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HEALTHIER WORKPLACES | A HEALTHIER WORLD

THE MANY ASPECTS OF OCCUPATIONAL RISK ASSESSMENT: UNDERSTANDING DIFFERING APPROACHES AND GOALS

August 25, 2022
1:00 p.m.-3:00 p.m. EST

AIHA OPENING REMARKS

LAWRENCE SLOAN, MBA, FASAE, CAE
CEO

HEALTHIER WORKPLACES

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MODERATOR INTRODUCTION

- Andrew Maier, MS, PhD, CIH, DABT
  - Director of the WEEL Committee
  - Principal Health Scientist at ChemRisk (Stantec)
  - Former IH in petrochemical industry, associate professor at University of Cincinnati, NIOSH Fellow

WORKSHOP OVERVIEW

- Overall goal is information sharing
- Highlight the key differences in terminology, objectives, and methods
- Describe assessments from different contexts
  - TSCA occupational risk evaluations, health and safety compliance, research, and product stewardship programs.
- Provide comparison of approaches and extrapolating from one domain to another
- Identify common data gaps and opportunities for data sharing

ROADMAP (AGENDA)

Time	Topic	Presenters
1:00-1:10	AIHA opening remarks, moderator introduction	Larry Sloan (AIHA), Andy Maier (OARS)
1:10 - 1:55	Speaker presentations	Majd El-Zoobi, Chris Whittaker, Bill Perry
1:55 - 2:00	Break	
2:00 – 2:15	Speaker presentation	Fred Boelter
2:15 – 2:55	Discussion and Audience polls	Facilitated Panel
2:55 – 3:00	Next Steps	AIHA Staff

SPEAKERS AND DISCUSSANTS

Speakers

- Fred Boelter, CIH, PE, BCEE, FAIHA
- Majd El-Zoobi, PE
- William Perry, CIH
- Christine Whittaker, PhD

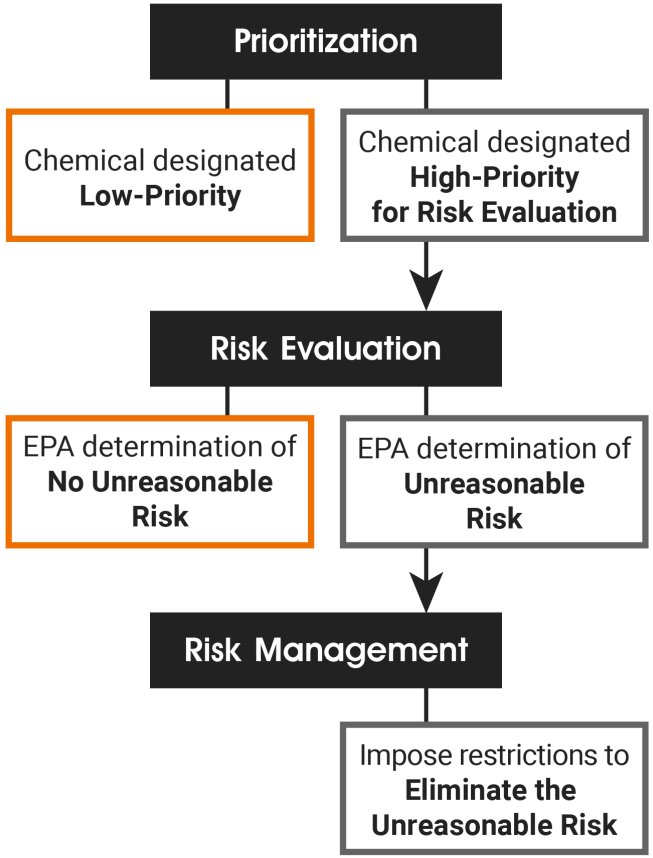
Discussants

- Brenda Finter, CIH, CSP, CHMM
- John Henshaw, CIH, FAIHA
- MaryAnn Hoff, CIH
- Steve Jahn, CIH, FAIHA
- Silvia Maberti, PhD
- Paul Price, PhD
- Rebecca Reindel, CIH

