

Medical Surveillance in Occupational Hlth

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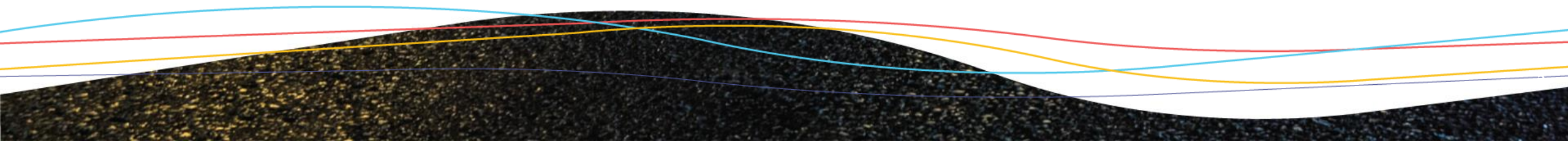
Mobile, AL 36615



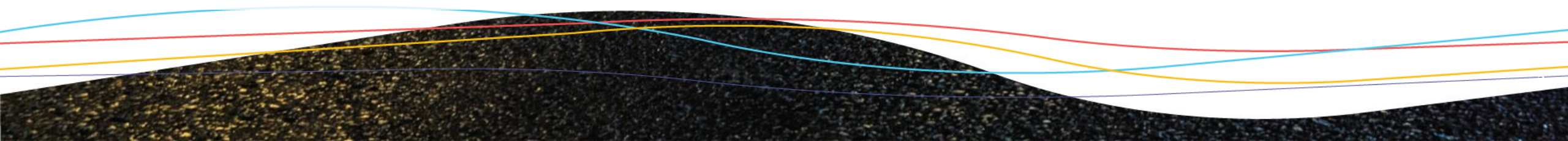
COLLEGE OF
URGENT CARE
MEDICINE

Faculty Disclosures

- None



Learning Objectives

1. Explain how at-risk workers are identified for medical surveillance programs.
 2. Describe how medical surveillance programs protect workers health.
 3. Explain the importance of pre-placement, periodic, and termination exams.
 4. Illustrate specific medical surveillance protocols for:
 - Asbestos
 - Pesticides
 - Hazardous noise
 - Lead (Pb)
- 

Medical Surveillance- Definition

- Periodic assessment of individual workers in terms of occupational history, medical history, and symptoms and signs related to hazardous substances/conditions exposure.

Medical Surveillance- Purpose

- Prevent occupational disease
- Serve as a check on engineering controls because symptoms of exposure may indicate a failure that must be corrected.
- The extent of medical surveillance depends on the hazards and seriousness of exposures as determined by industrial hygienists.

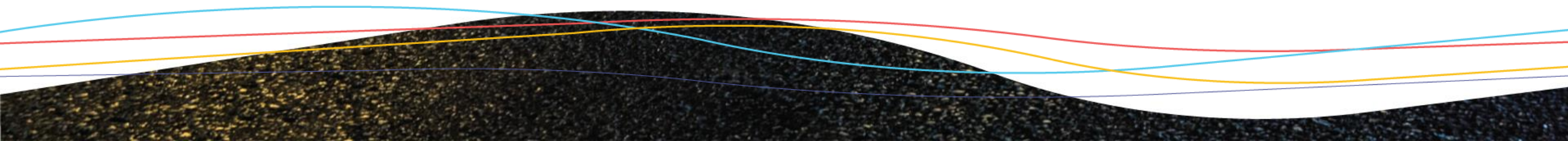
Occupational Hazards

- **Chemical:** Gases, fumes, vapors
- **Biological:** Bacteria, viruses, molds
- **Physical:** Noise, heat, cold, radiation
- **Ergonomic:** Cumulative trauma



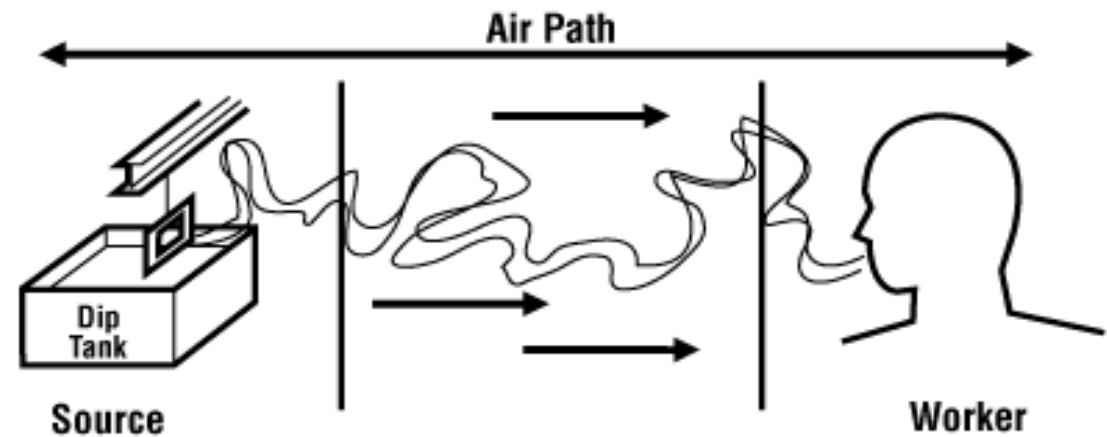
Industrial Hygiene

- Recognition, evaluation, and control of workplace hazards
- Perform workplace sampling
- Determine need for medical surveillance (action levels)



Control Measures

- Substitute a less hazardous chemical
- Isolate the worker or process
- Administrative controls
- Personal protective equipment

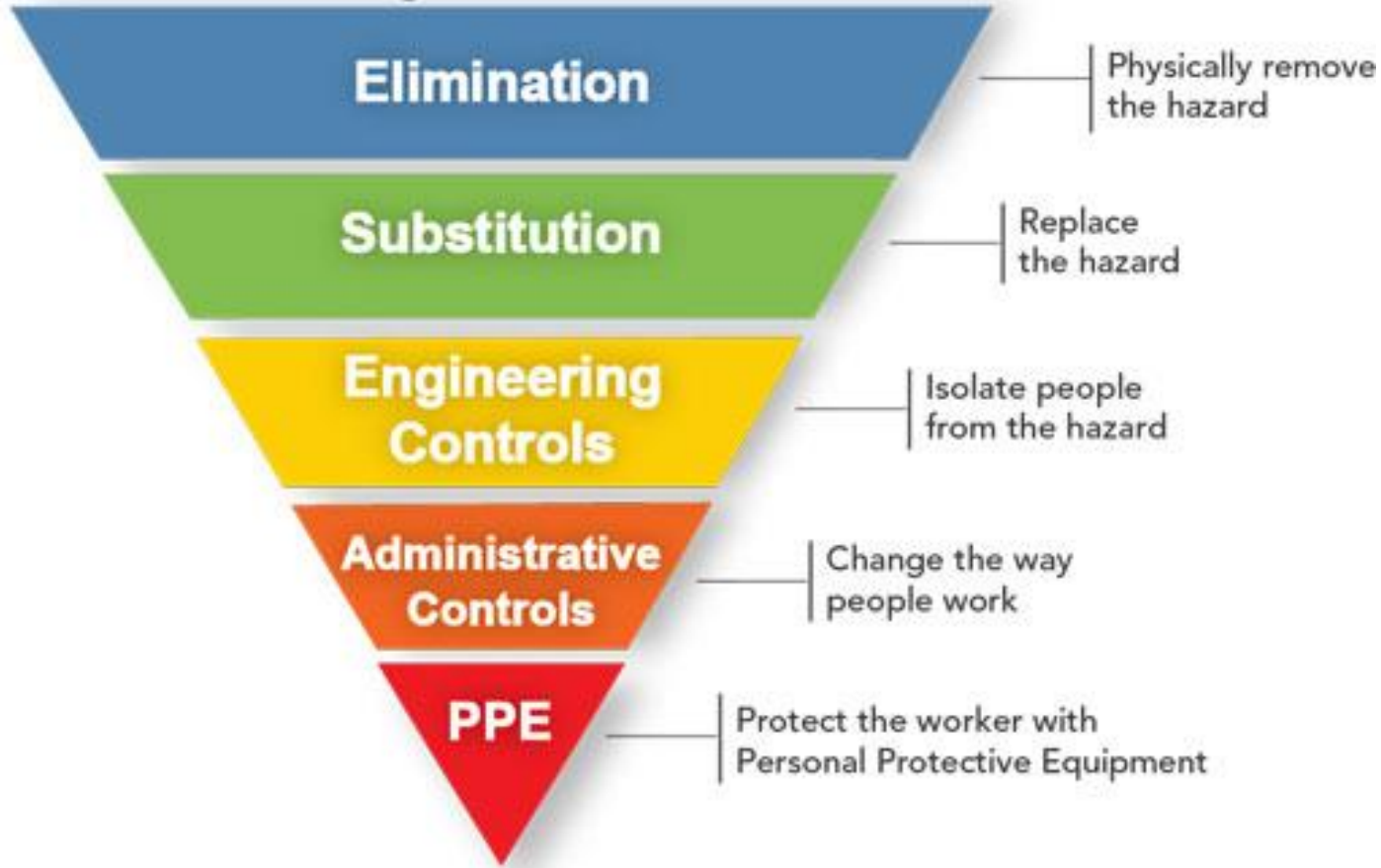


Hierarchy of Controls

Most effective

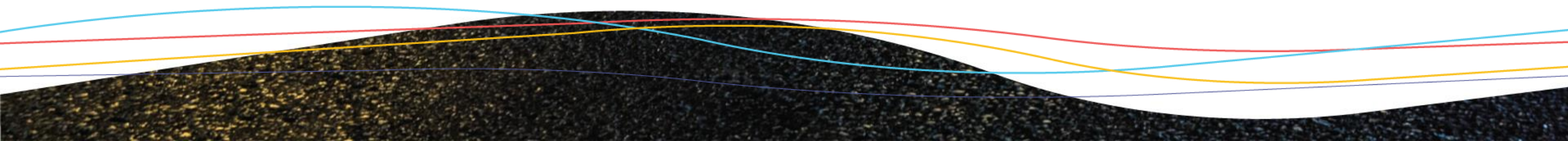


Least effective



PEL vs. AL

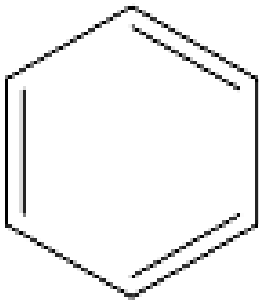
- **PEL:** Permissible Exposure Level
- **AL:** Action level
- **AL:** Exposure level where **surveillance** becomes advisable
 - Usually it is 50% of the permissible exposure limit (PEL).



