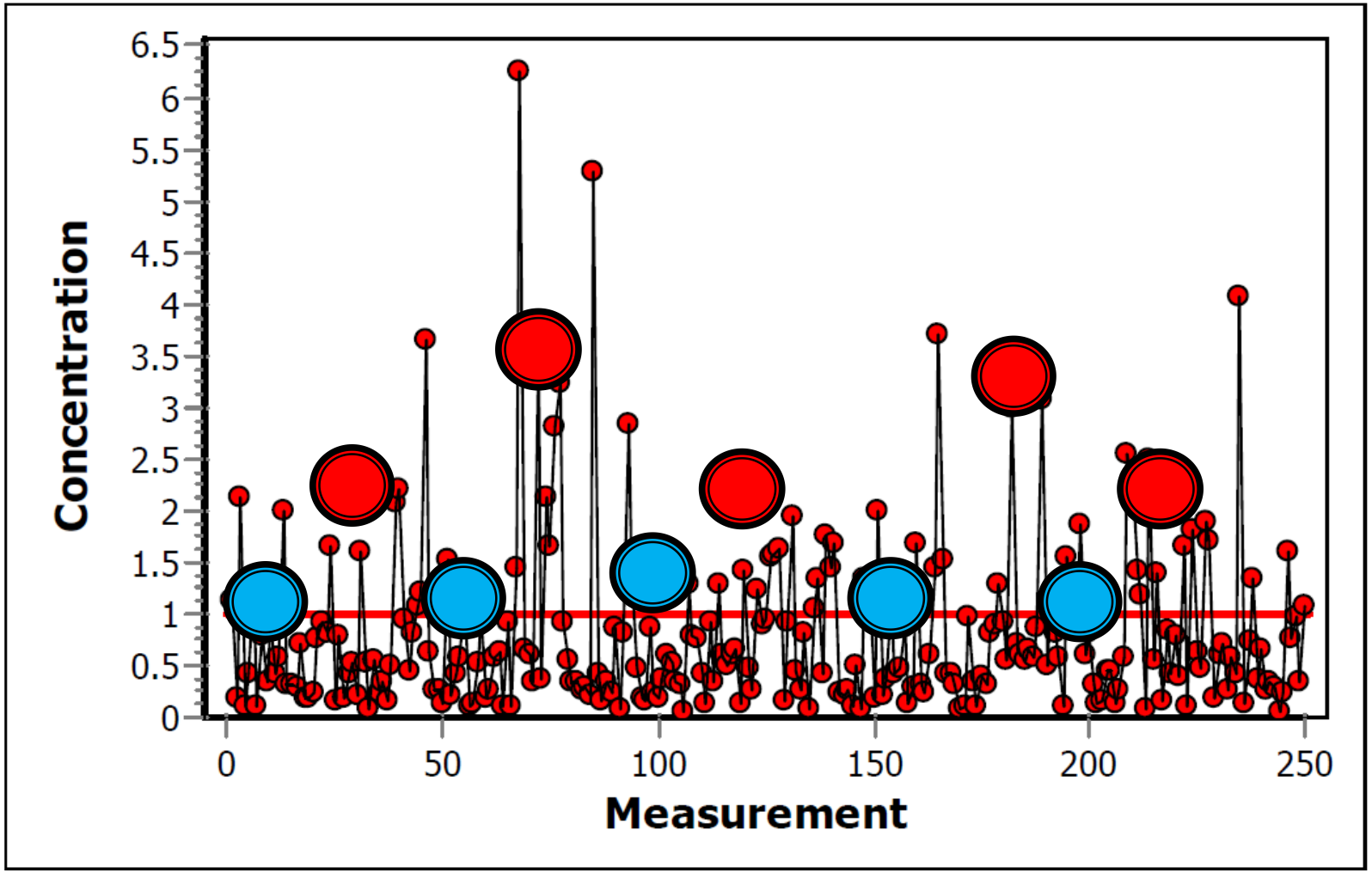
- Wet fabrication methods, without exception, with OPU for violations
- Use of PAPRs (APF 1000), including with wet methods
- Wet methods or HEPA vacuum for clean-up
- Prohibitions on compressed air, dry sweeping, use of employee rotation, walking or moving through debris
- Medical surveillance, medical removal
- Updated signage; regulated area
- Employer and PLHCP reporting of cases to CDPH, Cal/OSHA.

Even for a single worker doing the same task, exposures vary widely day-to-day.

