Emerging Issues: NIOSH Update

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Presentation Outline

About NIOSH and its Partnerships
Disease Detective Case Study 1
Confusing Chemicals
Occupational Exposure Banding
Disease Detective Case Study 2

About NIOSH and its Partnerships

NIOSH Mandate

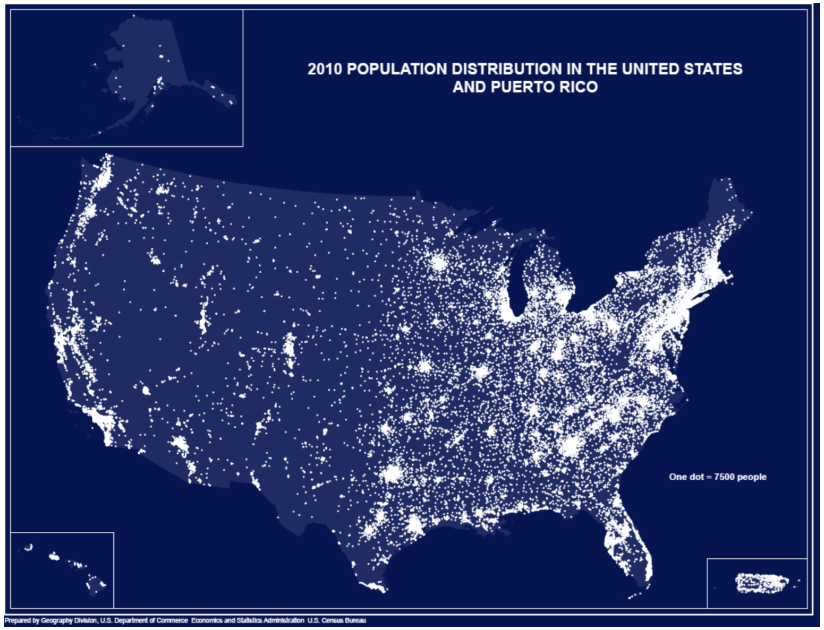
NIOSH has the mandate to assure “every man and woman in the Nation safe and healthful working conditions and to preserve our human resources.”

Occupational Safety and Health Act of 1970

US Workforce Statistics

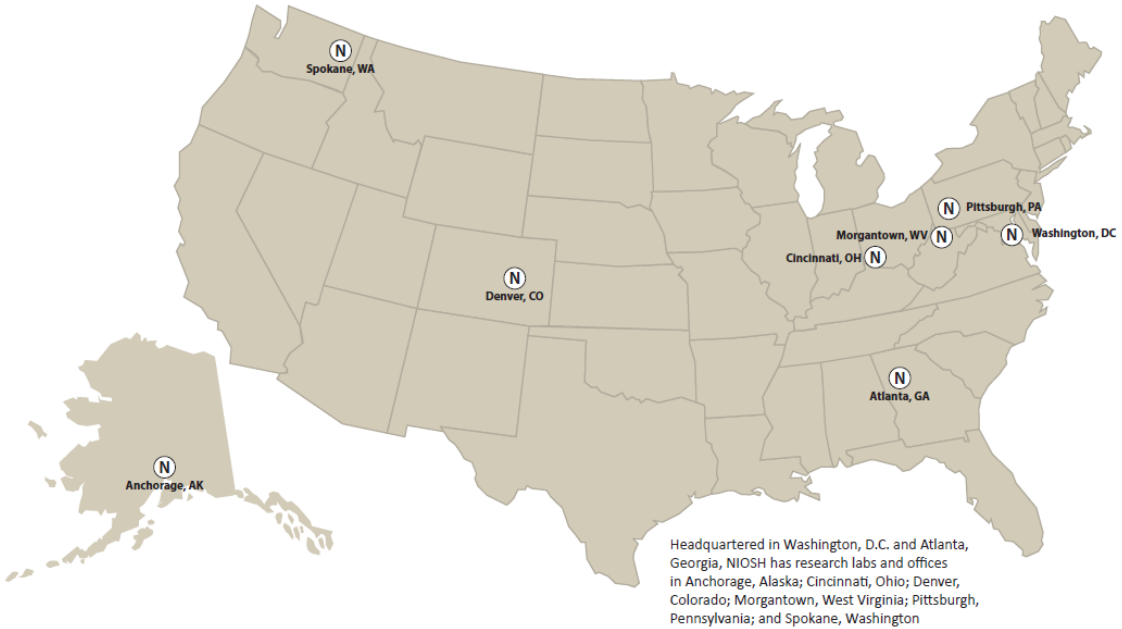
Around 160 million workers in the United States[1]

$250 billion in medical costs and productivity losses[2]



1.BLS 2017
2.Leigh 2011

The NIOSH mission is to develop new knowledge in the field of occupational safety and health, and to transfer that knowledge into practice.



NIOSH Work is Inherently Collaborative

Government, Industry, Labor, Professional Societies, Academia, Others

Why?

- Broad mission
- Large, diverse and geographically dispersed workforce
- Changing economic conditions
- Evolving technology and science
- Inherent challenge of moving science into practice

Why engage in partnership?

- Solve complex problems
- Accelerate discovery or innovation
- Facilitate knowledge translation or diffusion
- Optimize resource management
- Create value

NIOSH Partnership with AIHA

- NIOSH and AIHA have had a partnership agreement for almost 15 years
- Periodic identification of mutual areas of interest
- Examples of partnership activities
  - Webinars on nanomaterials
  - Enhancing the NIOSH Pocket Guide
  - Developing an App for IH Calculations
  - Integrating Safety Matters into school curricula
  - Identifying worksites for NIOSH projects
- Contact the AIHA board liaison from your local section or committee

Disease Detective

Case Study

Disease Detective – Chronic cough and shortness of breath

- A 38 year old male visits his primary care physician because of a chronic cough and shortness of breath when climbing stairs.
- His symptoms began two years ago and are getting progressively worse.

What could be causing these symptoms?

- Asthma
- Cancer
- Chemical or toxin
- Chronic obstructive pulmonary disease
- Infection
- Immune disorder
- Medication

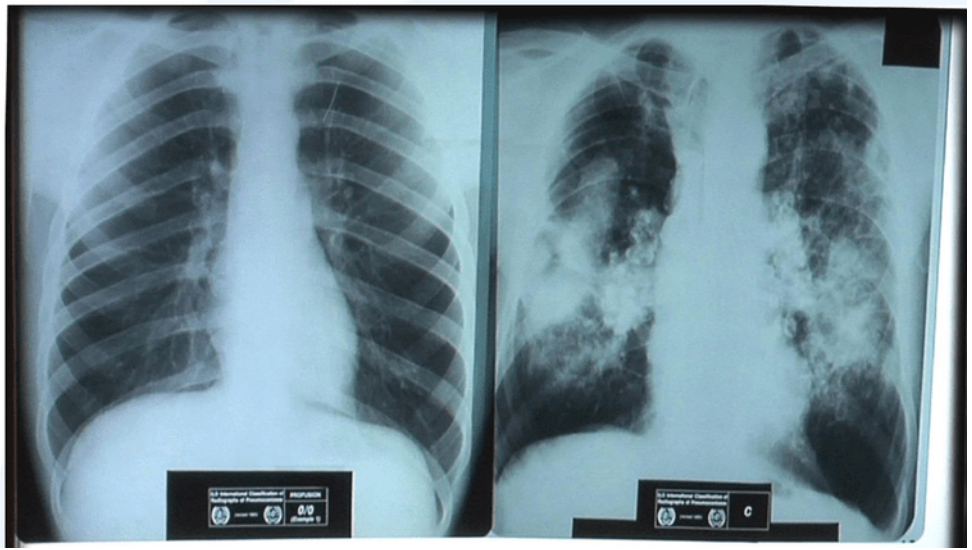
What additional history would be helpful?