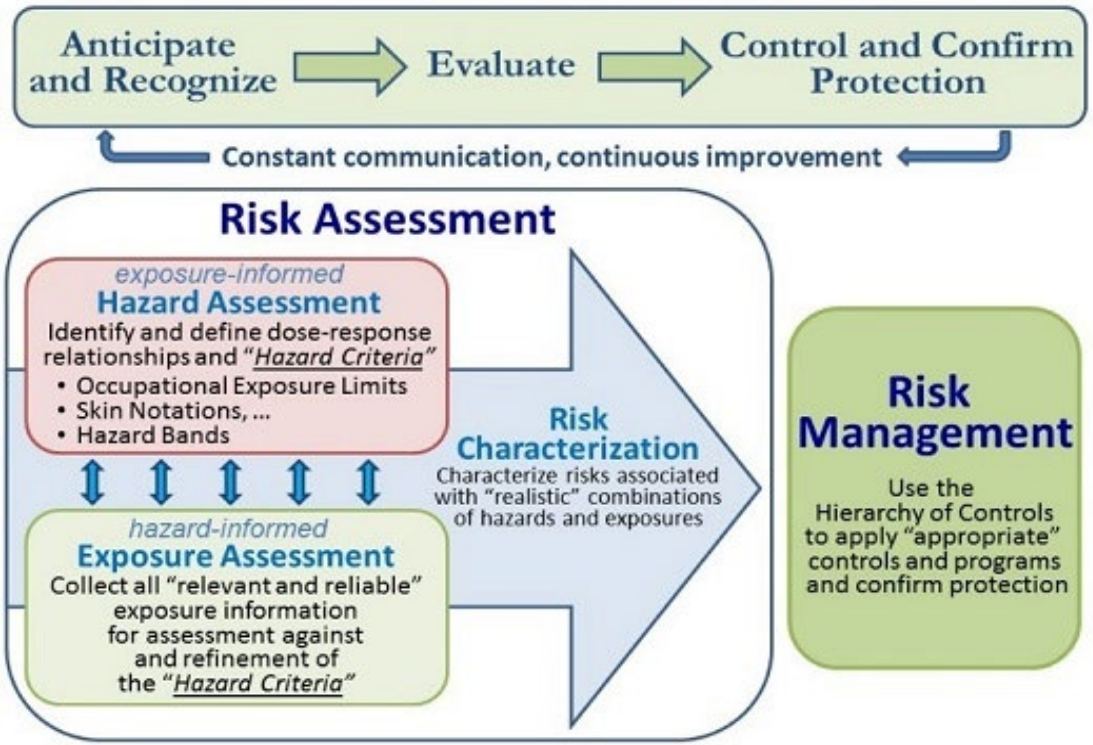
GOALS OF OCCUPATIONAL RA

- Overall goal is protecting worker health
- Fit-for-purpose
- Domains of occupational risk assessment
  - Facility/site based (exposure control)
  - Research-oriented (NIOSH, academic)
  - Compliance-based (OSHA)
  - Chemical registration and evaluation (REACH, TSCA)