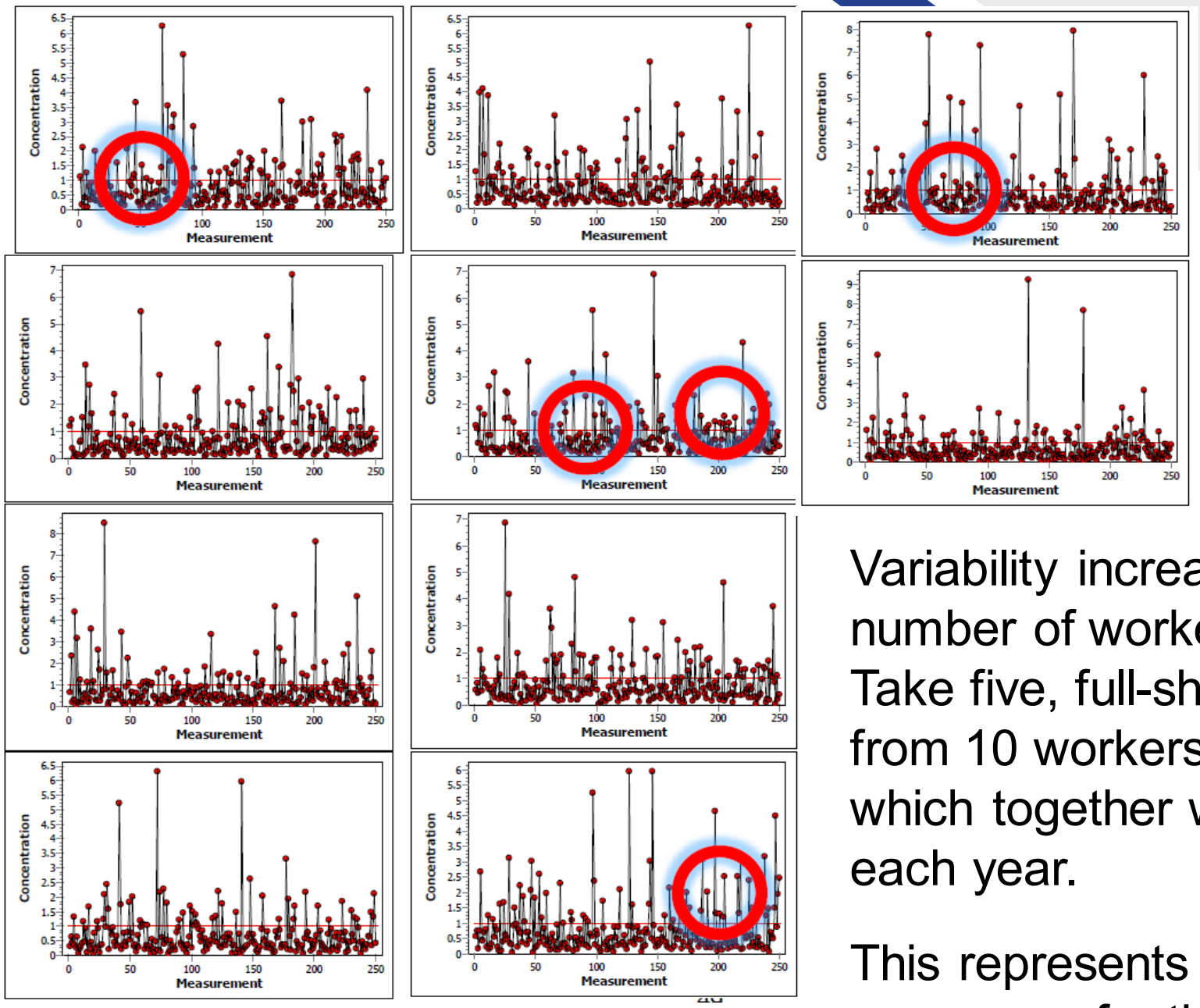


Courtesy of John Mulhaussen, PhD, CIH

Exposure measurements are “snapshots” that do not represent actual workplace conditions over time.