- He was previously in good health
- Has no medical conditions
- Does not smoke
- Occasionally takes acetaminophen for shoulder pain

Chest X-ray and CT Scan Results

Chest x-ray shows large round opacities

CT scan shows ground glass appearance



What about an occupational history?

- He works as a subcontractor for a kitchen remodeling company
- He started with is present employer 18 months ago
- He has done similar work for the past 10 years
- His job tasks include installing cabinetry and counter tops
- He wears personal protective equipment intermittently

Disease Detective – Key Questions

- What is the likely occupational hazard?
- What is the source?
- What job tasks are associated with exposure?
- How do you protect workers?

Crystalline silica

- Exposure to respirable crystalline silica is associated with silicosis, lung cancer, pulmonary tuberculosis, and airways diseases.
- Exposures may also be related to autoimmune disorders, chronic renal disease and other adverse health effects.

Industries and occupations associated with silica exposure

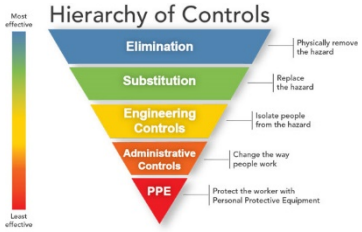
- Construction
- Countertop manufacturing, finishing and installation
- Dentistry
- Hydraulic fracturing
- Mining
- Sandblasting

Work operations leading to exposure to crystalline silica dust

- Operating powered hand tools for cutting, grinding, edging and contouring
- Opening bags of ground quartz
- Moving or mixing bulk raw materials
- Cleaning and scraping mixers
- Cleaning dust collector bag houses

OSHA/NIOSH [2015]

Controlling exposure to silica dust



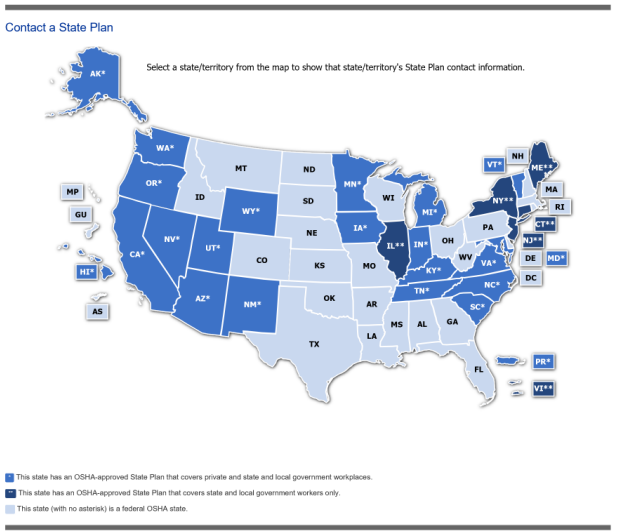
Strategy	Control
Elimination	Different countertop materials
Substitution	Less toxic formulation
Engineering	Water spray systems, hand tools with a shroud, local exhaust ventilation
Administrative	Wet sweeping, prewash stone slabs, regular housekeeping for water slurry and settled dust, training, medical monitoring
PPE	Respirators

OSHA/NIOSH [2015]

Federal OSHA and State Plan Silica Standards

Requires employers to limit worker exposures to respirable crystalline silica and to take other steps to protect workers.

Federal OSHA	Cal OSHA
General Industry, 1910.1053 - Respirable crystalline silica	General Industry, § 5204. Occupational Exposures to Respirable Crystalline Silica
Construction, 1926.1153 – Respirable crystalline silica	Construction, § 1532.3. Occupational Exposures to Respirable Crystalline Silica



Severe silicosis in engineered stone fabrication workers, MMWR, 2019

- Respirable crystalline silica exposure causes silicosis
- Cases have been previously reported internationally
- In 2019, 18 cases of silicosis, including 2 deaths, were reported in CA, CO, TX and WA.
- Several workers also had latent tuberculosis and autoimmune disease
- Stone fabrication workers, especially those working with engineered stone are at risk for silicosis
- Reducing exposure, complying with standards and conducting medical screening can protect workers

MMWR 2019

Centers for Disease Control and Prevention

MMWR

Silicosis in Stone Fabrication Workers

Silicosis

- **Incurable** lung disease
- Occurs after **breathing silica dust**

Workers are at risk

18 cases in **4** states

2 deaths

Most worked with engineered stone

How to protect workers

- **Control and monitor** exposures
- **Comply** with standards

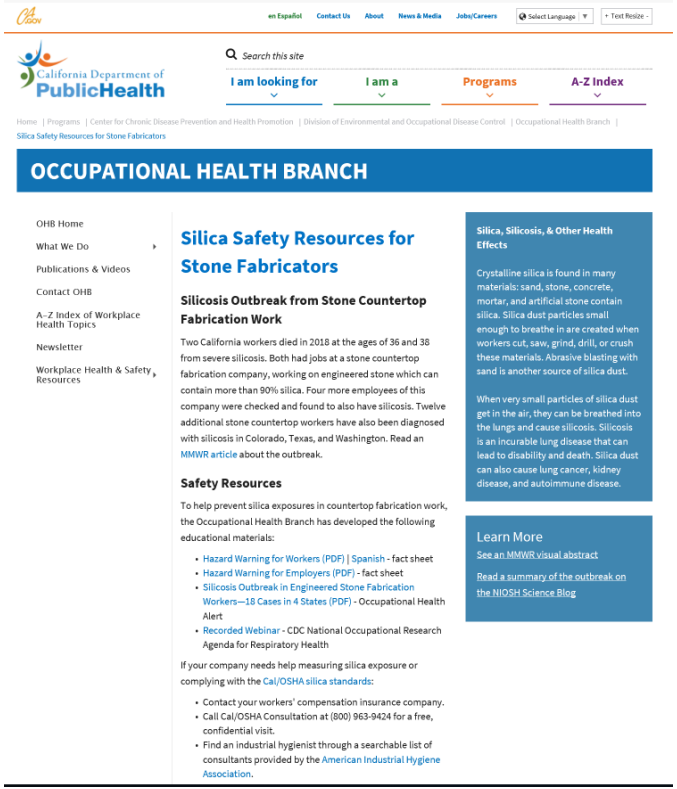
- **Conduct** medical screening

Cases identified in CA, CO, WA, and TX through surveillance and case reports as published in Rose, Heinzerling, et al. MMWR 2019. bit.ly/CDCVA31

WWW.CDC.GOV

CS 282376-AB

California Resources



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Silica Safety Resources for Stone Fabricators

Silicosis Outbreak from Stone Countertop Fabrication Work

Two California workers died in 2018 at the ages of 36 and 38 from severe silicosis. Both had jobs at a stone countertop fabrication company, working on engineered stone which can contain more than 90% silica. Four more employees of this company were checked and found to also have silicosis. Twelve additional stone countertop workers have also been diagnosed with silicosis in Colorado, Texas, and Washington. Read an MMWR article about the outbreak.