RISK ASSESSMENT PROCESSES VARY



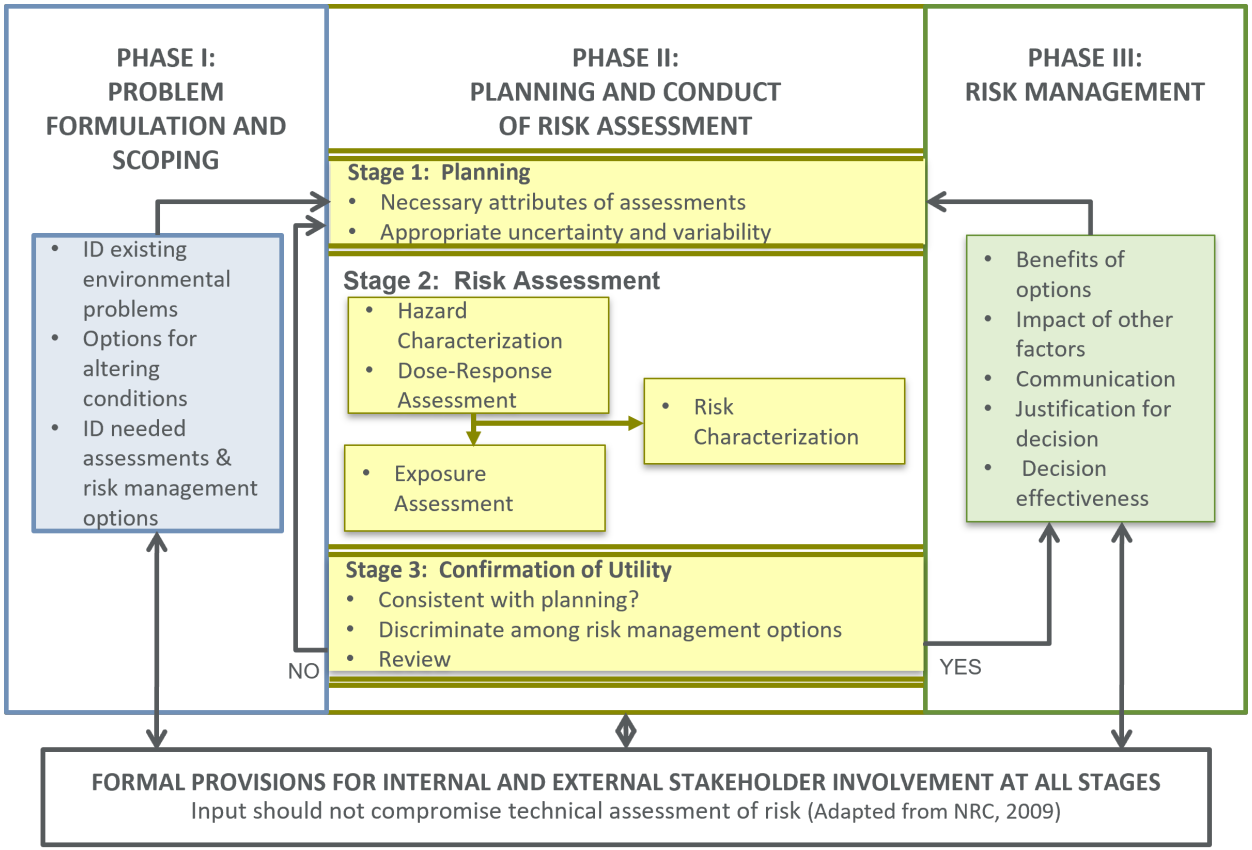
EPA Risk Evaluation Process for Existing Chemicals



AIHA framework

A SHARED FOUNDATION

- Problem formulation
- Exposure assessment
- Dose-response
- Risk characterization
- Risk management
- Risk communication



NRC (National Research Council of the National Academy of Science) (2009). Science and decisions: Advancing risk assessment. National Research Council, National Academies Press, Washington, DC. AKA, "Silverbook

MEET THE SPEAKER

Majd El-Zoobi, PE,
Chemical Engineer, U.S. EPA OCSPP, Existing Chemicals Risk Assessment Division

- 18 years at EPA as a Chemical Engineer in the Office of Chemical Safety and Pollution Prevention (OCSPP)
- Prior to joining EPA, he worked as a project, process design, and production engineer in the chemical industry
- Expertise in exposure assessment

Occupational Exposure Assessments in TSCA Risk Evaluations

Majd El-Zoobi, M.S., P.E.