Courtesy of John Mulhaussen, PhD, CIH

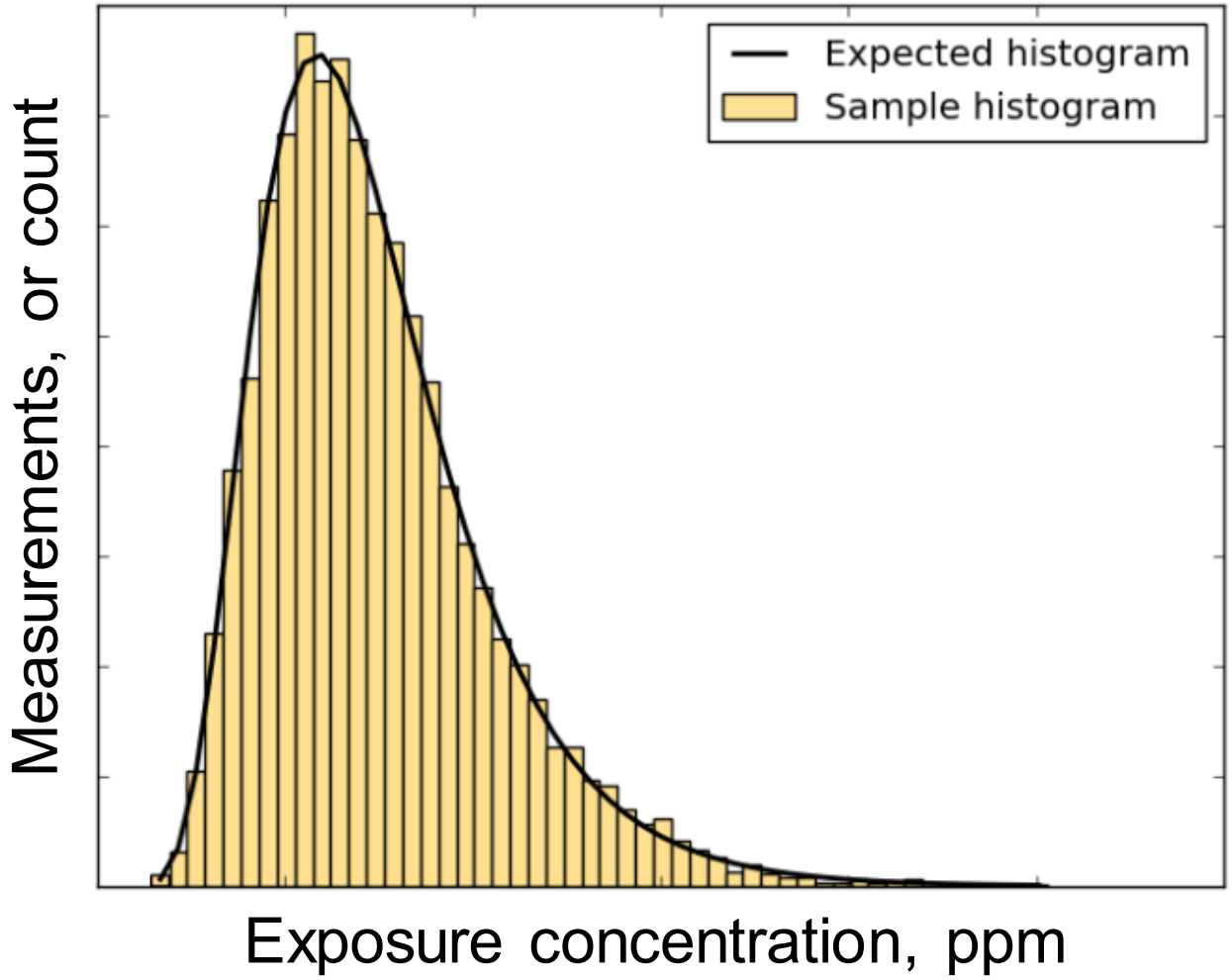


Courtesy of John Mulhaussen, PhD, CIH

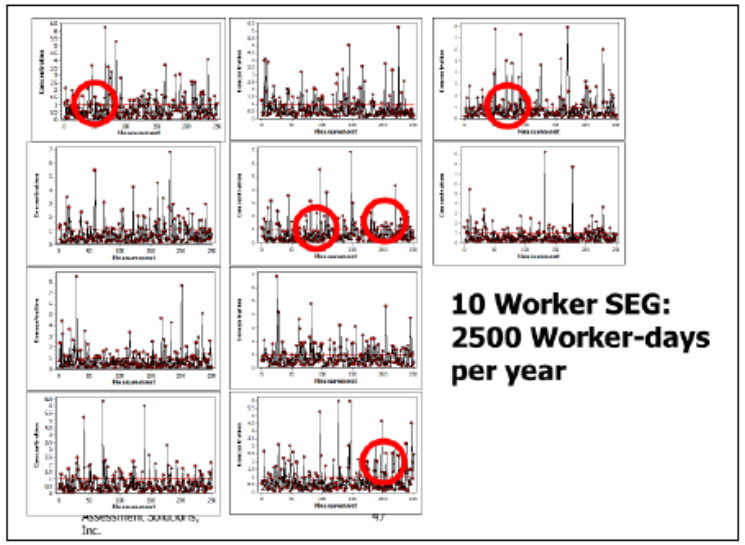
Variability increases with the number of workers in an SEG. Take five, full-shift samples from 10 workers in a SEG, which together work 2500 days each year.

This represents 0.2% of their exposures for that year.

Studies published since the 1960s show that exposure data are lognormally distributed.