Safety Resources

To help prevent silica exposures in countertop fabrication work, the Occupational Health Branch has developed the following educational materials:

- Hazard Warning for Workers (PDF) | Spanish - fact sheet
- Hazard Warning for Employers (PDF) - fact sheet
- Silicosis Outbreak in Engineered Stone Fabrication Workers—18 Cases in 4 States (PDF) - Occupational Health Alert
- Recorded Webinar - CDC National Occupational Research Agenda for Respiratory Health

If your company needs help measuring silica exposure or complying with the Cal/OSHA silica standards:

- Contact your workers' compensation insurance company.
- Call Cal/OSHA Consultation at (800) 963-9424 for a free, confidential visit.
- Find an industrial hygienist through a searchable list of consultants provided by the American Industrial Hygiene Association.

Silica, Silicosis, & Other Health Effects

Crystalline silica is found in many materials: sand, stone, concrete, mortar, and artificial stone contain silica. Silica dust particles small enough to breathe in are created when workers cut, saw, grind, drill, or crush these materials. Abrasive blasting with sand is another source of silica dust.

When very small particles of silica dust get in the air, they can be breathed into the lungs and cause silicosis. Silicosis is an incurable lung disease that can lead to disability and death. Silica dust can also cause lung cancer, kidney disease, and autoimmune disease.

Learn More

See an MMWR visual abstract

Read a summary of the outbreak on the NIOSH Science Blog

https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/OHB/Pages/SilicaStoneFabricators.aspx

Confusing Chemicals

Glyphosate

- Most widely used herbicide in the United States and worldwide
- Applied as a formulation (or mixture) with other substances that help plants to absorb glyphosate
- Prevents susceptible plants from making proteins that are needed for growth
- Use of glyphosate has risen dramatically due to development of glyphosate-resistant genetically modified crops
- Most people are exposed to residual amounts of glyphosate by ingestion of food or water

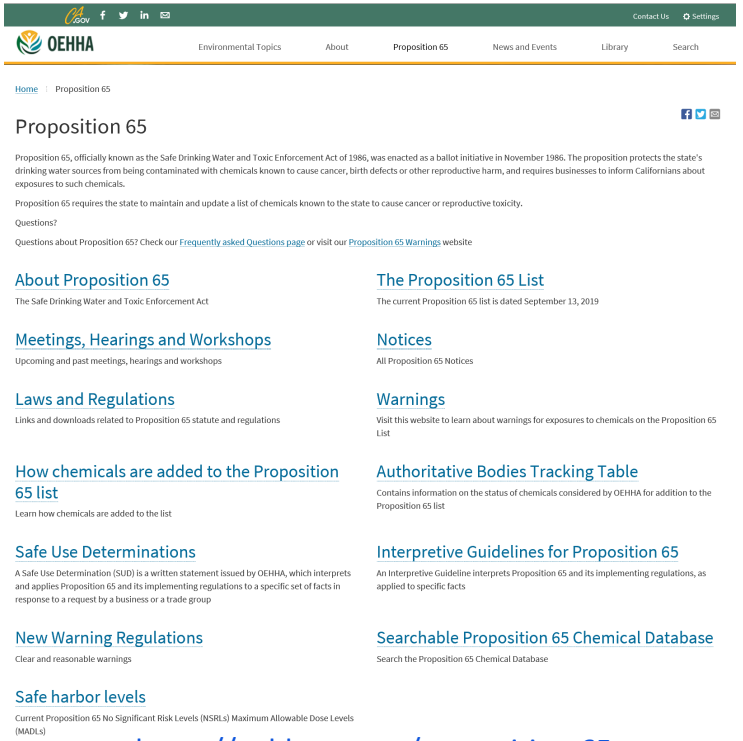
NTP 2019

Glyphosate, glyphosate based formulations and Cancer Assessments

Agency	Date	Determination
US Environmental Protection Agency	December 12, 2017	Not likely to be carcinogenic to humans
California's Office of Environmental Health Hazard Assessment	July 7, 2017	Known to the State of California to Cause Cancer
Joint Food and Agricultural Organization of the United Nations/World Health Organization Meeting on Pesticide Residues	May 2016	Glyphosate is unlikely to pose a carcinogenic risk to humans from exposure in the diet
European Food Safety Authority	November 2015	Unlikely to pose a carcinogenic risk for humans
International Agency for Research on Cancer	March 2015	Probably carcinogenic to humans • Limited evidence in humans • Sufficient in animals
National Toxicology Program	1992	No genotoxicity and few systemic effects

Proposition 65

- Officially known as the Safe Drinking Water and Toxic Enforcement Act of 1986
- Protects the state's drinking water sources from being contaminated with chemicals known to cause cancer, birth defects or other reproductive harm
- Requires businesses to inform Californians about exposures to such chemicals.
- Requires California to publish a list of such chemicals



https://oehha.ca.gov/proposition-65

Proposition 65

- Health and Safety code 25249.8(a). Section 6382(b)(1) “a chemical shall be included on the [Proposition 65] list if it is classified by [IARC]…as (2) probably carcinogenic to humans (Group 2A) with sufficient evidence of carcinogenicity in experimental animals…” 27 Cal. Code Regs 25904(b).
- OEHHA decision on glyphosate is based on Labor Code mechanism

National Toxicology Program Research Plan

- Evaluate whether glyphosate is genotoxic (causes DNA damage)
- Evaluate whether glyphosate induces oxidative damage
- Compare the effects of glyphosate on measures of genotoxicity, oxidative stress, and cell viability to the effects of glyphosate-based formulations
- Identify data gaps on the effects of glyphosate and glyphosate-based formulations on human health outcomes other than cancer.

NTP 2019

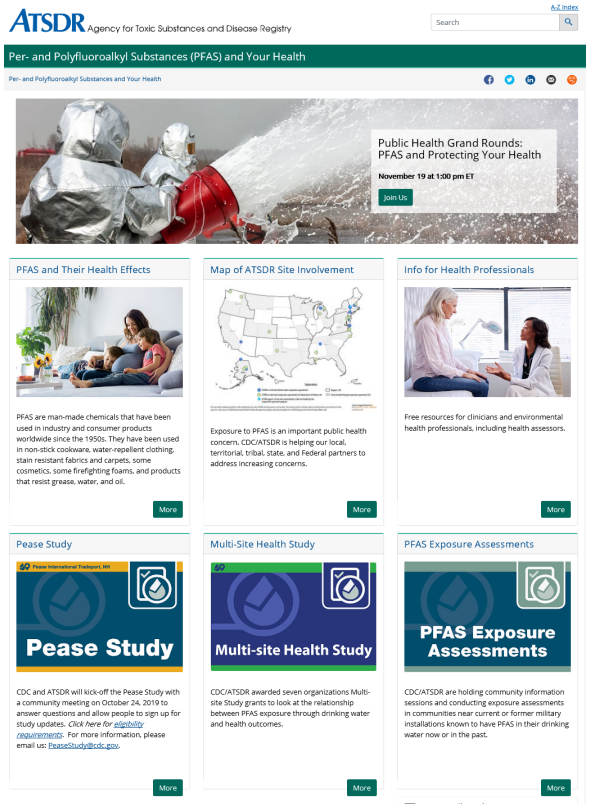
NIOSH Evaluation of Occupational Glyphosate Exposures

- We evaluated employee exposures when they mixed and applied herbicides in a national park.
- We saw evidence of herbicide contamination on employees' boots, clothing, and in work areas.
- Environmental conditions approached limits for heat stress.
- Some employees reported symptoms that are consistent with early heat illness.
- Some employees reported musculoskeletal symptoms.
- We recommended improvements in training and developing written site-specific policies and procedures for herbicide handling.