Substitution

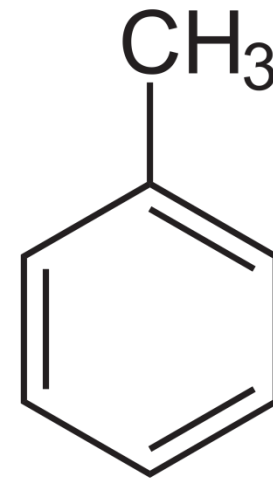
Benzene

- PEL 1ppm
- Carcinogen: AML, etc.



Toluene

- PEL 200ppm
- Noncarcinogen



Medical Surveillance

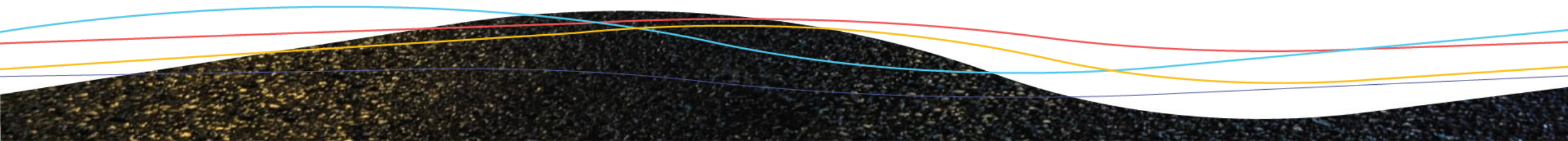
Analysis of health information to detect problems that may occur in the workplace that require targeted prevention.

| Exposure | Effect | Surveillance |
|-------------------|---------------------------|-----------------------|
| Asbestos | Lung CA | CXR, PFTs |
| Pesticides | Cholinesterase inhibition | Cholinesterase Levels |
| Noise | Hearing loss | Audiogram |
| Lead (Pb) | Multisystem | Blood lead levels |

| Chemical | OSHA Standard |
|--------------------|----------------------|
| Asbestos | 1910.1001 |
| Benzene | 1910.1028 |
| Cadmium | 1910.1027 |
| Ethylene oxide | 1910.1047 |
| Formaldehyde | 1910.1048 |
| Lead | 1910.1025 |
| Methylene Chloride | 1910.1052 |
| Vinyl chloride | 1910.1017 |

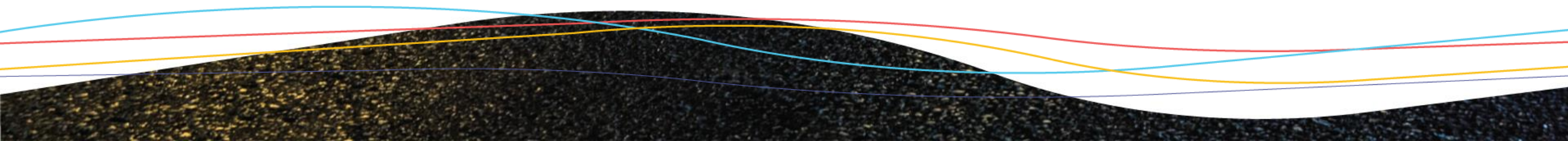
Medical Surveillance- Components

- Medical history (vulnerable to occupational exposures?)
- Occupational history (present and past exposures)
- Determination of fitness for duty
- Determination of fitness to use PPE such as respirators.
- Ancillary testing required for certain exposures such as: laboratory tests, pulmonary function tests, CXR, audiograms, etc.



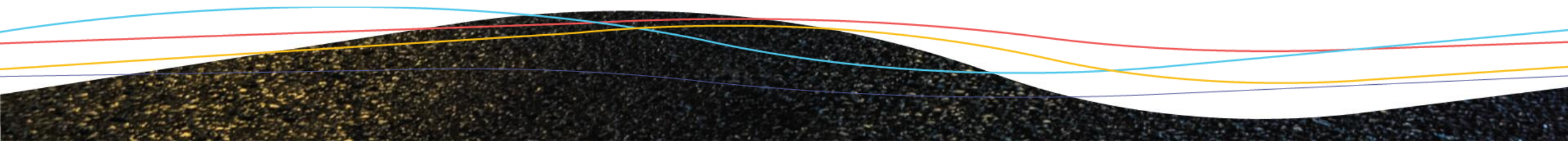
Medical Surveillance Exams

- Pre-placement screening exams
- Periodic screening exams
- Termination screening exams



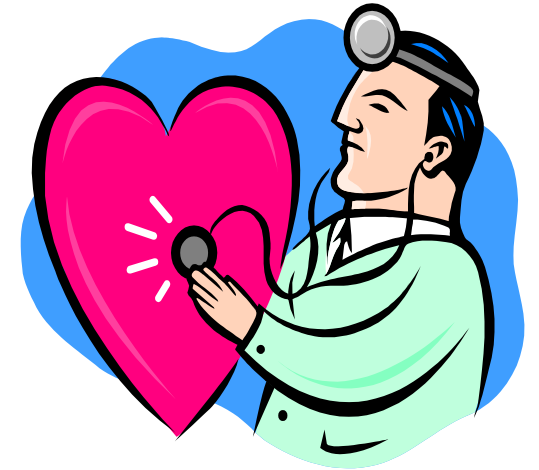
Screening Exams

- Screening exams are target-organ specific
- Screening exams are substance-specific - focused
- Abnormal findings requires further investigation
 - Change in the work process?
 - Change in the PPE?
 - Non-occupational causes?
 - Group trends?



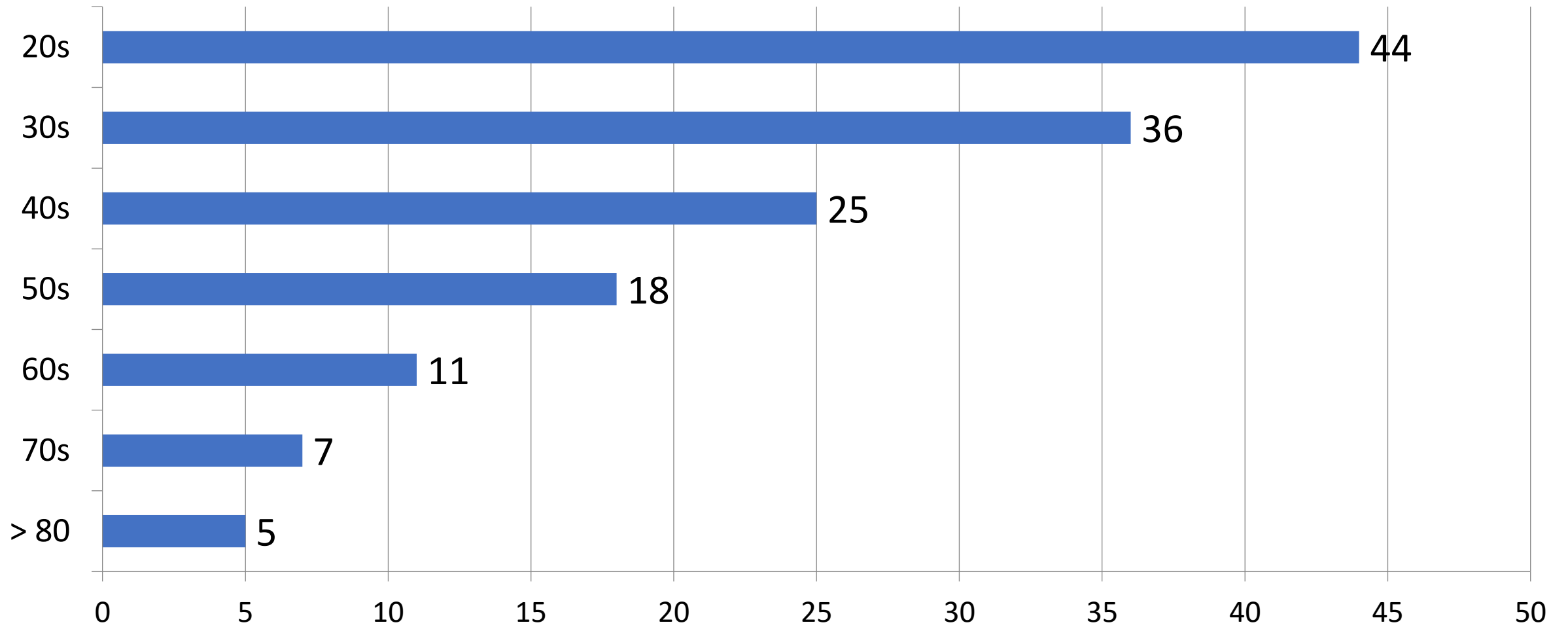
Physical Exams

- Focused exam based on work exposures
- Exam components delineated by OSHA requirements
- Not a substitute for primary care exam
 - Investigation of abnl results (not work-related) performed by PCP



US Adults by Age Without a PCP (%)

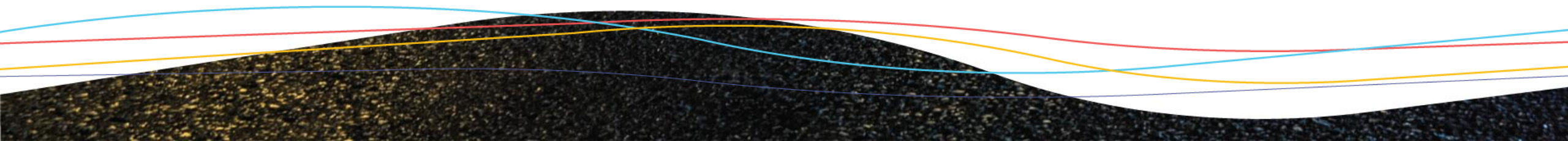
2015 Data

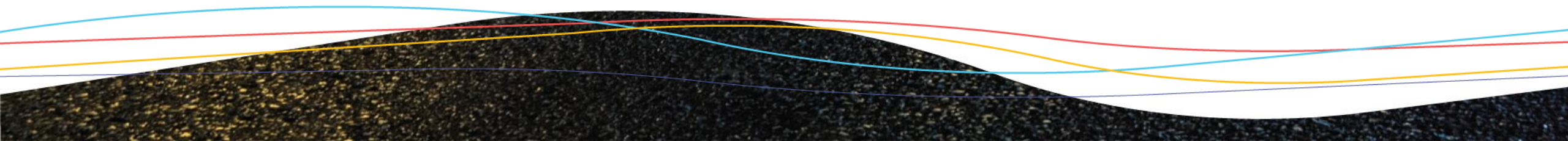


Levine DM, et al. JAMA Int Med, 2020 Vol. 180, No.3. pp. 463-466.