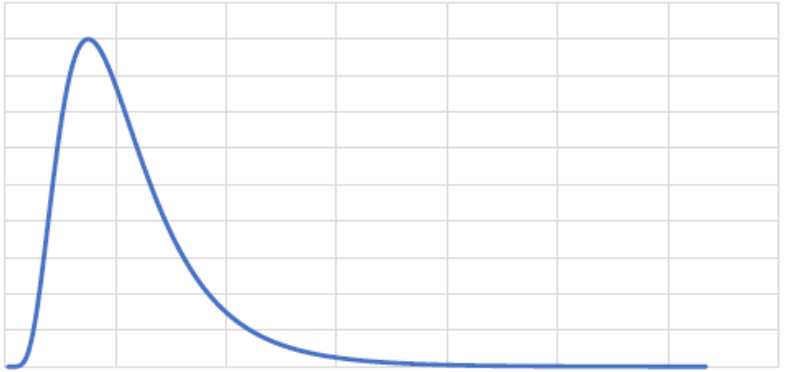


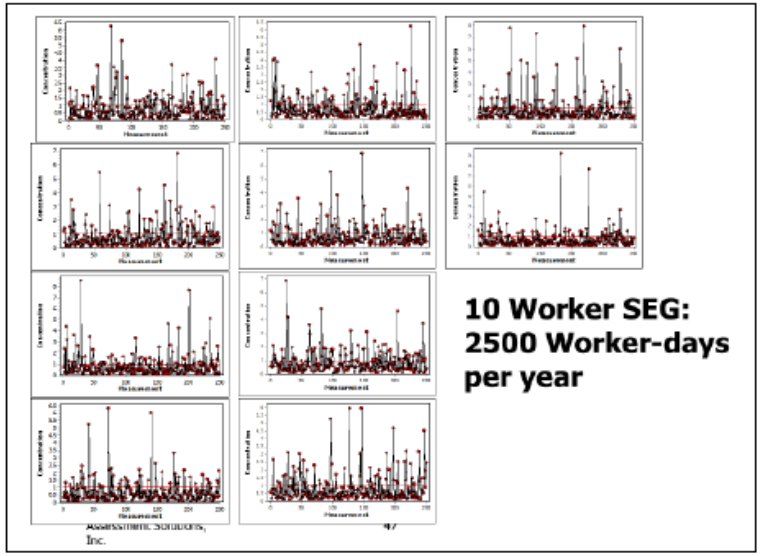
Courtesy of John Mulhaussen, PhD, CIH



Estimate From What We Looked At (Our Five Samples) . . .

Using Knowledge of Underlying Shape (Lognormal Distribution) .





The Actual Population Exposure Profile (SEG of 10 Workers)