NIOSH 2017

Questions About PFAS

- What is PFAS?
- How might I get exposed to PFAS?
- Can exposure affect my health?
- How do I know if I am being exposed?
- What can I do to protect myself?
- Is NIOSH doing any research on PFAS?



Per- and Polyfluoroalkyl Substances (PFAS)

- A group of over 3,000 man-made chemicals[1]
- Used in many different industry and consumer products, including stain-resistant textiles, food-handling materials, firefighting foam, medical devices, personal care products, construction materials, and industrial processing aids.

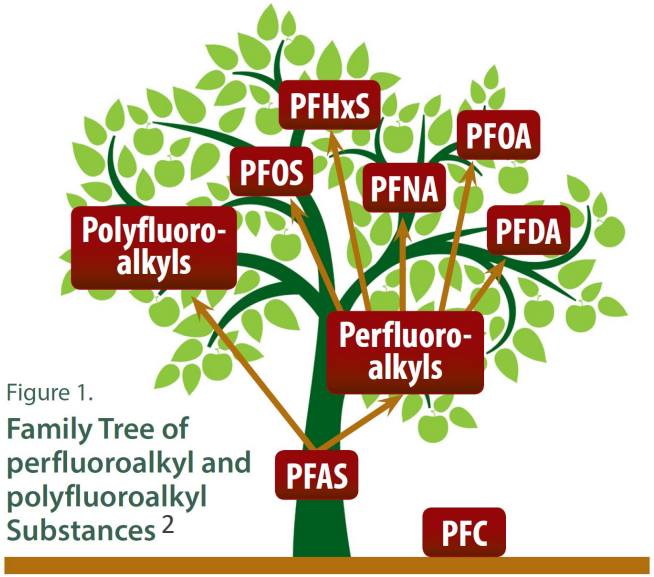
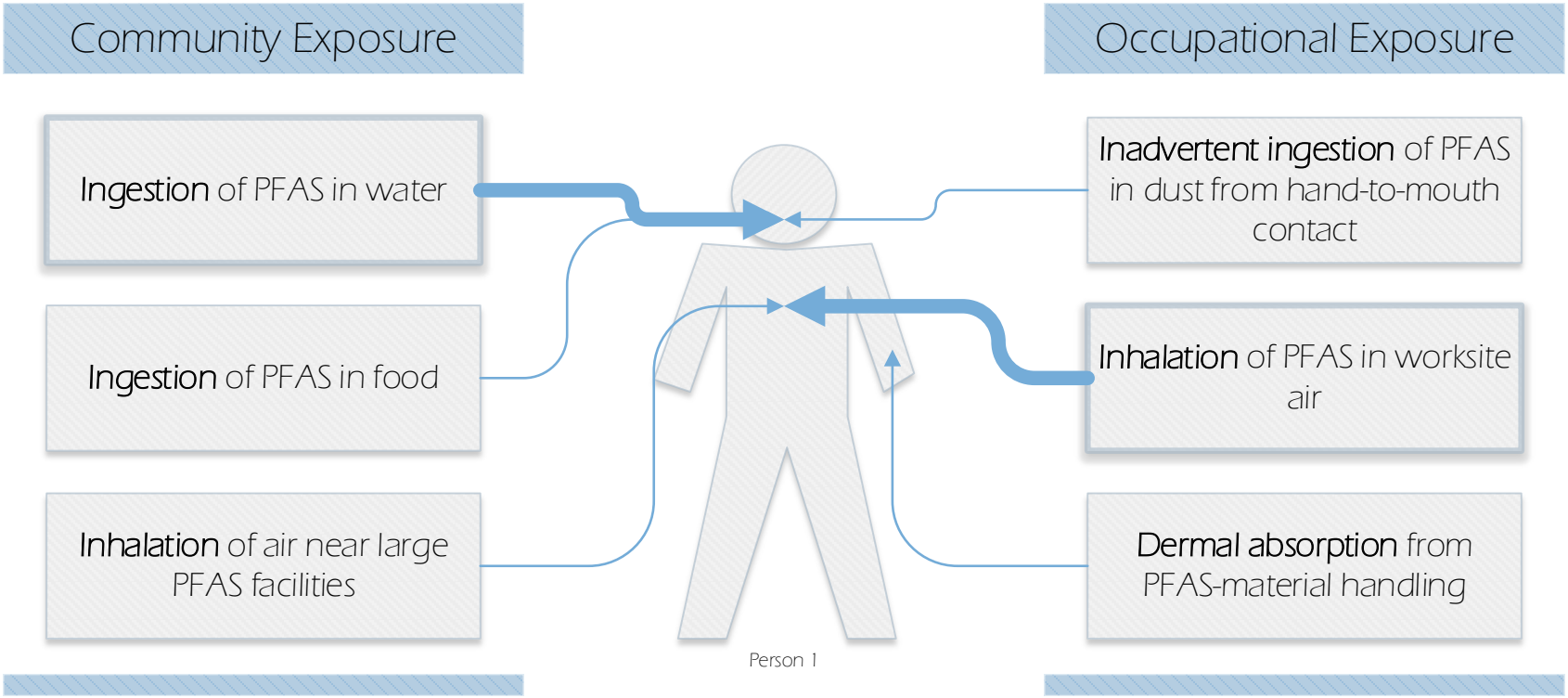


Figure 1.
Family Tree of perfluoroalkyl and polyfluoroalkyl Substances [2]