Specific Examples

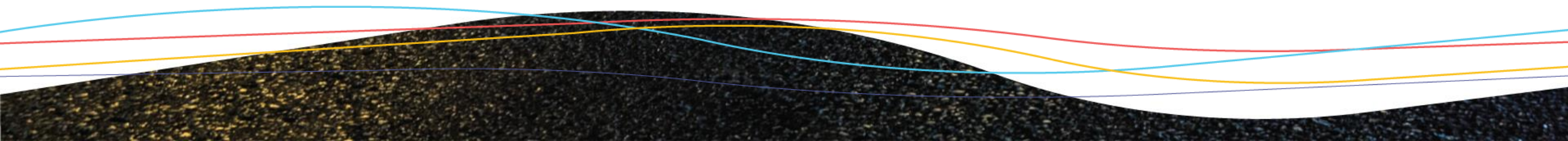
- Asbestos
- Pesticides
- Noise
- Lead (Pb)





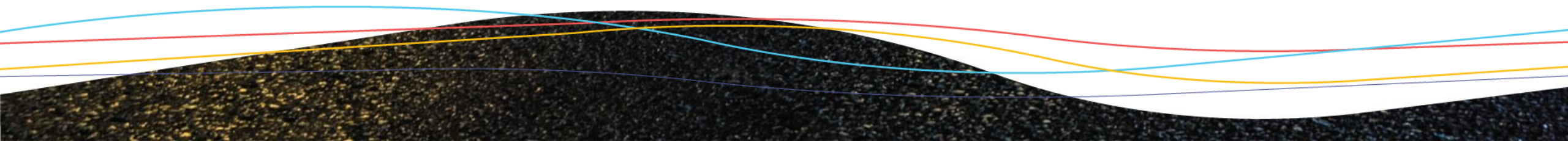
Asbestos Use in the US

- Asbestos is a fibrous material that is resistant to fire, resulting in its use as insulation and in fire safety products.
- Used in a wide variety of products: brake linings, roofing products, floor tiles, and cement.
- Production and use peaked in the US during the 1930s-1960s and slowly tapered off during the 1970s.
- Most use of asbestos in the US stopped after 1989.



Prior to 1981- Asbestos Sources

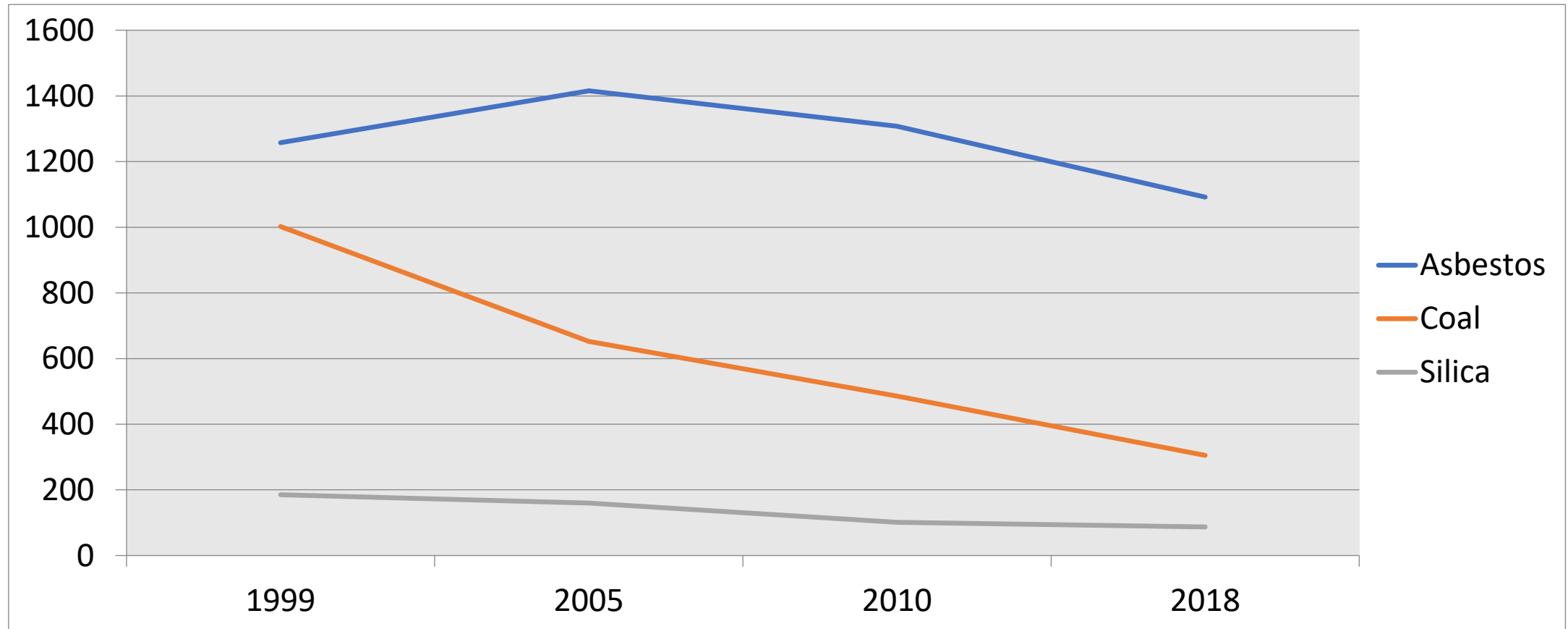
- Roofing, shingles and siding
- Block insulation
- Heating and cooling systems
- Floor tiles and vinyl flooring
- Adhesives
- Electrical insulation and panels
- Plaster, cement, putties, taping compounds and caulk
- Textured paints
- Appliance components
- Ceiling tiles and spray-on coatings
- Popcorn ceiling materials
- Attic insulation (vermiculite)
- Gardening products (vermiculite)
- Pipe, boiler, and duct insulation
- Wallboard
- Fireplace decorations
- Heat-resistant textiles



Pneumoconiosis

- Preventable occupational lung diseases caused by inhaling dust:
 - Asbestos
 - Coal dust
 - Silica
 - Other inorganic dusts: aluminum, bauxite, beryllium, iron, and tin oxide

Pneumoconiosis Deaths US 1999-2018



Data from CDC. MMWR June 12, 2020. Vol. 69, No. 23. p.693-698.

Asbestos Regulation History- US

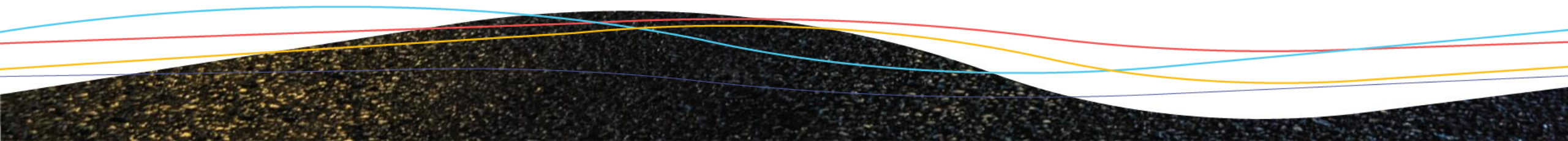
| Date | PEL (fibers/cc) |
|-------------|------------------------|
| 1971 | 12 |
| 1972 | 5 |
| 1975 | 0.5 |
| 1986 | 0.2 |
| 1994 | 0.1 |

PEL: Permissible exposure level



Asbestos Medical Surveillance

- Must institute medical surveillance for all employees who are or will be exposed to airborne asbestos at or above the PEL and/or EL.
- Medical examinations and procedures must be performed by or under the supervision of a licensed physician.
- Exams must occur at a reasonable time and place and shall be provided at no cost to the employee.

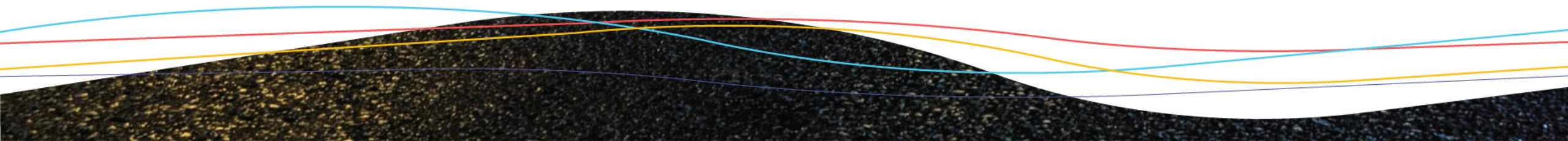


Asbestos Medical Surveillance- Exams

- Medical history
- Work history
- Respiratory disease standardized questionnaire
- Complete physical examination with emphasis on the respiratory system, the cardiovascular system, and the digestive tract.
- Chest X-ray with “B” reader interpretation
- Pulmonary function tests
- Any additional tests deemed appropriate by the examining physician

Restrictive Lung Disease

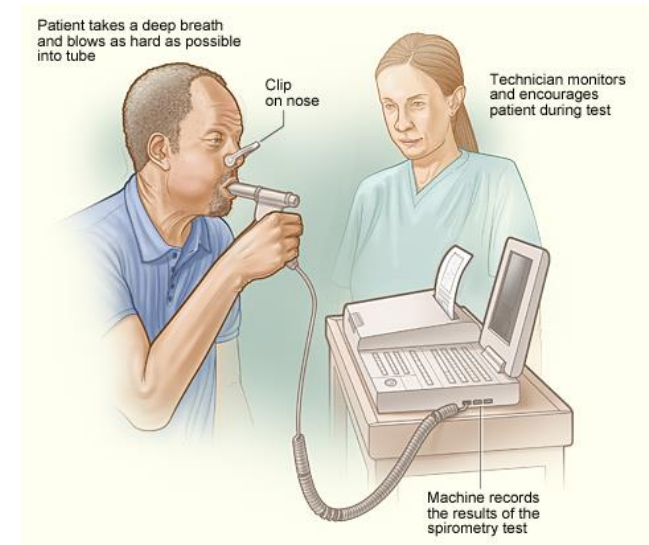
- Loss of functioning alveoli with parenchymal lung disease
- Etiology:
 - Sarcoidosis: Idiopathic multisystem disease.
 - Pulmonary fibrosis: Pneumonias, TB, gastric aspiration, uremia, pancreatitis, pulmonary amyloidosis.
 - **Work exposures: Asbestos, Silica, coal, beryllium, welders, talc.**



Restrictive Lung Disease- Spirometry

- Severity of disease:

- FVC and TLC < 80% = Restrictive disease
 - 70-80 % predicted: mild restrictive disease
 - 60-70% predicted: moderate restrictive disease
 - 50-60% predicted: moderately severe restrictive disease
 - < 50% predicted: severe restrictive disease
- The ratio of FEV₁ to FVC is usually preserved or increased.
 - Lung function changes may precede radiographic changes.