Courtesy of John Mulhaussen, PhD, CIH

AL = 25 µg/m³

Samples, µg/m³

18

03

12

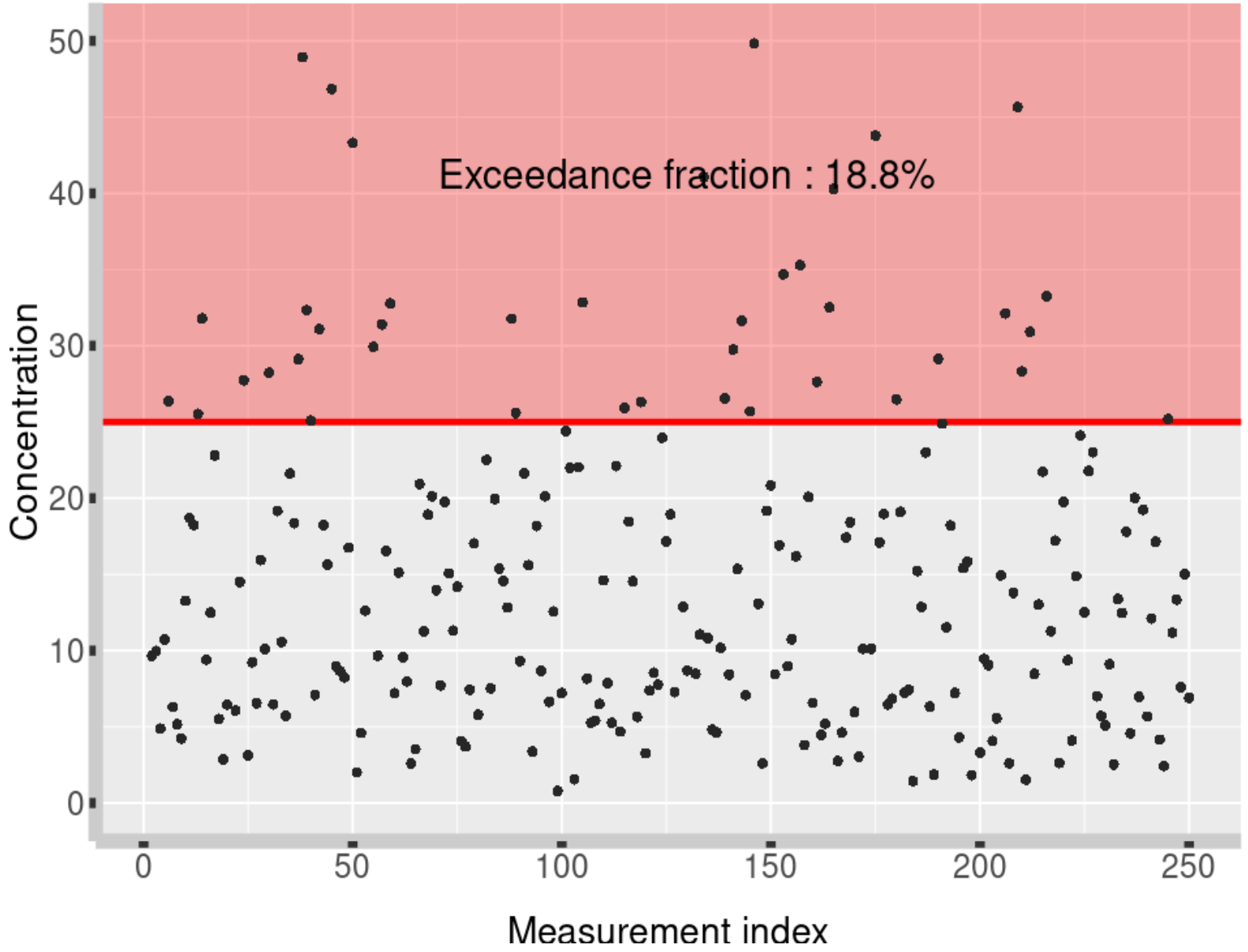
17

22

AM = 14

GM = 12

GSD = 2.23



AIHA EXPOSTATS Bayesian Calculator (2024) https://expostats.ca/site/en/tools.htm

AL = 25 µg/m³

Samples, µg/m³

50

03

12

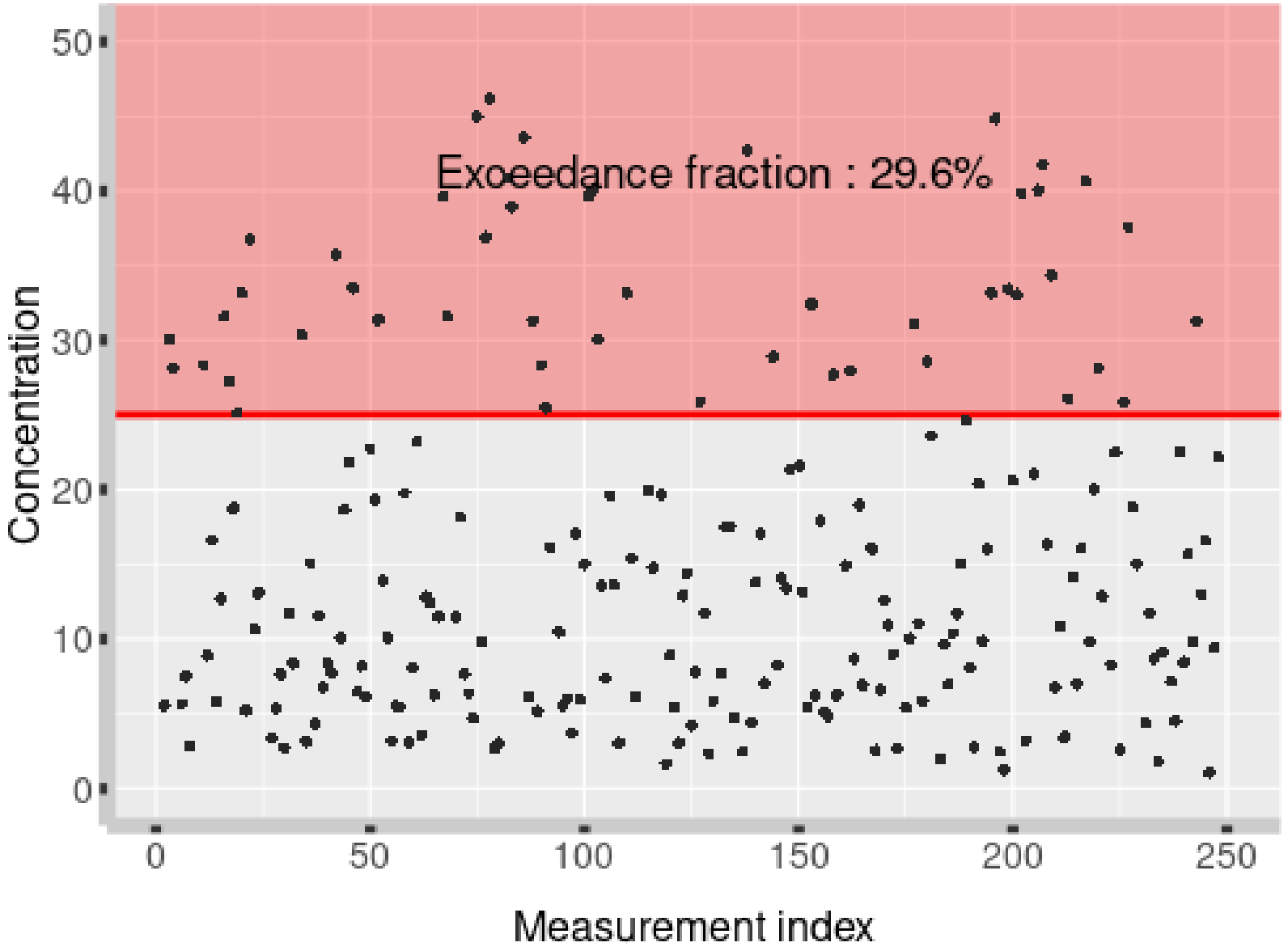
17

22

AM = 21

GM = 15

GSD = 2.8



AIHA EXPOSTATS Bayesian Calculator (2024) https://expostats.ca/site/en/tools.htm

AL = 25 µg/m³

Samples, µg/m³

112

03

12

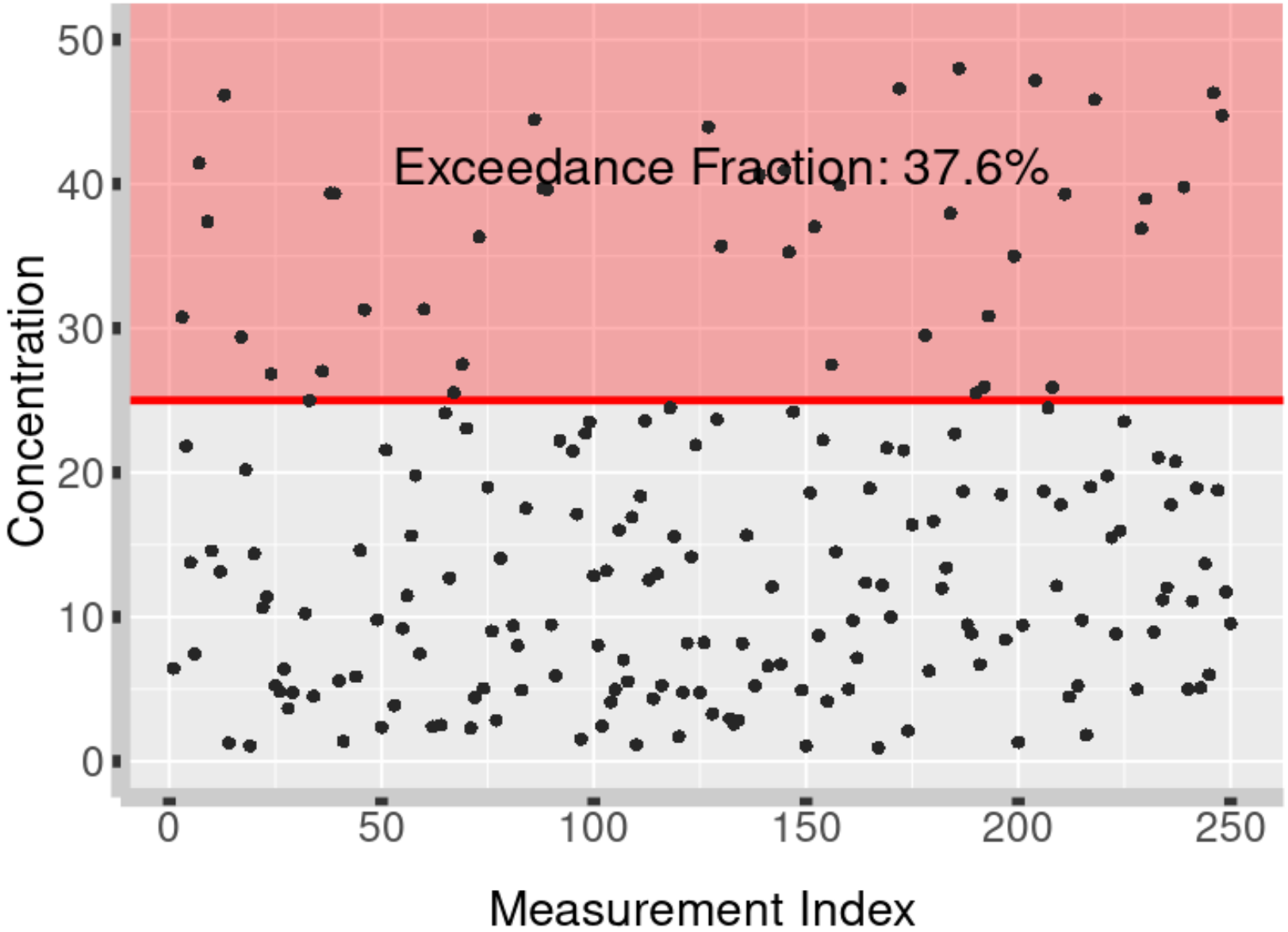
17

22

AM = 21

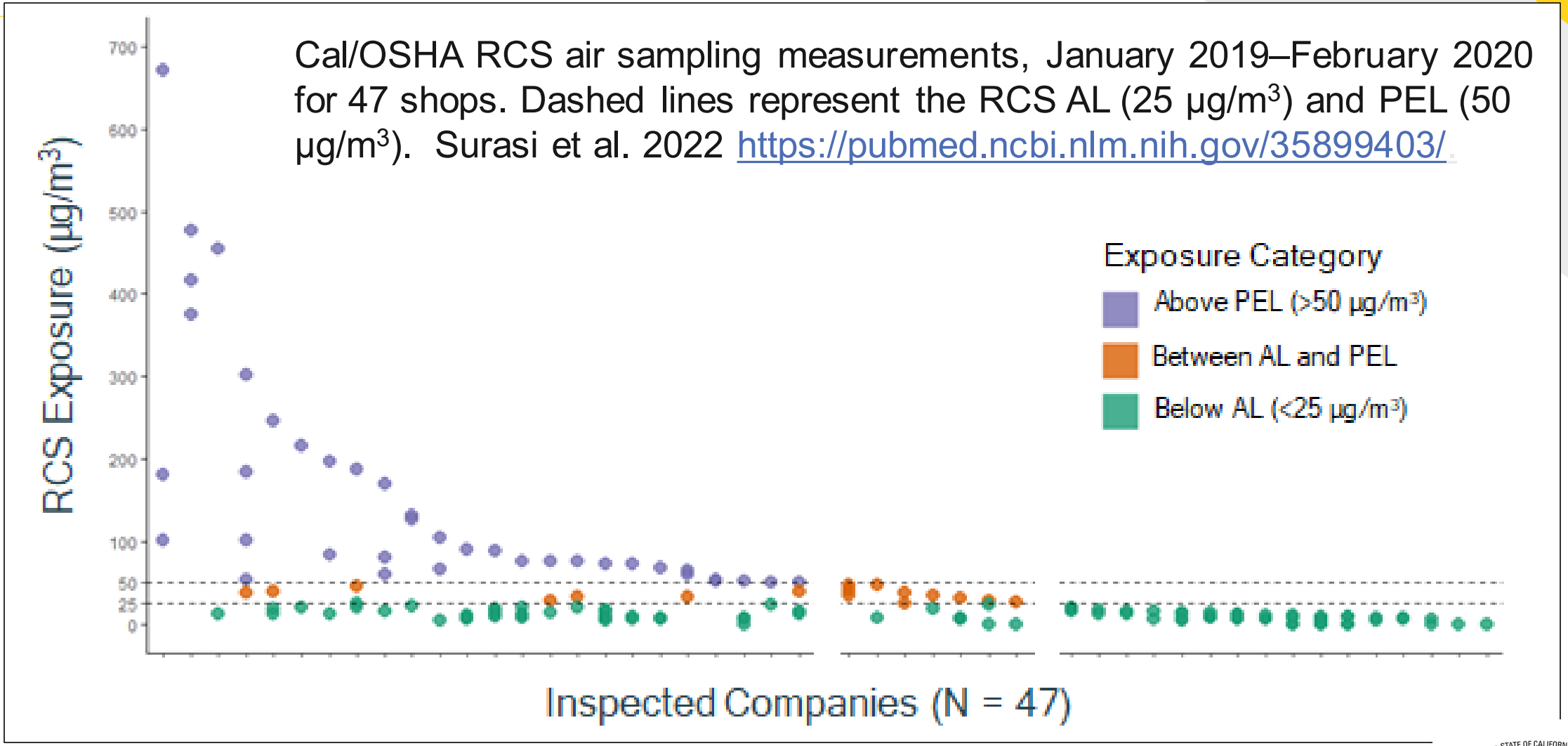
GM = 15

GSD = 2.8



AIHA EXPOSTATS Bayesian Calculator (2024) https://expostats.ca/site/en/tools.htm

Widespread Non-compliance found in the 2019-2020 SEP



(g) Imminent Hazards

- Violation of (f)(2) wet methods is a mandatory Order Prohibiting Use (OPU) by Cal/OSHA.
- No exposure sampling required. Shop closed until hazards abated.
- Violations of respiratory protection (h); reporting of silicosis (m); and carcinogen reporting (5203) may be subject to OPU.
- Imbedding OPU into regulation improves effectiveness.

Cal/OSHA's Response (Part 2)

2017	Silica Regulation (5204) adopted from federal OSHA
2019-2020	Enforcement: Silica Special Emphasis Program 106 inspections, 72% not compliant with Silica Regulation