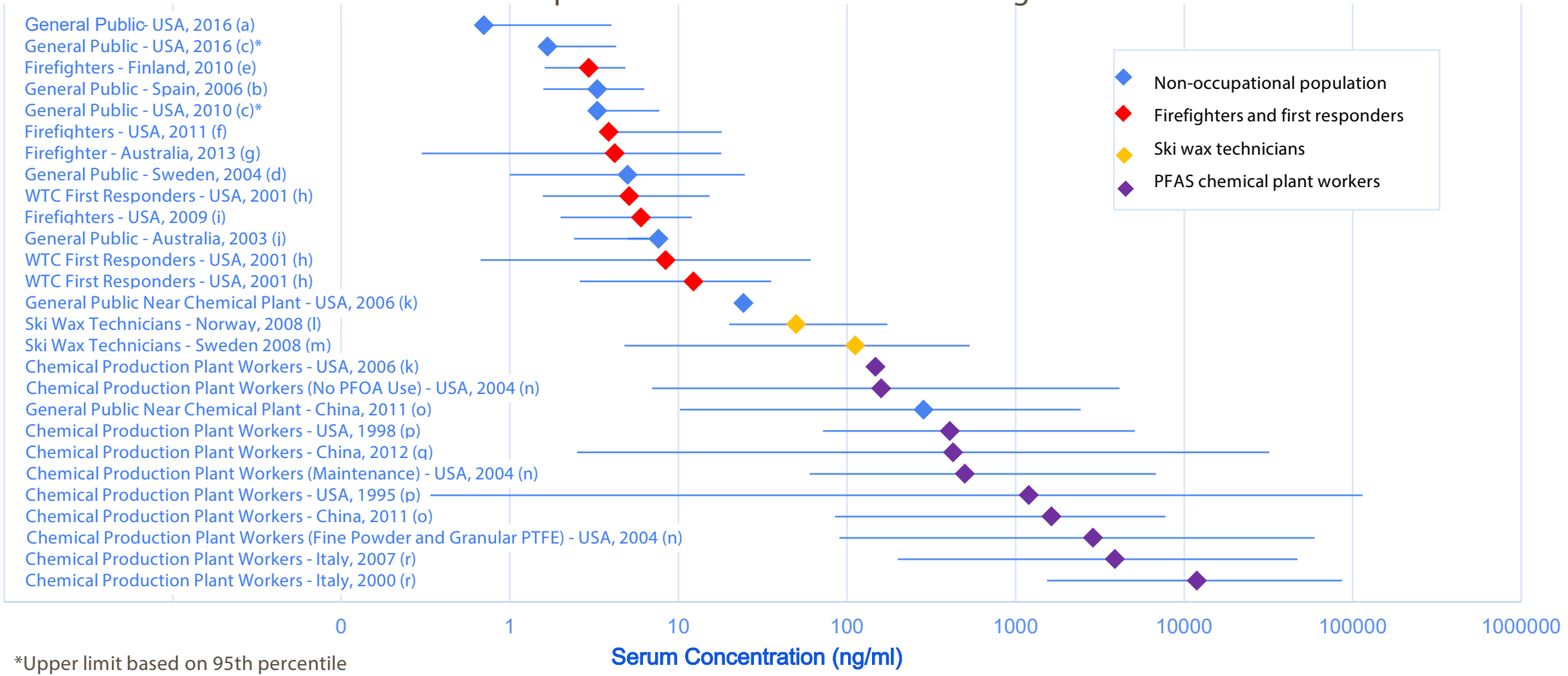
1. ITRC 2017
2. ATSDR 2017

Exposure Routes and Pathways



Comparison of PFOA in Serum, Plasma, or Whole Blood by Population, Geographic Region, and Year of Most Recent Test

-Comparison based on median and range-



*Upper limit based on 95th percentile

(a) Kato et al., 2018; (b) Ericson et al., 2007; (c) CDC, 2019; (d) Karrman et al., 2006b; (e) Laitinen et al., 2014; (f) Dobraca et al., 2015; (g) Rotander et al., 2015; (h) Tao et al., 2008; (i) Shaw et al., 2013; (j) Karrman et al., 2006a; (k) Steenland et al., 2009; (l) Freberg et al., 2010; (m) Nilsson et al., 2010; (n) Woskie et al., 2012; (o) Wang et al., 2012; (p) Olsen et al., 2007; (q) Fu et al., 2016; (r) Costa et al., 2009

Epidemiology Studies Linking PFAS and Health Effects

Target	Effect
Hepatic	Increases in total cholesterol and LDL cholesterol
Cardiovascular	Pregnancy induced hypertension and preeclampsia
Endocrine	Increased risk of thyroid disease
Immune	Increased risk of asthma
Reproductive	Decreased fertility
Developmental	Decreased birth weight

ATSDR 2018

PFOA, PFOS and Proposition 65

- Effective November 10, 2017, the Office of Environmental Health Hazard Assessment (OEHHA) added perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) to the list of chemicals known to the state to cause reproductive toxicity (developmental endpoint) for purposes of Proposition 65.[1]
- The listing of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) is based on formal identification by the US Environmental Protection Agency (US EPA), an authoritative body, that the chemicals cause reproductive toxicity.[2]

1. The Safe Drinking Water and Toxic Enforcement Act of 1986, Health and Safety Code section 25249.5 et seq.
2. See Health and Safety Code section 25249.8(b) and Title 27, Cal. Code of Regs., section 25306.

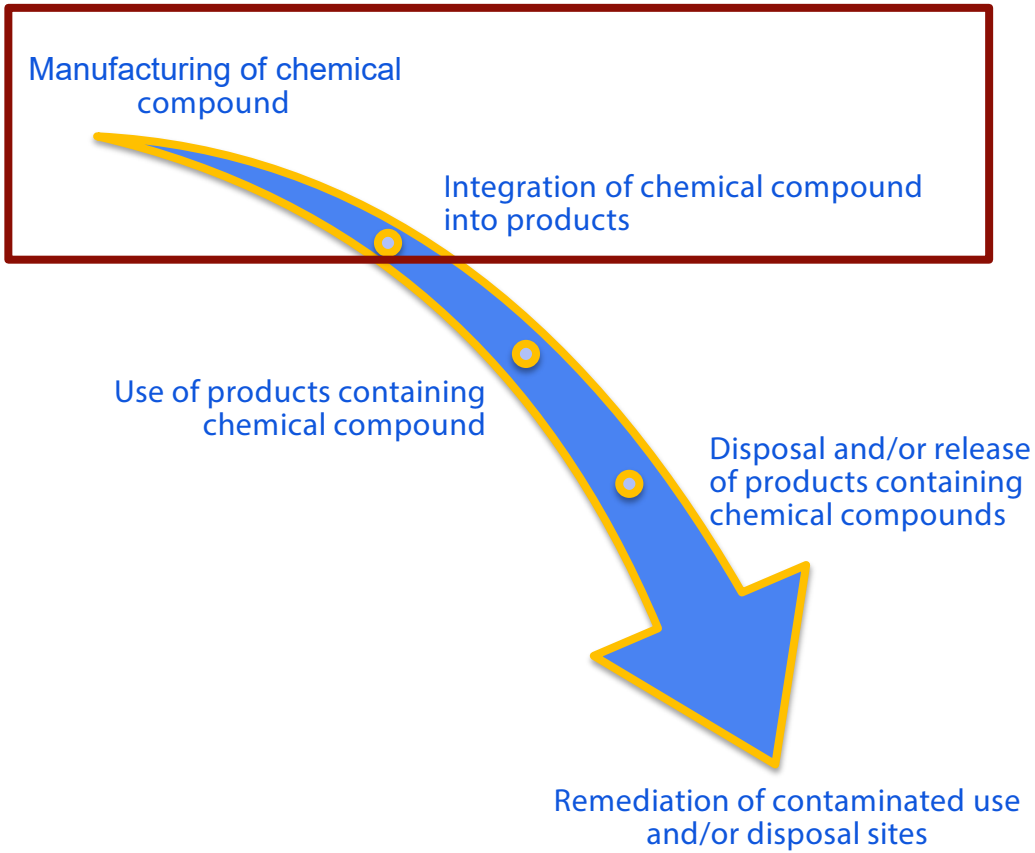
PFOA and PFOS Cancer Assessments

Agency	Determination
EPA[1,2]	There is “suggestive evidence of carcinogenic potential” for PFOA and PFOS.
IARC[3]	Perfluorooctanoic acid (PFOA) is possibly carcinogenic to humans (Group 2B). A positive association was observed for cancers of the testis an kidney.