Chest X ray

- Mild asbestosis is not easily diagnosed on CXR
- First changes: Irregular linear densities initially seen at the lung bases which increase in number and coarseness as the disease progresses.
- “B” reader interpretation required.
 - <https://www.cdc.gov/niosh/topics/chestradiography/breader.html>

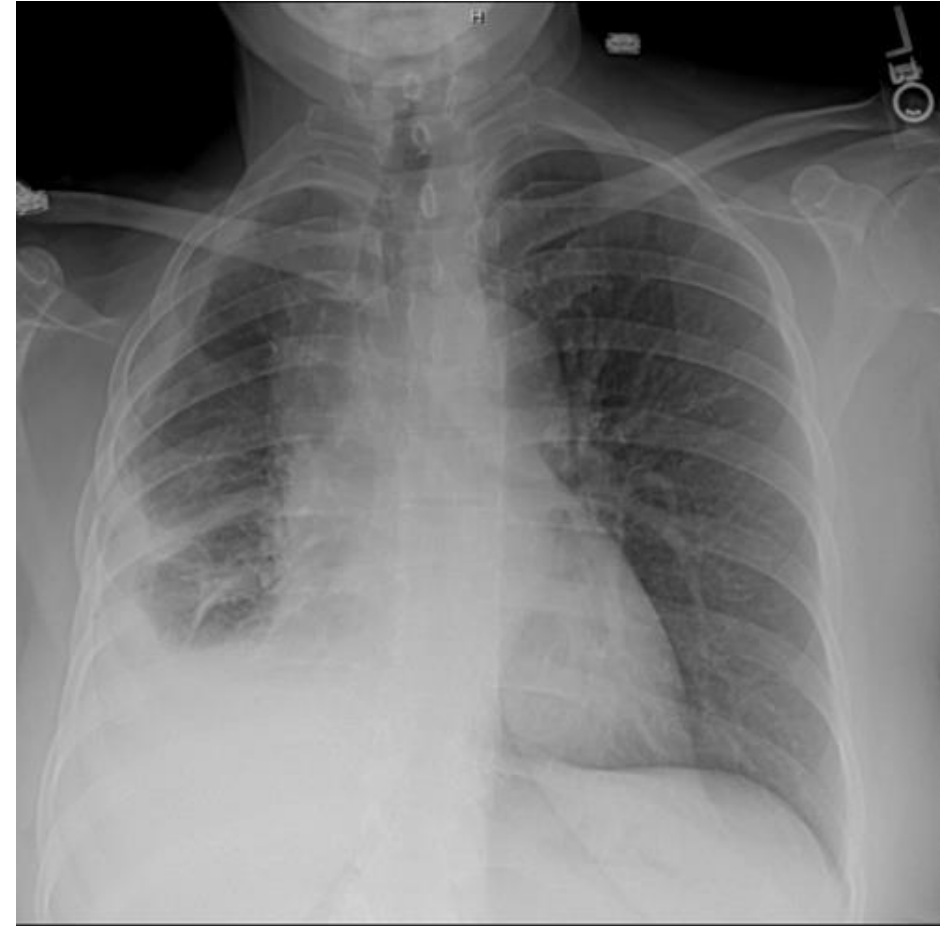




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THE URGENT CARE CONVENTION

Mesothelioma

- Approximately 80% of affected individuals have a significant history of asbestos exposure making it the major associated risk factor for mesothelioma.



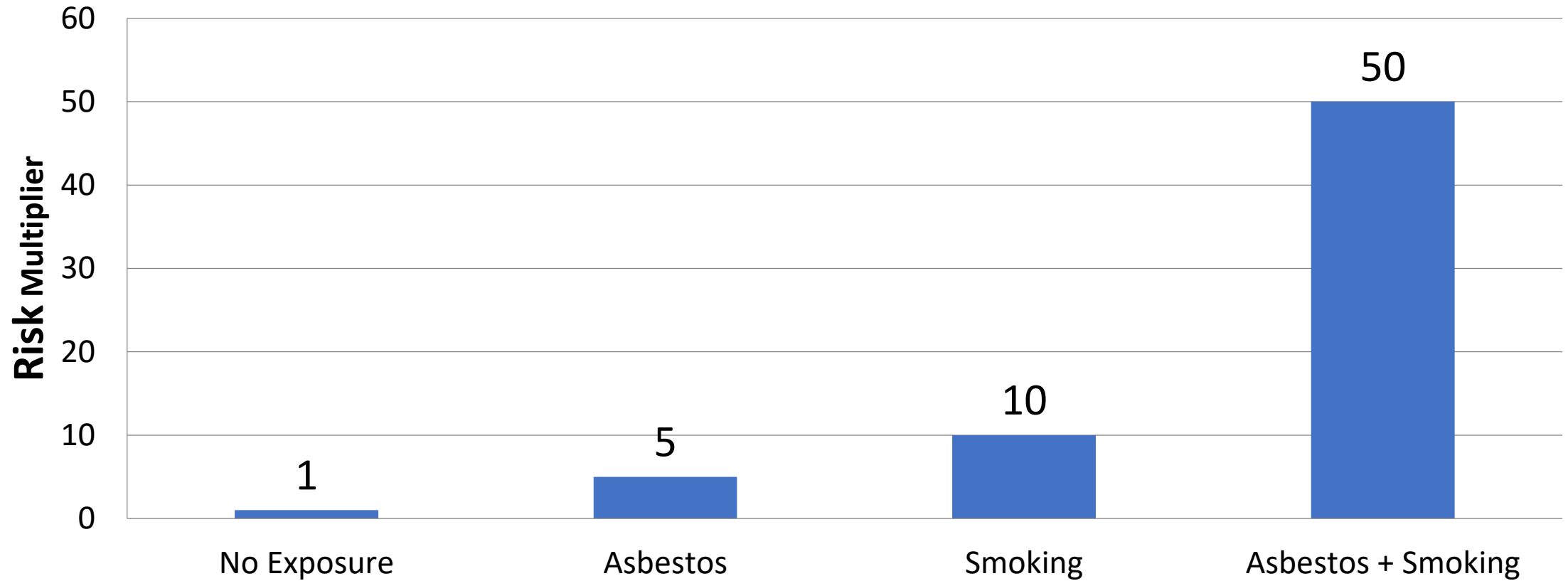
Asbestos Medical Surveillance

CXR Frequency

| Years since first exposure | Age of employee | | |
|----------------------------|-----------------|-------------|-------------|
| | 15 to 35 | 35+ to 45 | 45+ |
| 0 to 10 | Every 5 yrs | Every 5 yrs | Every 5 yrs |
| 10+ | Every 5 yrs | Every 2 yrs | Every 1 yr |

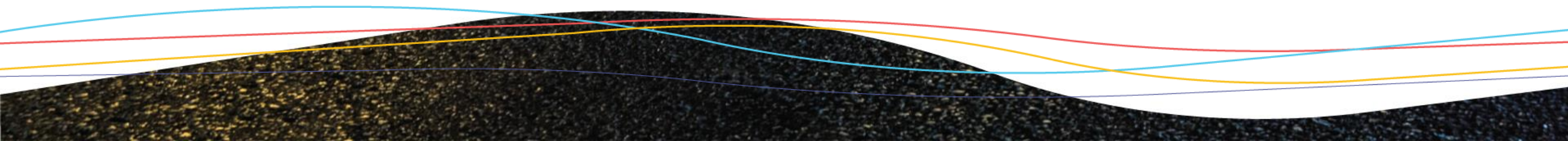
Lung Cancer Risks

Synergism with smoking



Asbestos Medical Surveillance Recordkeeping

- **Exposure records:** Employer must keep an accurate record of all exposure measurements taken to monitor employee exposure to asbestos. This record must be kept for 30 years.
- **Medical surveillance records:** Employer also must maintain an accurate record for each employee subject to medical surveillance. Record must be maintained for the duration of employment plus 30 years.



Physician's Written Opinion

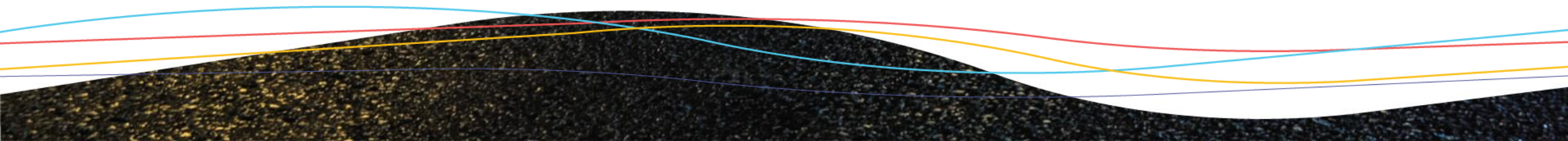
- Employer shall provide a copy of the physician's written opinion to the affected employee within 30 days from its receipt.
- Physician's opinion: Exam results in writing, as well as information on any medical conditions that may make the employee more susceptible to asbestos, recommended limitations on the employee or safety equipment, and statements that the employee has been informed of the exam's results, and that lung cancer risk increases when combining smoking and asbestos exposure.
- Clinical statement: “No work-related disease identified”

Pesticides



Pesticides- Cholinesterase Inhibitors

- Pesticides that inhibit acetylcholinesterase
 - Organophosphates
 - Carbamates
- Cholinesterase levels
 - Levels vary greatly btw individuals
 - Pre-exposure baseline level required to detect any significant changes
 - A biomarker that reflects the activity of acetylcholinestrace



Cholinesterase Inhibitors- Sx

- Acetylcholine excess causes stimulation of cholinergic systems
- **Early symptoms:** Headache, nausea, dizziness, and increased secretions, such as sweating, salivation, tearing and respiratory secretions (*SLUDGE* and *DUMBELS*).
- **Progressive symptoms:** Muscle twitching, weakness, tremor, incoordination, vomiting, abdominal cramps and diarrhea.