Dec 2023	WOEMA petition 597 Feb 2023. Emergency Temporary Standard (ETS) in effect by December – HETT approach, wet methods, PAPR, wet or HEPA cleanup, OPU etc.
Feb 2025	Permanent Silica Regulation in effect – strengthened ETS requirements – Medical surveillance and removal
2024 – present	Enforcement: Silica Special Emphasis Program 124 inspections, 94% not compliant with silica regulation, 24% shut down immediately using OPU due to presence of an "imminent hazard;" 2025 Silicosis Technical Committee

Widespread non-compliance continues

Karen Smith, CIH, CSP
Cal/OSHA Senior Industrial Hygienist
May 2024

“I’m averaging about 10 citations per countertop inspection. Other CSHOs I have talked to are finding similar results. Even cutting wet, they are still over the PEL.”

“By issuing OPUs without sampling we can stop the exposures immediately. We are also requiring a higher level of protection for those workers once the shops do reopen.”

Photo: NIOSH, CDC

Fabrication work that would comply with section 5204

Non-compliant practices are the norm.

Photo: olivemill.com/the-process/shop-and-showroom

Fabrication shops lack capacity and/or will to implement protections.

Photo: olivemill.com/the-process/shop-and-showroom

California's Silicosis Epidemic in the Artificial Stone Industry

- Current status of silicosis
- Hazards of artificial stone
- Cal/OSHA's response
- **Silicosis Technical Committee: Next steps**