1. EPA. 2016d
2. EPA. 2016e
3. IARC 2016

Occupational Exposures

- Occur throughout the life of a compound or product
- Often include industry, occupation, and task-specific differences

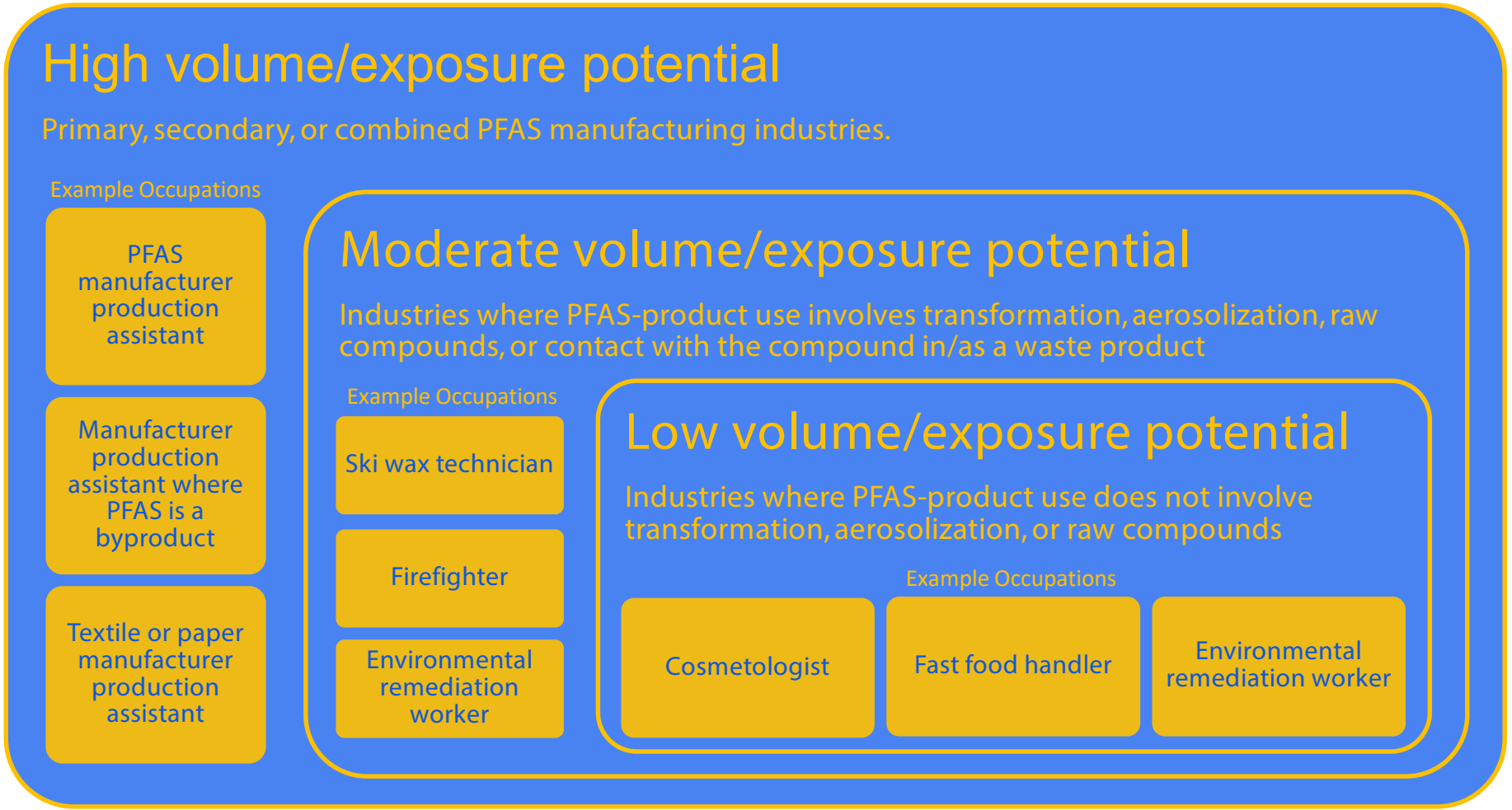


NIOSH/NTP Study Overview

- 3-year study starting in FY20

- Project Leader: Miriam Calkins, PhD, MS

- Objectives
  - Identify industries and occupations where PFAS compounds are likely present
  - Identify PFAS compounds currently in use
  - Develop air monitoring methods for use in occupational settings
  - Conduct a targeted occupational exposure assessment focusing on current exposures
  - Evaluate a limited set of health indicators in study participants


High volume/exposure potential
Primary, secondary, or combined PFAS manufacturing industries.
Example Occupations
PFAS manufacturer production assistant
Manufacturer production assistant where PFAS is a byproduct
Textile or paper manufacturer production assistant
Moderate volume/exposure potential
Industries where PFAS-product use involves transformation, aerosolization, raw compounds, or contact with the compound in/as a waste product
Example Occupations
Ski wax technician
Firefighter
Environmental remediation worker
Low volume/exposure potential
Industries where PFAS-product use does not involve transformation, aerosolization, or raw compounds
Example Occupations
Cosmetologist
Fast food handler
Environmental remediation worker

Study Aims

1. Characterize the presence of PFAS compounds across U.S. industries through review of literature, regulatory documents, and direct communications with industry and worker representatives.

2. Develop and validate air monitoring methods appropriate for occupational environments.

3. Assess exposure to PFAS in a sample of occupational environments and worker populations from 3-4 high- and moderate-volume PFAS industries.

4. Evaluate the association between PFAS exposure and select health indicators.

Study Design

- Enroll workers from industries with ongoing exposure
  - Targeting high to moderate PFAS-using work environments
  - Anticipated industries include: manufacturing and services
- Exposure assessment
  - Biological samples
  - Full-shift breathing zone air samples
  - Observation of job task and personal protective equipment used
- Health Assessment
  - Survey questions
  - Anticipated health indicators
    - Lipids
    - Thyroid
    - CBC
    - CMP
    - Hormones
    - Immune markers

Other PFAS Exposure Research: Firefighters

NIOSH Collaborations with U Arizona and U Miami

- Structural and Aircraft Rescue Firefighting (ARFF) Firefighters
  - Assessment of acute exposure from AFFF, turnout gear, and structural fire response
  - Assessment of chronic exposure and epigenetic effects in aircraft rescue and firefighting (ARFF) firefighters
  - In vitro assessment of acute toxicity of PFAS identified in AFFF, turnout gear, and biological samples

- Wildland-urban interface (WUI) firefighters
  - Assessment of biomarkers of exposure and effect among firefighters in urban areas that are also increasingly experiencing wildland fires