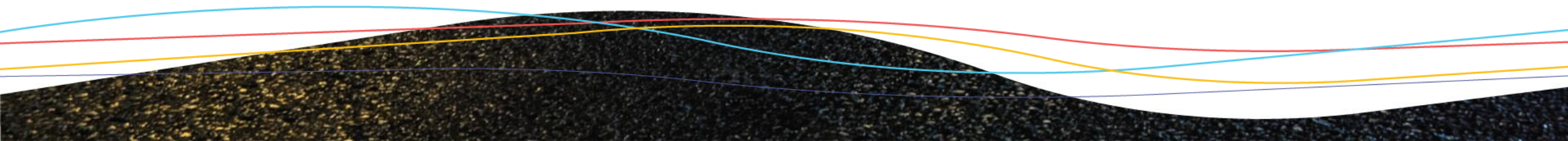
Removal From Work Criteria

| Percent of Baseline | RBC ChE | Plasma ChE |
|---------------------|--|---|
| < 80 % | Prompt retesting of worker and investigation of work practices by employer | |
| <u>≤ 70%</u> | Immediate removal of worker from further exposure | |
| <u>≤ 60%</u> | | Immediate removal of worker from further exposure |

Guidelines for Physicians Who Supervise Workers Exposed to Cholinesterase Inhibiting Pesticides Edition 6.0 .

Published: Dec 2017.

<https://oehha.ca.gov/media/downloads/pesticides/document-pesticides/physicianguidelines.pdf>

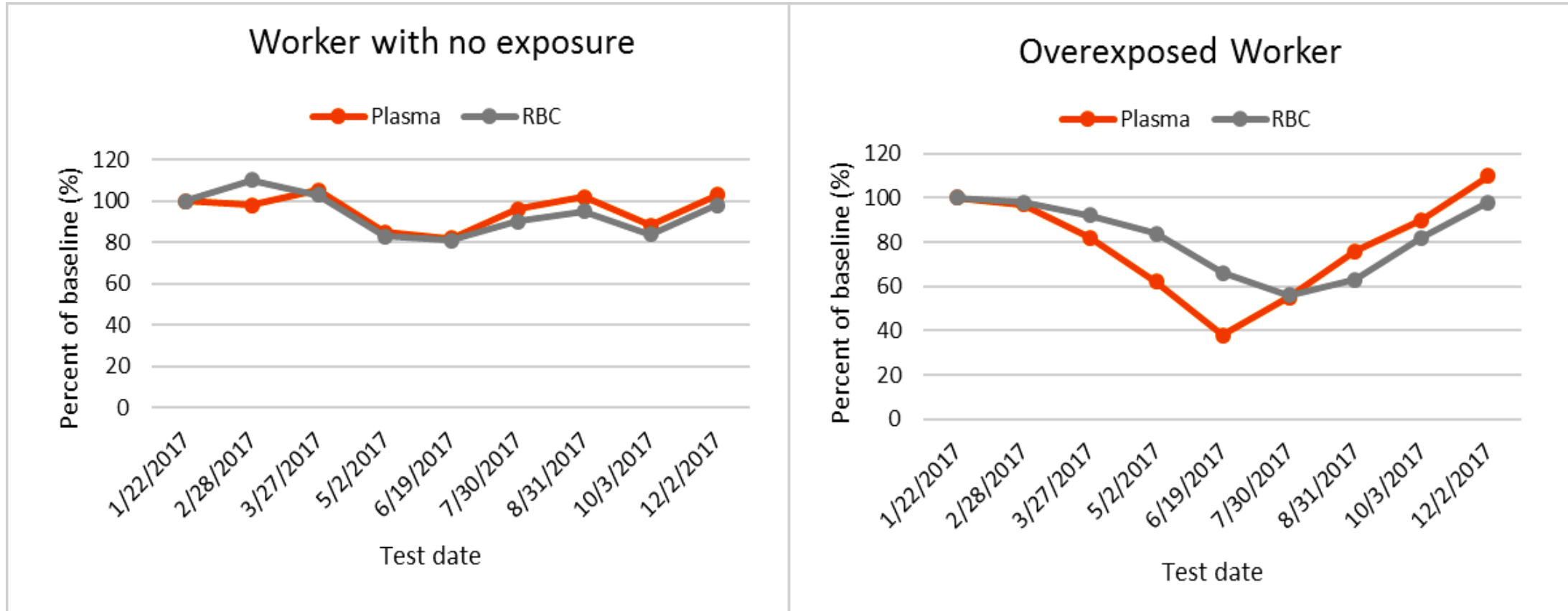


Investigate Work Practices

- 80% decrease of either rbc or plasma cholinesterase requires:
 - Further investigation of work practices
 - Prompt re-testing

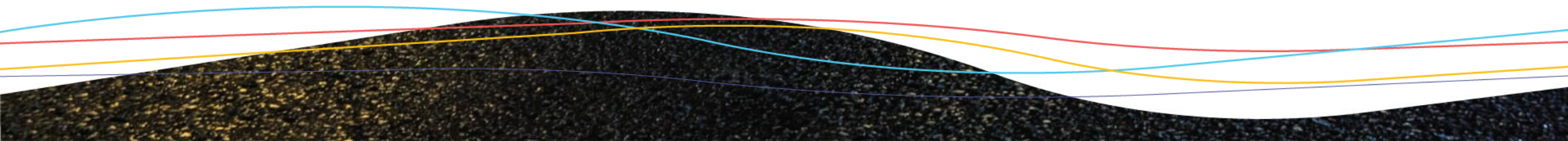


Cholinesterase Monitoring



<https://oehha.ca.gov/media/downloads/pesticides/document-pesticides/physicianguidelines.pdf>

Pesticide applicator



Chemical Resistance Chart- Gloves

| Chemical | Neoprene | Latex/rubber | Butyl | Nitrile |
|----------------------|-----------------|---------------------|--------------|----------------|
| Acetaldehyde | VG | G | VG | G |
| Acetone | G | VG | VG | P |
| Diesel fuel | G | P | P | VG |
| Hexane | F | P | P | G |
| Propyl alcohol | VG | VG | VG | VG |
| Sodium hydroxide | VG | VG | VG | VG |
| Toluene diisocyanate | F | G | G | F |
| Trichloroethylene | F | F | P | G |
| Xylene | P | P | P | F |

OSHA 3151-12R 2004. Personal Protective Equipment.
<https://www.osha.gov/Publications/osha3151.pdf>

Hazardous Noise



Hazardous Noise

- > 84 dBA
- Impulse or impact noise > 140 dB



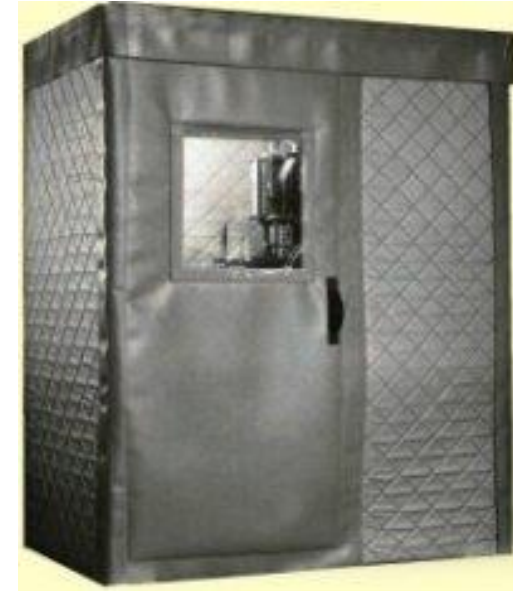
Noise Dosimeter



- Sound level meters evaluate three time-averaging characteristics: fast, slow, and peak
- The slow setting should be used when measuring sound intensity for purposes of assessing occupational noise

Noise Control Measures- Engineering

- Enclose noisy machines and/or operators
- Sound absorbent surroundings
- Improve machine maintenance
- Mufflers



Hearing Protection

Employers shall make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employees.



Why Hearing Protection is **Not** Used

| | |
|---------------------------------|-----|
| Causes headaches | 24% |
| Causes head pressure | 37% |
| Causes itching | 43% |
| Interferes with job performance | 46% |
| Interferes with communication | 70% |

Only 20% of workers wear HPD at all times while in hazardous noise areas.