Board: Convene Silicosis Technical Committee

UCLA
Rachael Jones
Lizbeth Diaz
Veronica Ponce de Leon

UC San Francisco
Robert Harrison

CDPH OHB
Alya Khan
Justine Weinberg
Ximena Vergara
Jennifer Flattery
Kristin Cummings

Los Angeles County DPH
Alice Berliner
Lisa Patrick-Mudd

Georgia Institute of Technology
Jenny Houlroyd

Instituto de Educacion Popular del Sur de California
Meagen Ortiz

Cal/OSHA Enforcement
Karen Smith

Cal/OSHA Research and Standards
Eric Berg
Kevin Graulich
Betsey Noth
Mike Wilson

Cal/OSHA Medical Unit
Margeret Murray
Mary Kochie
Janice Prudhomme
Paul Papanek

Ucla
UCSF University of California San Francisco
CDPH California Department of Public Health
County of Los Angeles
IDEPSCA
STATE OF CALIFORNIA CAL OSHA DEPARTMENT OF INDUSTRIAL RELATIONS
DIR EST. 1927 State of California Department of Industrial Relations

Silicosis Technical Committee

- Cost to industry of silica standard over 10 years: $66M.
- Benefits over 10 years: $603M in medical costs avoided.
- Figure does not include lost wages and benefits, lost lifetime productivity, family care and expenses, pain and suffering from losing family member.
- Benefits accrue only if industry implements the standard.
- Heinzerling 2025: Medi-Cal has covered 64% of lung transplants. No worker received workers compensation coverage for their treatment (Heinzerling 2025).