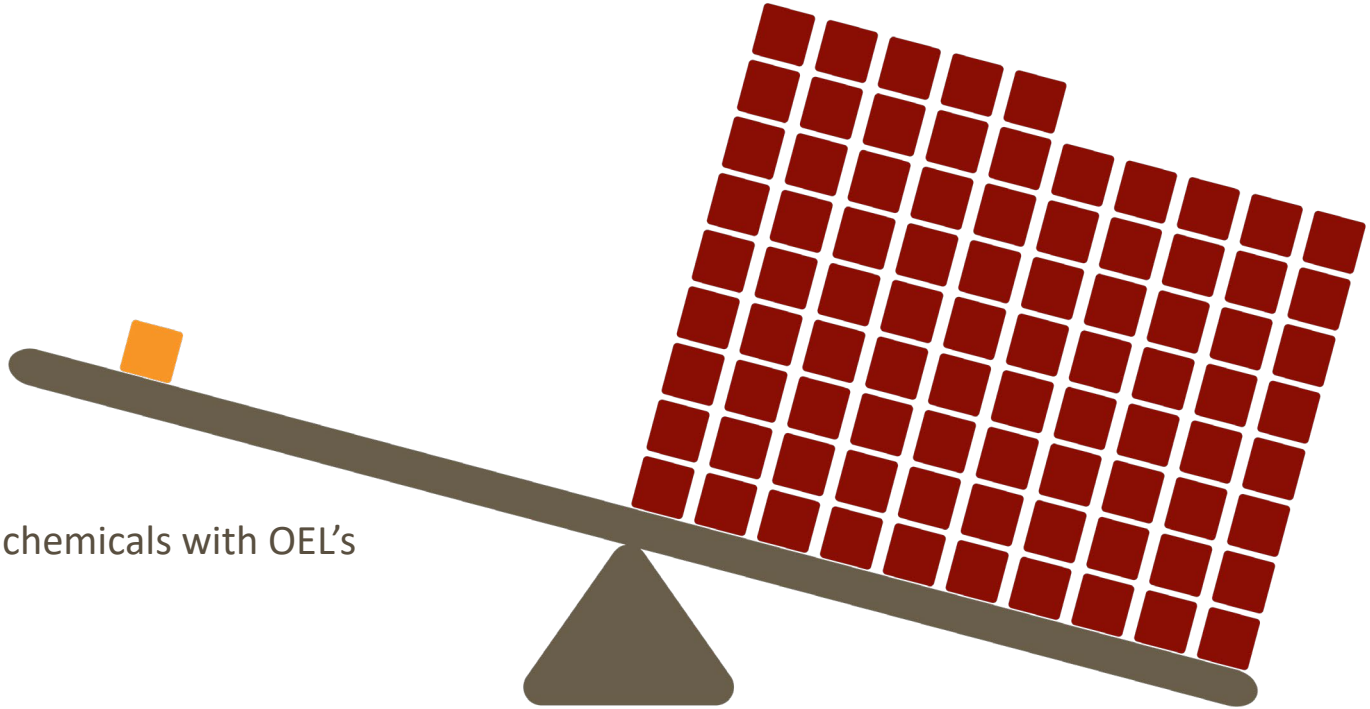
Occupational Exposure Banding

Chemicals are one of the most significant occupational hazards

- 52.1 Million workers estimated exposed to chemicals in their work[1]
- From 2011-2015
  - 71,140 illnesses or injuries associated with chemical exposures[2]
  - 4,836 chemical-related fatalities[3]
- Difficult to estimate number of chronic diseases: cancer, pulmonary, cardiovascular, neurologic related to chemicals
  - 2–8% of cancers attributed to occupational exposures[4]
  - Severe underestimation has been identified

1.Calvert et al 2013
2.BLS 2011-2015
3.BLS 2011-2015
4.Purdue et al 2015

Few chemicals have occupational exposure limits (OELs)

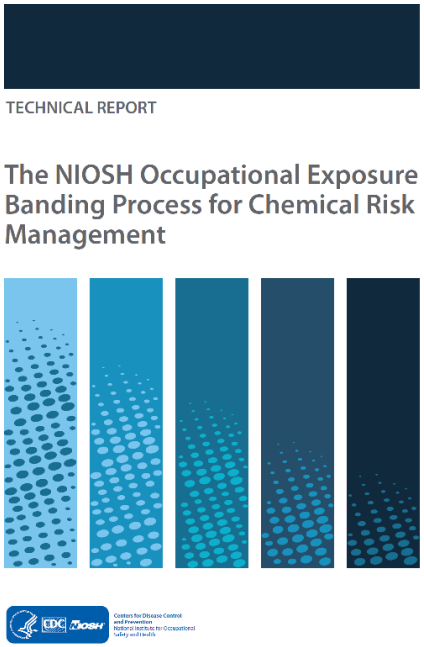


Number of chemicals with OEL's

Number of chemicals in commerce

NIOSH Occupational Exposure Banding Process for Chemical Risk Management

- Process intended to quickly and accurately assign chemicals into specific categories (bands)
- Bands are assigned based on a chemical's toxicological potency and the adverse health effects associated with exposure to the chemical
- Utilizes available, but often limited, toxicological data to determine a potential range of chemical exposure levels that can be used as targets for exposure controls to reduce risk among workers



NIOSH 2019

Occupational Exposure Banding

Document Objective

To create a consistent and documented process to characterize chemical hazards so timely and well-informed risk management decisions can be made for chemicals lacking OELs.

What is Occupational Exposure Banding?

A mechanism to quickly and accurately assign chemicals into “categories” or “bands” based on their health outcomes and potency considerations

Proposed NIOSH Occupational Exposure Bands

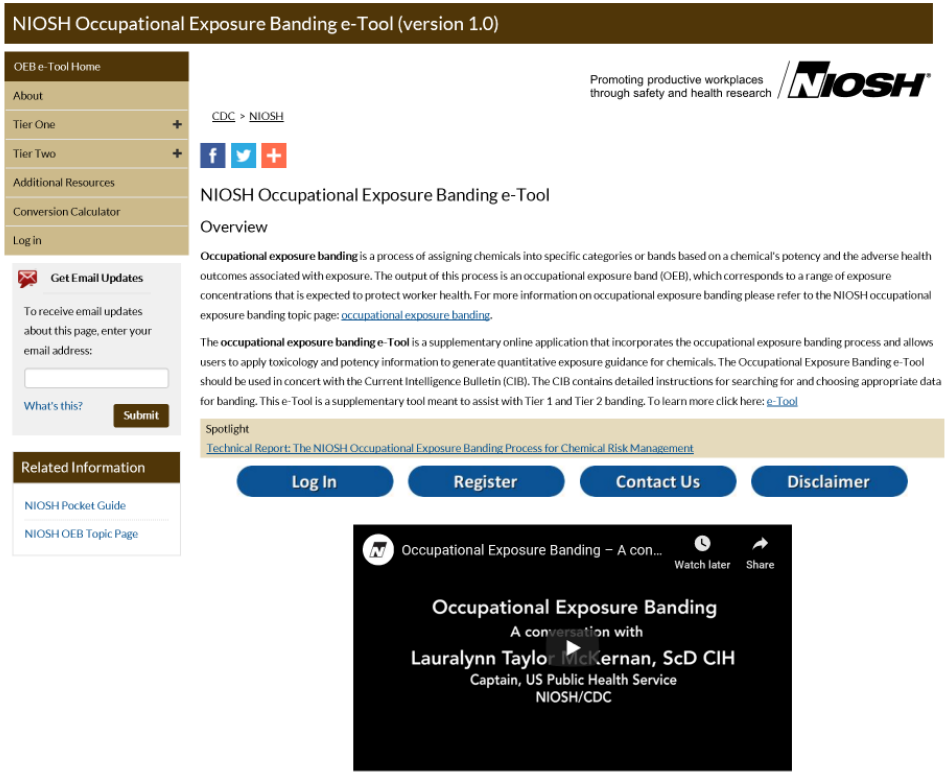
Occupational Exposure Band	Airborne Target Range for Particulate Concentration (mg/m^3)	Airborne Target Range for Gas or Vapor Concentration (ppm)
A	>10mg/m^3	>100 ppm
B	>1 to 10 mg/m^3	>10 to 100 ppm
C	>0.1 to 1 mg/m^3	>1 to10 ppm
D	>0.01 to 0.1 mg/m^3	>0.1 to 1 ppm
E	≤0.01 mg/m^3	≤0.1 ppm

IMPORTANT POINT

An OEB is not meant to replace an OEL, rather it serves as a starting point to inform risk management decisions.

NIOSH Occupational Exposure Banding e-Tool

- Allows users to apply toxicology and potency information to generate quantitative exposure guidance for chemicals
- Used with the Occupational Exposure Banding Technical Report



https://wwwn.cdc.gov/Niosh-oeb/

Disease Detective Case Study 2

Disease Detective – Case Study 2

- An employer manufactures fiberglass products for building boats
- An employer asks you to review an audiometry report for a population of employees.
- You note a trend of high frequency hearing loss in both ears among a group of employees
  - High frequency - 3,4 and 6 Hz
  - Hearing loss – ≥ 25 dB threshold

What would you like to know about the hearing conservation program?