<http://www.cdc.gov/niosh/topics/noise/pubs/presentations/MorataASA2003-1.pdf>

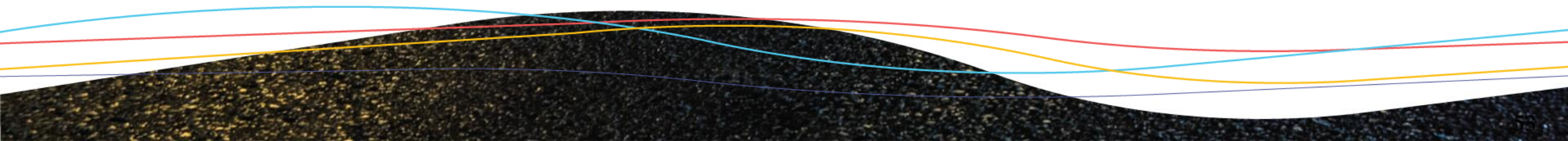
Permissible Exposure Levels- OSHA

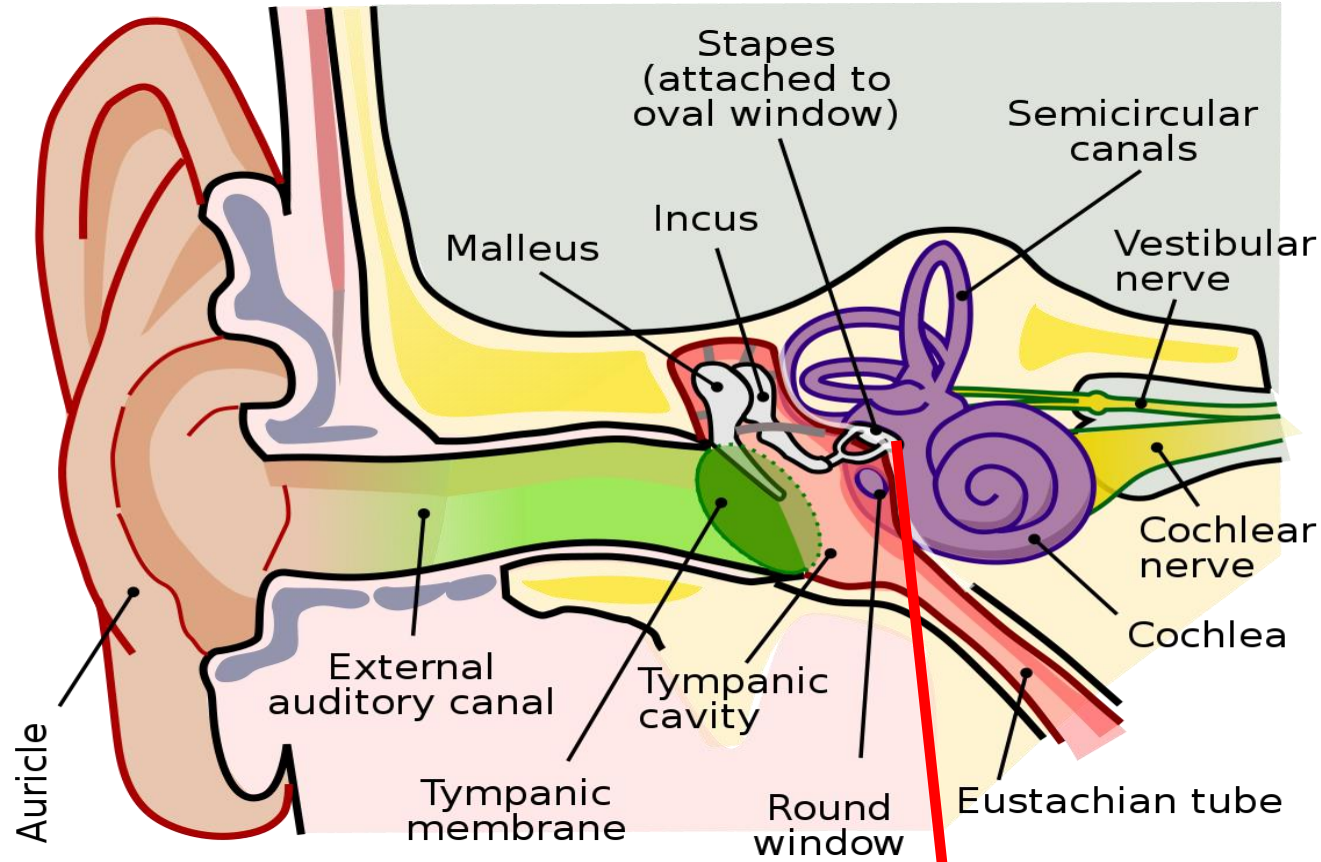
| Sound intensity in dBA | Duration in hours |
|-------------------------------|--------------------------|
| 85 (Action level) | 16 |
| 90 (PEL) | 8 |
| 92 | 6 |
| 95 | 4 |
| 97 | 3 |
| 100 | 2 |
| 102 | 1.5 |
| 105 | 1.0 |
| 110 | 0.5 (30 mins) |
| 115 | 0.25 (15 mins) |

| Noise Source | Loudness in dB |
|-------------------------------|-----------------------|
| Gun shot | 140-170 |
| Jet engine | 140 |
| Pain threshold | 125 |
| Rock concert/chain saw | 110-120 |
| Diesel locomotive/stereo | 110-120 |
| Loader/backhoe- no cab | 103 |
| Jack hammer | 96 |
| Motor cycle/lawnmower | 90 |
| Loader/backhoe- insulated cab | 90 |
| OSHA- Hearing program AL | 85 |
| Conversation | 60 |
| Whisper | 30-40 |

Types of Hearing Loss

- **Sensori-neural: Hazardous noise exposure**
- Conductive
- Mixed
- Non-organic

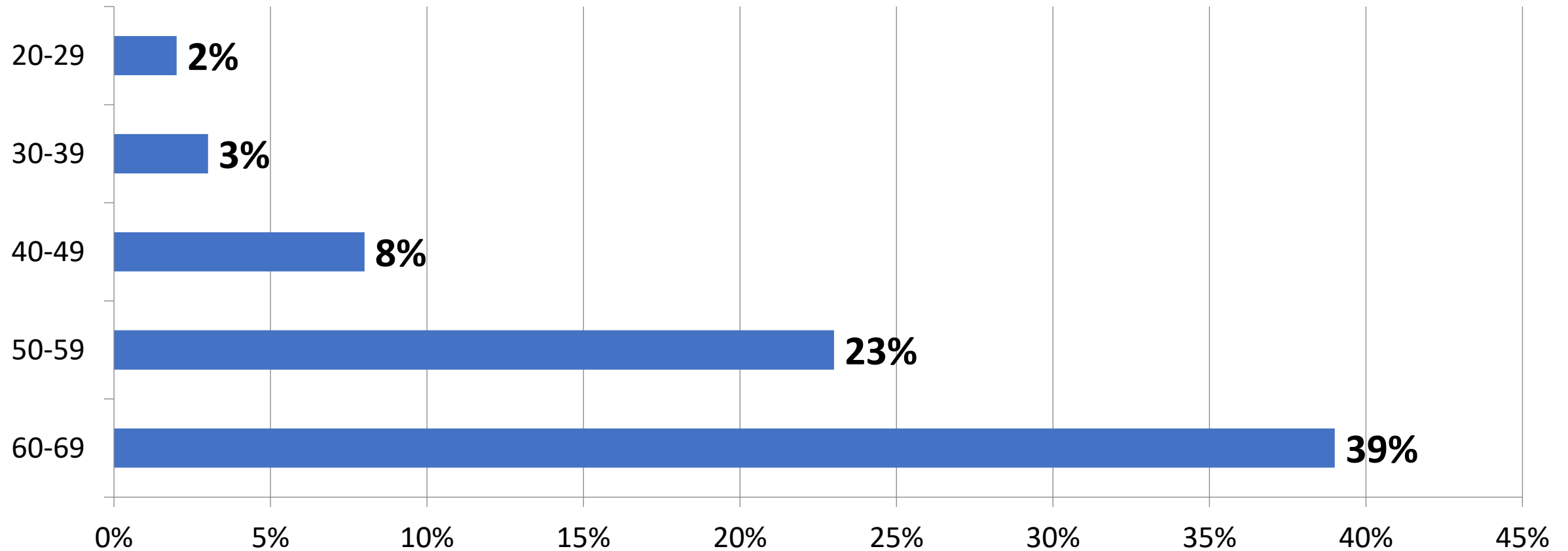




Conductive loss

Sensori-neural loss

Hearing Loss US Adults Age 20-69 yrs



Hoffman HJ, et al. JAMA Otolaryngol Head Neck Surg. 2017;143(3):274-285.

Hazardous Noise Prevalence

- 25% of all workers have been exposed to hazardous noise
- 53% of noise-exposed workers report not wearing hearing protection.



- Kerns E, et al. Cardiovascular conditions, hearing difficulty and occupational noise exposure within U.S. industries and occupations. *Amer Journal of Indust Med*, 2018;61, 477-491.
- Green DR, et al. Prevalence of hearing protection device non-use among noise-exposed US workers in 2007 and 2014. *Amer Journal of Indust Med*. Vol 64, Issue12. Dec 2021. Pages 1002-1017.

Noise-Induced Hearing Loss

- Painless
- Progressive
- Preventable
- Permanent

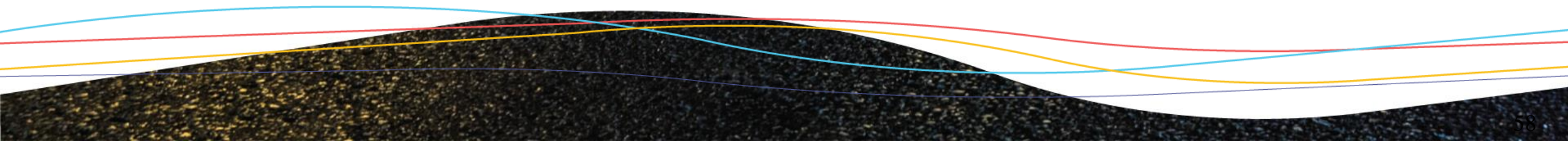


Sensori-Neural Hearing Loss- Causes

- Genetics/Congenital
- Disease: Mumps, Meningitis
- Ototoxic drugs
- Head trauma
- Presbycusis
- Meniere's disease
- Acoustic neuroma

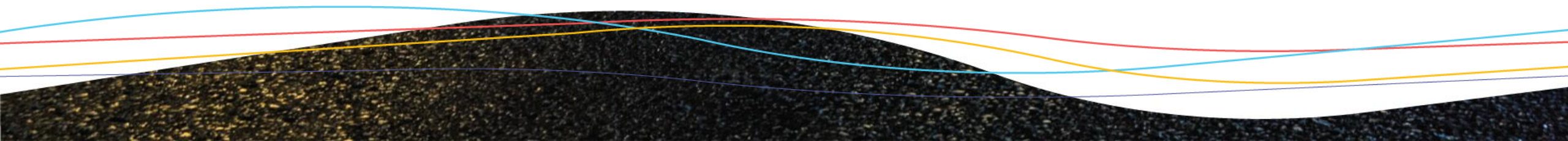
Noise Exposure

Prolonged exposure to hazardous noise causes hearing loss by the physical destruction of the hair cells of the cochlea