Heinzerling, Flattery, Sooley, Harrison, Gibb, Fazio, Ghanhi, Cummings (May 2025). Characteristics of California Engineered Stone Countertop Fabrication Workers Undergoing Lung Transplantation.

Silicosis Technical Committee

Silicosis epidemic is a violation of the human right to life. It can also be thought of as a market failure with at least three causes:

- **Externalities**
  - Costs of silicosis are passed on to workers, families and the public, not incorporated into price.
- **Inequity**
  - Silicosis worsens existing inequities for immigrant, non-union, low income workers.
- **Information asymmetry**
  - Manufacturers not adequately transmitting hazard information to employers and workers.

Market Failures

Direct Policy Mechanisms

DIRECT POLICY MECHANISMS

- Strengthen safety regulations
- Enhance enforcement
- Implement licensing scheme
- Phase-out all handling
- Immediately prohibit all handling

Indirect Policy Mechanisms

INDIRECT POLICY MECHANISMS

- Point-of-sale fee
- Warning label
- Educate workers, employers
- Increase insurance premiums
- Require public reporting
- Tax credits for safer alternatives
- Presumption under WC
- Support workers to unionize
- Tech assistance for alternatives
- Subsidies for safer alternatives

DIRECT POLICY MECHANISMS

- Strengthen safety regulations
- Enhance enforcement
- Implement licensing scheme
- Phase-out all handling
- Immediately prohibit all handling

INDIRECT POLICY MECHANISMS

- Point-of-sale fee
- Warning label
- Educate workers, employers
- Increase insurance premiums
- Require public reporting
- Tax credits for safer alternatives
- Presumption under WC
- Support workers to unionize
- Tech assistance for alternatives
- Subsidies for safer alternatives

PRINCIPLES OF EFFECTIVE PUBLIC POLICY

- Match the severity and immediacy of harm
- Protect the most vulnerable, improve equity
- Motivate technology innovation
- Maintain or expand employment
- Place the fewest demands on public agencies
- Leverage market forces
- Emphasize prevention over mitigation
- Influence the full product life cycle

PRINCIPLES OF EFFECTIVE PUBLIC POLICY

- Match the severity and immediacy of harm
- Protect the most vulnerable, improve equity
- Motivate technology innovation
- Maintain or expand employment
- Place the fewest demands on public agencies
- Leverage market forces
- Emphasize prevention over mitigation
- Influence the full product life cycle

DIRECT POLICY MECHANISMS

- ETS already implemented
- Permanent rule implemented
- Licensing time period too lengthy
- Recommend: Prohibit all handling of AS, immediate or phased in over time.

INDIRECT POLICY MECHANISMS

- Silicosis ca[illegible]nful death at a yo[illegible] mech[illegible] the seve[illegible] harr[illegible]
- Effec[illegible]he cost of[illegible]eaths.
- Allow cases [illegible]aths to grow during implementation.

Silicosis Technical Committee

- Silicosis is 100% preventable.
- Silicosis is killing young, immigrant workers.
- Large and growing occupational health emergency.
- Burden of disease and death is underestimated.
- Market for artificial stone is increasing 5% per year.
- LA rebuild will accelerate need for artificial stone.
- Unable to “enforce our way out of the problem.”
- Under current industry structure, it is not feasible to fabricate artificial stone safely.

Silicosis Technical Committee

"Because artificial stone is an optional, aesthetic design choice rather than a product that might be viewed as essential to the public, the Committee concluded that the risks of continuing to fabricate it into countertops far exceed its benefits to the public."

August 2025

Silicosis Technical Committee

UCLA
Rachael Jones
Lizbeth Diaz
Veronica Ponce de Leon

UC San Francisco
Robert Harrison

CDPH OHB
Alya Khan
Justine Weinberg
Ximena Vergara
Jennifer Flattery
Kristin Cummings

Los Angeles County DPH
Alice Berliner
Lisa Patrick-Mudd

Georgia Institute of Technology
Jenny Houlroyd

Instituto de Educacion Popular del Sur de California
Meagen Ortiz

Cal/OSHA Enforcement
Karen Smith

Cal/OSHA Research and Standards
Eric Berg
Kevin Graulich
Betsey Noth
Mike Wilson

Cal/OSHA Medical Unit
Margeret Murray
Mary Kochie
Janice Prudhomme
Paul Papanek

Ucla
UCSF University of California San Francisco
CDPH California Department of Public Health
County of Los Angeles
IDEPSCA
STATE OF CALIFORNIA CAL OSHA DEPARTMENT OF INDUSTRIAL RELATIONS
DIR EST. 1927 State of California Department of Industrial Relations