- Is there a hearing conservation program?
- What are the components of the program?
  - monitoring,
  - audiometric testing,
  - hearing protectors,
  - training, and
  - recordkeeping requirements

Hearing Conservation Program Information

Component	History
Monitoring	Some areas of the facility show exposure to noise at or above 85 decibels (dB) averaged over 8 working hours.
Audiometry	Trend of bilateral high frequency hearing loss among a group of employees
Protectors	Employer provides hearing protectors to all workers exposed to 8-hour TWA noise levels of 85 dB or above.
Training	Employees receive annual training
Recordkeeping	Employer maintains 2 years of monitoring and audiometry for employees for the duration of employment

Additional review of the audiometry report

- Many employees with hearing loss worked in areas with exposure >85 dB
- For employees with exposure >85dB, there is one group with a higher level of hearing loss
- Some employees with hearing loss did not work in areas with exposure >85 dB

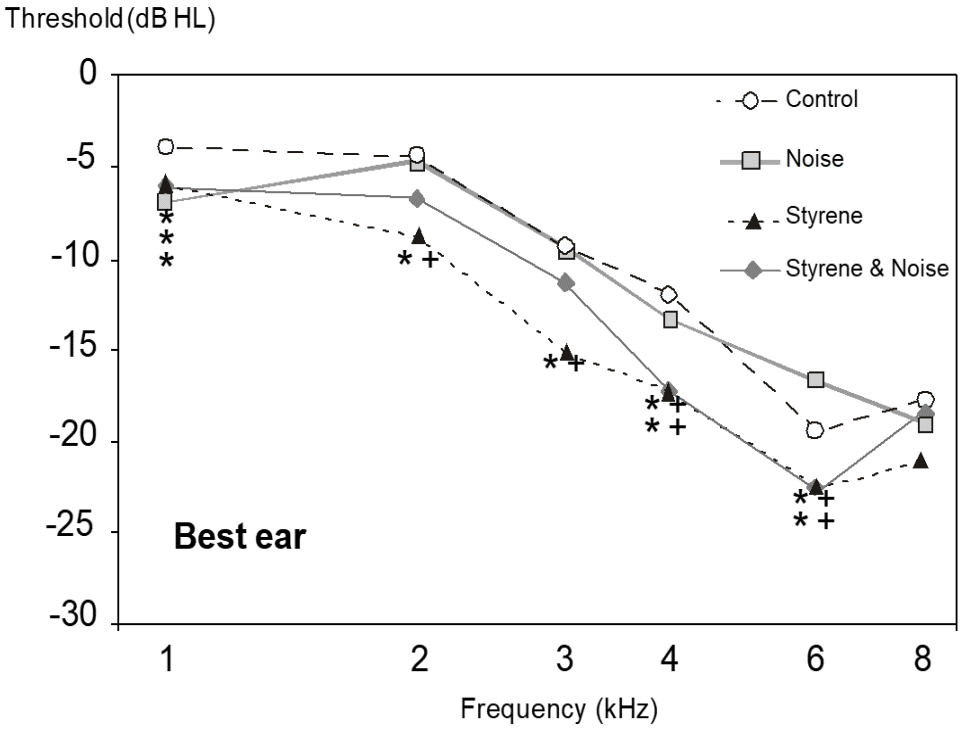
How do you explain the audiometry results?

- Medical cause
- Inaccurate monitoring
- Inconsistent use of hearing protection
- Additional hazard

Classification of Ototoxicants

Site	Effect
Neurotoxicant	Damage nerve fibers affecting hearing and balance
Cochleotoxicant	Damage cochlear hair cells affecting hearing
Vestibulotoxicant	Damage vestibular hair cells affecting balance

Workers exposed to Low Levels of Styrene and Noise



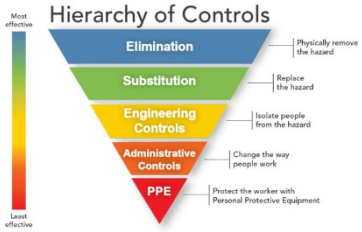
Morata et al., 2002

Chemicals and substances causing ototoxicity

Substance Class	Chemicals
Pharmaceuticals	• Aminoglycosidic antibiotics (e.g. streptomycin, gentamycin) and some other antibiotics (e.g. tetracyclines), • Loop diuretics* (e.g. furosemide, ethacrynic acid) • Certain analgesics* and antipyretics* (salicylates, quinine, chloroquine) • Certain antineoplastic agents (e.g. cisplatin, carboplatin, bleomycin).
Solvents	Carbon disulfide, n-hexane, toluene, p-xylene, ethylbenzene, n-propylbenzene, styrene and α-methylstyrene, trichloroethylene.
Asphyxiants	Carbon monoxide, hydrogen cyanide and its salts, tobacco smoke
Nitriles	3-Butenenitrile, cis-2-pentenenitrile, acrylonitrile, cis-crotononitrile, 3,3'-iminodipropionitrile.
Metals and Compounds	Mercury compounds, germanium dioxide, organic tin compounds, lead. Combined exposure: health effects below the noise PEL

OSHA 2018

Controlling exposure to ototoxicants

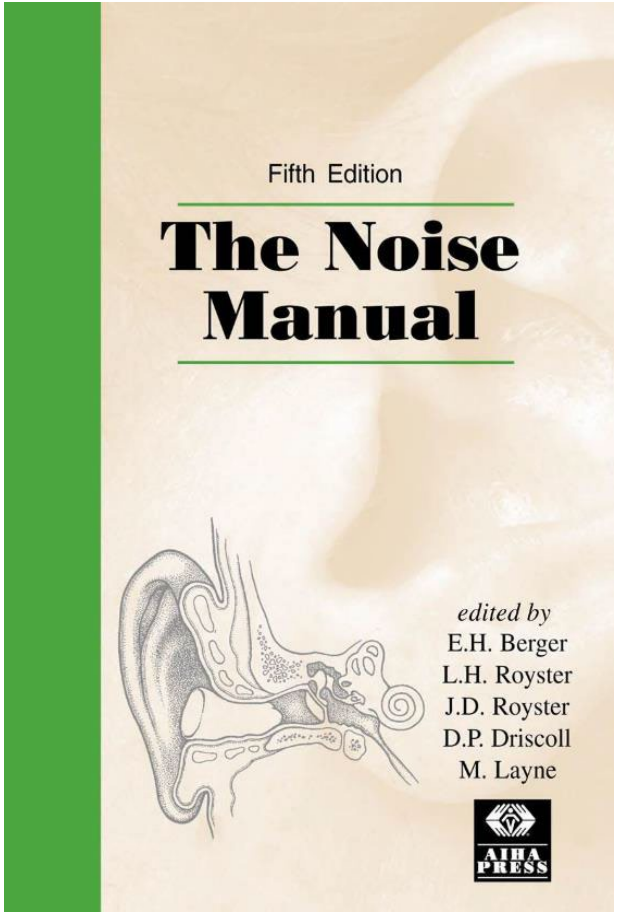


Strategy	Control
Elimination	Eliminate the hazardous chemical
Substitution	Replace hazardous chemical
Engineering	Isolation and enclosures Ventilation
Administrative	Eliminate unnecessary tasks that cause exposure
PPE	PPE, Respiratory protection and hand protection

OSHA 2018

AIHA Noise Manual 6th Edition

- To be published in early 2020
- Chapter Highlights
  - Brief High-Level Sounds
  - Ototoxicty and Otoprotection
  - Field Fit-Testing



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Thank you to all of our partners

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