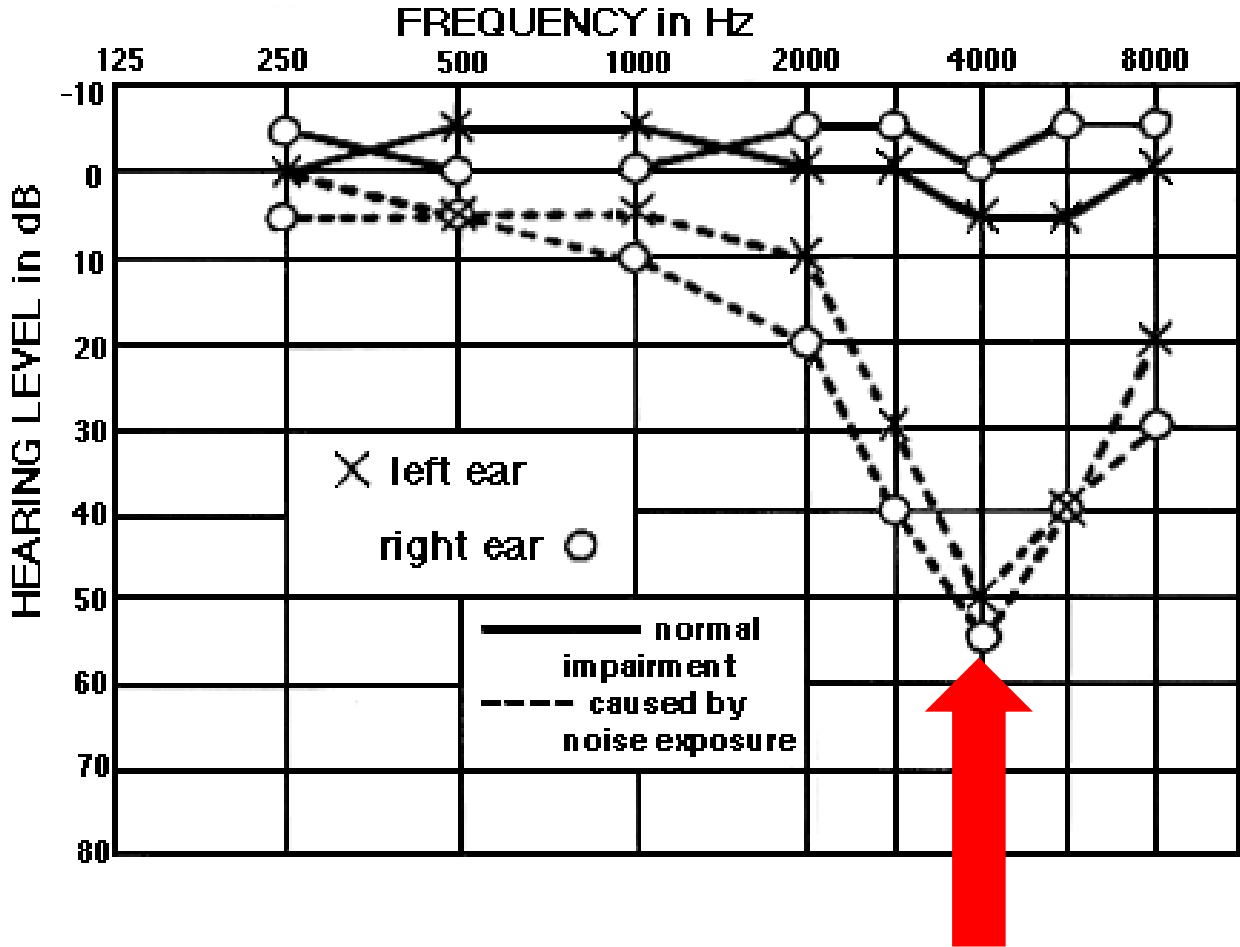


Audiograms

- Baseline: Within 30 days
- Monitoring i.e. annually
- Exit



Audiogram Pattern: NIHL



OSHA Recordability- 2 Criteria

- 10 dB average loss or greater from baseline for 2000, 3000, 4000 kHz in either ear

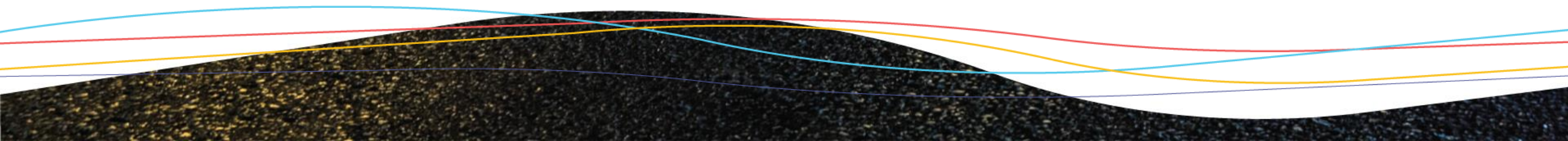
and

- Hearing level at the same frequencies is 25 dB or greater regardless of employee's age

Hearing Conservation Amendment 29 CFR 1910.95: New record keeping rule for hearing loss issued July 1, 2002 with an effective date of Jan 1, 2003

Audiogram Interpretation

| | Date | 500 | 1000 | 2000 | 3000 | 4000 | 6000 | 8000 |
|-----------|-------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Left ear | 1 Jan 2022 | 5 | 10 | 20 | 20 | 15 | 15 | 20 |
| | 1 Feb 2023 | 5 | 10 | 30 | 30 | 30 | 20 | 20 |
| | | 0 | 0 | +10 | +10 | +15 | +5 | 0 |
| | | | | | | | | |
| Right ear | 1 Jan 2022 | 10 | 10 | 20 | 20 | 15 | 15 | 20 |
| | 1 Feb 2023 | 15 | 10 | 20 | 25 | 25 | 20 | 25 |
| | | +5 | 0 | 0 | +5 | +10 | +5 | +5 |



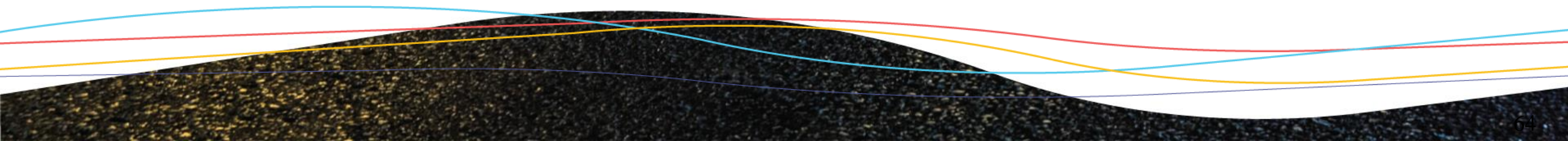
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|-----------|------------|-----|------|---------------------------------------|------|------|------|------|---------------------------------|
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| | 1 Feb 2023 | 5 | 10 | 30 | 30 | 30 | 20 | 20 | |
| | | 0 | 0 | +10 | +10 | +15 | +5 | 0 | |
| | | | | $10 + 10 + 15 = 35$ | | | | | $35/3 = 11.7$ |
| Right ear | 1 Jan 2022 | 10 | 10 | 20 | 20 | 15 | 15 | 20 | |
| | 1 Feb 2023 | 15 | 10 | 20 | 25 | 25 | 20 | 25 | |
| | | +5 | 0 | 0 | +5 | +10 | +5 | +5 | |

TTS vs. STS

TTS -Temporary threshold shift

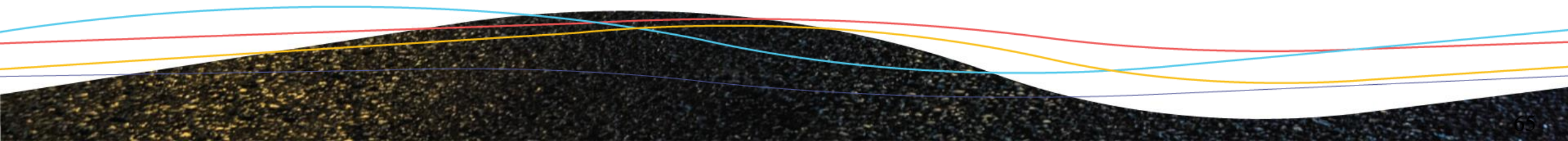
STS - Standard threshold shift



Temporary Threshold Shift (TTS)

Confirm Shift

- Retest after auditory rest (noise-free) \geq **14 hours**
 - Hearing protection vs. noise avoidance during “quite time”
- Retest within 30 days
 - If STS does not confirm- not recorded
 - If the retest confirms the STS= Recordable hearing loss case
 - Must record the hearing loss illness within 7 calendar days of the retest



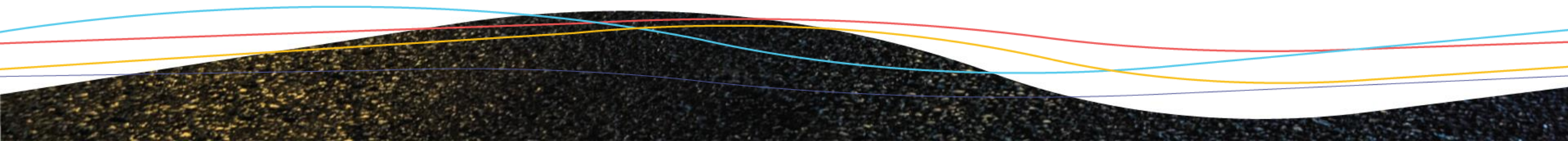
Audiogram Screening Frequencies

- **OSHA frequencies:** 2000, 3000, 4000
- **DOT frequencies:** 500, 1000, 2000
 - < 40 dB loss at 500, 1000, and 2000 kHz in better ear

Hearing Conservation Amendment 29 CFR 1910.95: New record keeping rule for hearing loss issued July 1, 2002 with an effective date of Jan 1, 2003

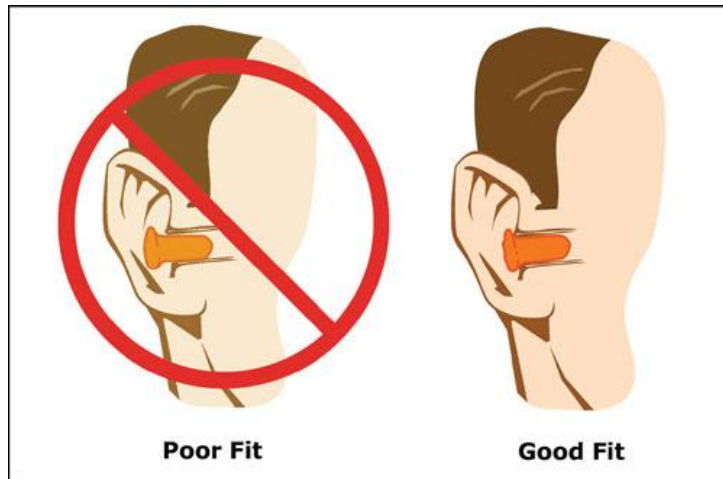
Hearing Loss Severity

- **Mild** hearing loss: 25 to 40 dB
- **Moderate** hearing loss: 40 to 55 dB
- **Moderate-to-severe** hearing loss: 55 to 70 dB
- **Severe** hearing loss: 70 to 90 dB
- **Profound** hearing loss: 90 dB or more



STS Follow-up

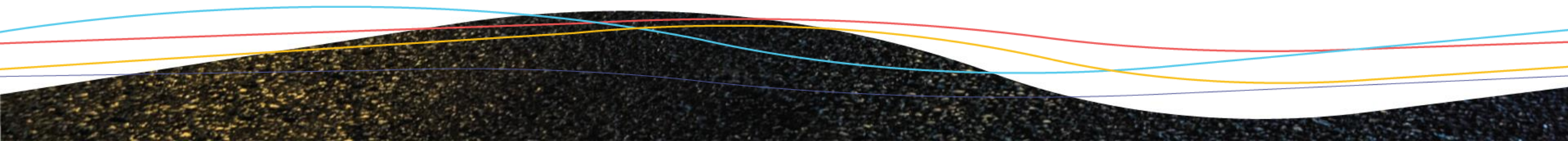
- Notify worker within 21 days (unless not work related)
- Fit or refit for hearing protection device



<http://www.hearingreview.com/2008/05/fit-testing-of-hearing-protection/>

Work-Relatedness of Hearing Loss

1. Is the audiogram valid?
2. Is the employee exposed to hazardous noise or ototoxic chemicals at work?
3. Hearing loss consistent with NIHL or is there a medical condition that can explain the loss?
4. Did a work exposure either cause or contribute to the hearing loss or significantly aggravate a pre-existing hearing loss?

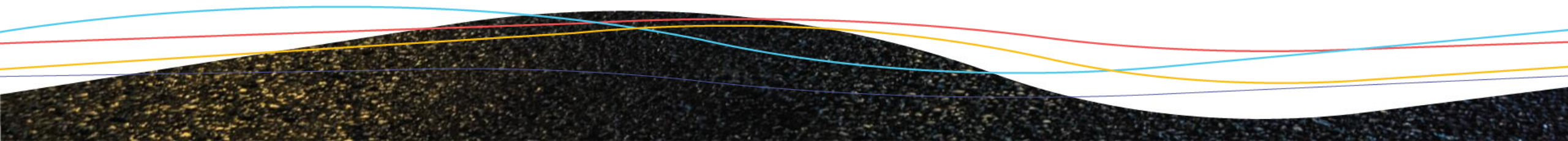


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Pb

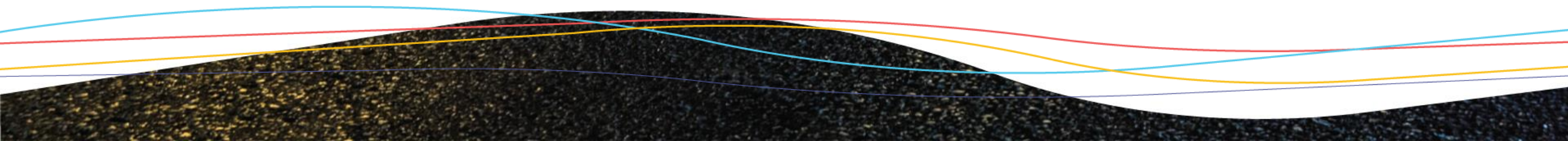
Lead

207.2



Lead (Pb) – Occupational Exposure

- Automotive repair
- Battery manufacturing or recycling
- Construction of bridges, tunnels, or elevated highways
- House painting or wallpapering
- Home renovation
- Firearms instruction
- Furniture refinishing
- Lead smelting or mining



Lead (Pb) Surveillance

- Biological monitoring and medical surveillance is to be made available to all employees exposed to lead above the action level of 30 ug/m(3) TWA for more than 30 days/year.
- Blood sampling and medical evaluation performed on a schedule which is defined by:
 - Previous laboratory results (lead levels)
 - Worker complaints or concerns
 - Clinical assessment of the examining physician

Lead (Pb) Surveillance

- **Every six months:** Blood lead level (BLL) of all employees who are exposed to lead above the action level of 30 ug/m(3).
- **Every two months:** BLL every two months for employees whose last blood lead level was ≥ 40 ug/100 g whole blood.
- **Monthly:** For employees who are removed from exposure to lead due to an elevated blood lead
- A zinc protoporphyrin (ZPP) is required on each occasion that a blood lead level measurement is made.

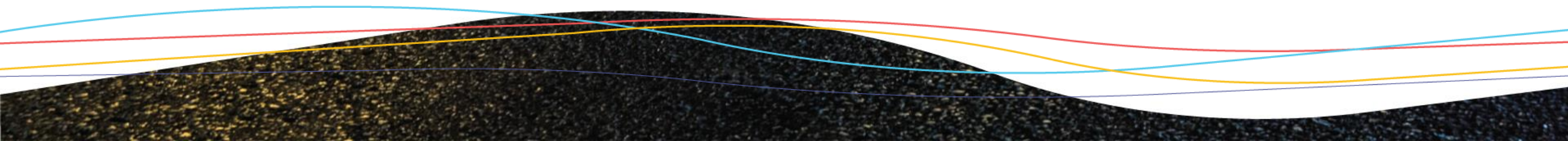
Regulations Versus Recommendations Related to Adult Lead Exposure in the Workplace

| Regulations | Blood lead levels (BLL) | Recommendations |
|--|-------------------------|---|
| Occupational Safety and Health Administration's (OSHA) medical removal BLL* for general industry → ■ | 60 µg/dL | ■ |
| OSHA's medical removal BLL* for construction → ■ | 50 µg/dL | ■ |
| OSHA's return to work → ■ | 40 µg/dL | ■ Association of Occupational and Environmental Clinics (AOEC), California Department of Public Health (CDPH), American College of Occupational and Environmental Medicine (ACOEM) and Michigan Occupational Safety and Health Administration (MIOSHA) recommend medical removal at 30 µg/dL. |
| | 30 µg/dL | ← |
| | 25 µg/dL | ← OSHA's National Emphasis Program for lead determined BLLs at 25 µg/dL among workers in high risk industries shall be considered serious and must be handled by inspection. |
| | 20 µg/dL | ← American Conference of Governmental Industrial Hygienists (ACGIH®) Biological Exposure Index states a typical worker can experience this level without adverse health effects. |
| | 15 µg/dL | ← MIOSHA recommends BLL testing every 2 months for employees found to have a BLL of 15 µg/dL or higher. |
| | 10 µg/dL | ← ACOEM and CDPH recommends BLL testing every 2 months. |
| Case definition for an elevated BLL → ■ | 5 µg/dL | ← Women should not exceed 5 µg/dL during pregnancy. |
| The average blood lead level among adults in 2015–2016. → ■ | 0.92 µg/dL | ■ |

*The OSHA Lead Standards state that the examining physician has broad flexibility to tailor protections to the worker's needs.

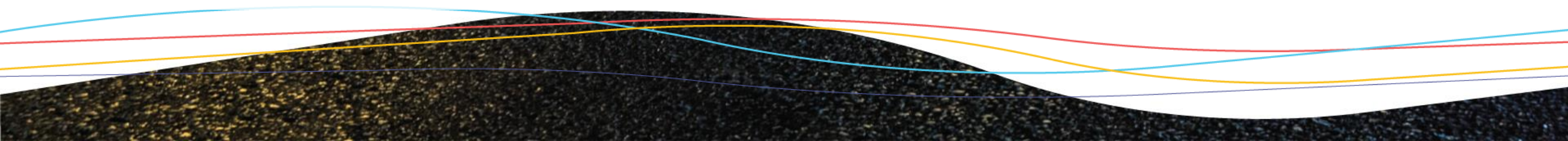
Pb Poisoning: Signs and Symptoms

- High blood pressure
- Numbness and/or tingling in the hands and feet
- Memory loss, mood disorders
- Weakness
- Abdominal pain
- Headache



Zinc protoporphyrin (ZPP)

- ZPP formed with:
 - Iron deficiency
 - Pb poisoning (insertion of iron is inhibited)
- Protoporphyrin combines with Zn instead of Fe to form ZPP.
- ZPP not useful in the body since it cannot bind to oxygen.
- ZPP will not reflect recent/acute lead exposure because it does not change quickly when a person's source of Pb exposure is removed.
- ZPP detects a person's average exposure to Pb over the last 3-4 mths.



Lead Exposure



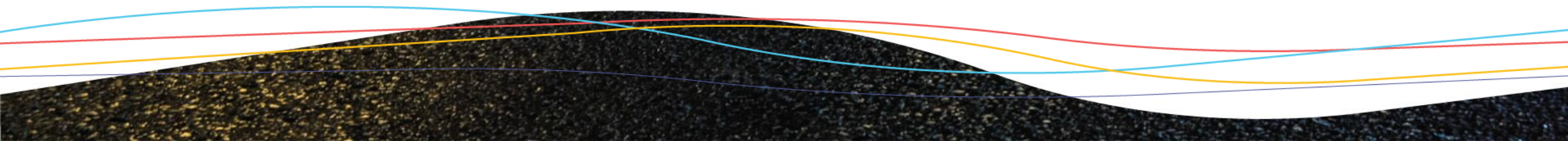
<https://natecintl.com/blog/lead-exposure-continues-to-impact-lives-especially-in-construction/>



<https://www.thetrace.org/2016/04/gun-range-toxic-lead-pollution/>



<http://www.okinternational.org/Projects>

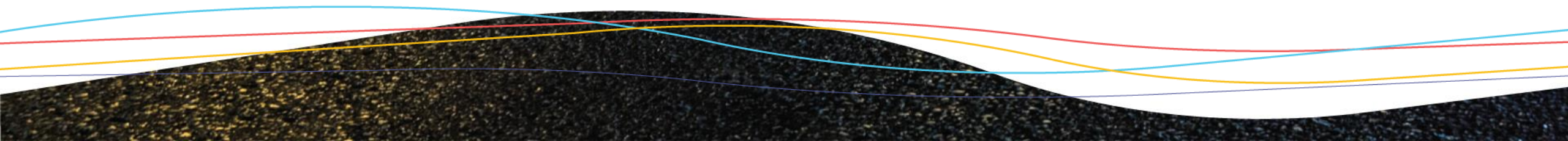


Summary comments

Medical Surveillance Programs

Large Amount of Data Generated

- Blood tests: CBC, metabolic panel, etc.
- Urinalysis
- Audiogram
- PFTs
- CXRs
- Specific exposure testing i.e. Pb, cholinesterase, etc.



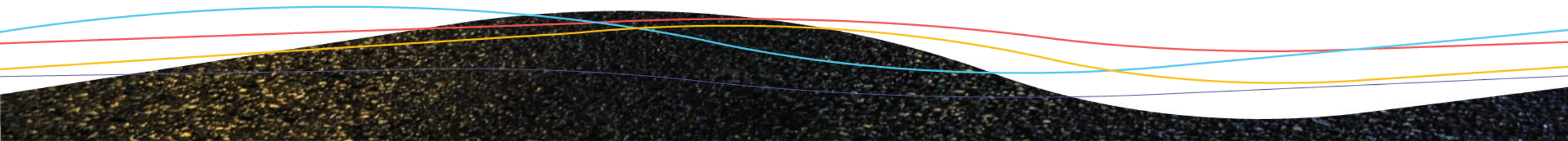
Medical Surveillance Programs

- Document appropriate follow up of all abnormal results.
 - Non-work-related abnormalities f/u with PCP.



Physician's Written Opinion

- Written opinion generated after review of all the data.
- The employer shall provide a copy of the physician's written opinion to the affected employee within 30 days from its receipt.
- “No work-related disease identified”



Take Away Points

Occupational Medical Surveillance Programs:

1. Preventive focus
2. Identifies workers that need surveillance.
3. Identifies potential hazards of work exposure.
4. Perform tests and examinations based on exposures.
5. Serves as a check on engineering controls since symptoms of exposure may indicate a failure that must be corrected.

The End

DRIVING **CHANGE**2023
THE URGENT CARE CONVENTION