Many Paths, One Goal – Protecting Worker Health: An AIHA Workshop Series on Occupational Risk Assessment

August 2022 Workshop: The Many Aspects of Occupational Risk Assessment - Understanding Differing Approaches and Goals

August 25, 2022

Outline

Introduction

- Background
- TSCA Provisions and EPA Work Process

Occupational Exposure Assessment

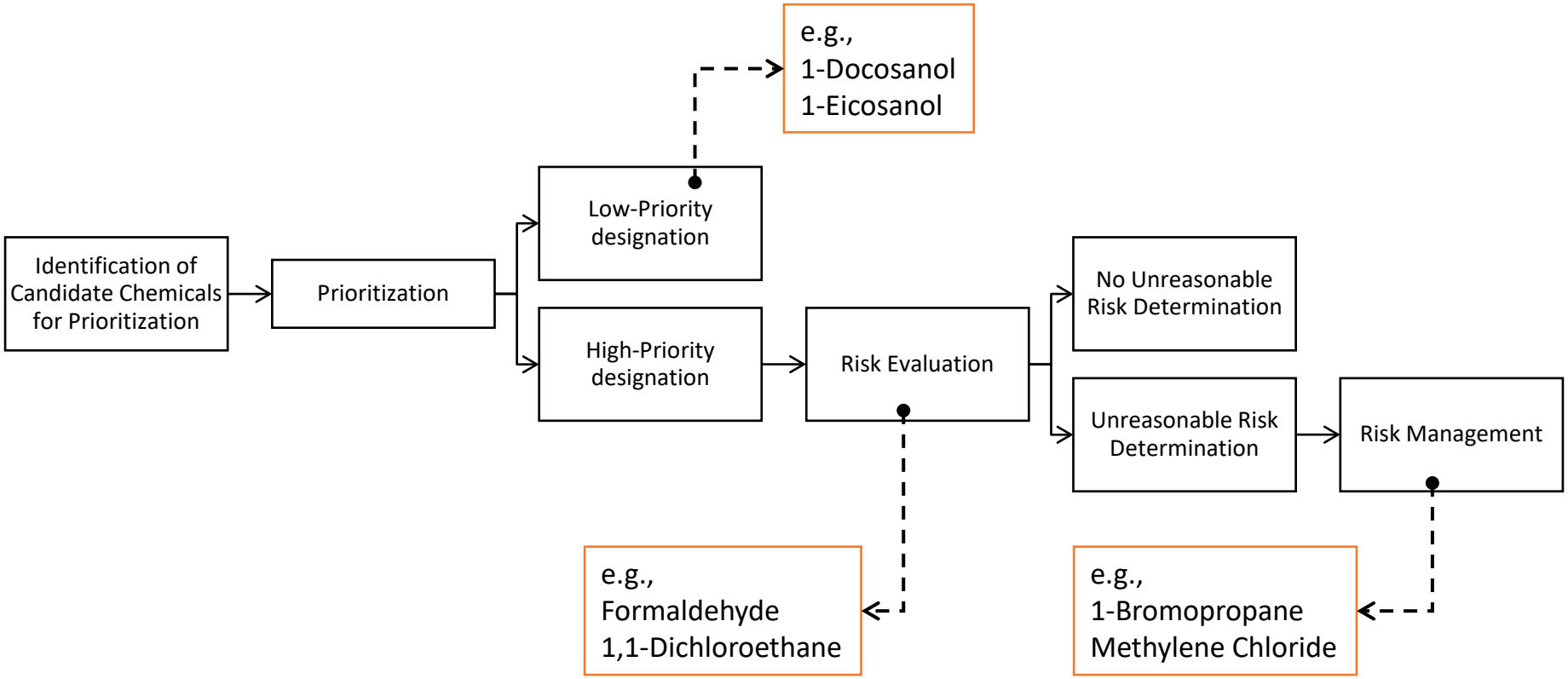
- Goals
- Elements
- Data Sources and Assessment Approach
- Opportunities for Improvement

Background

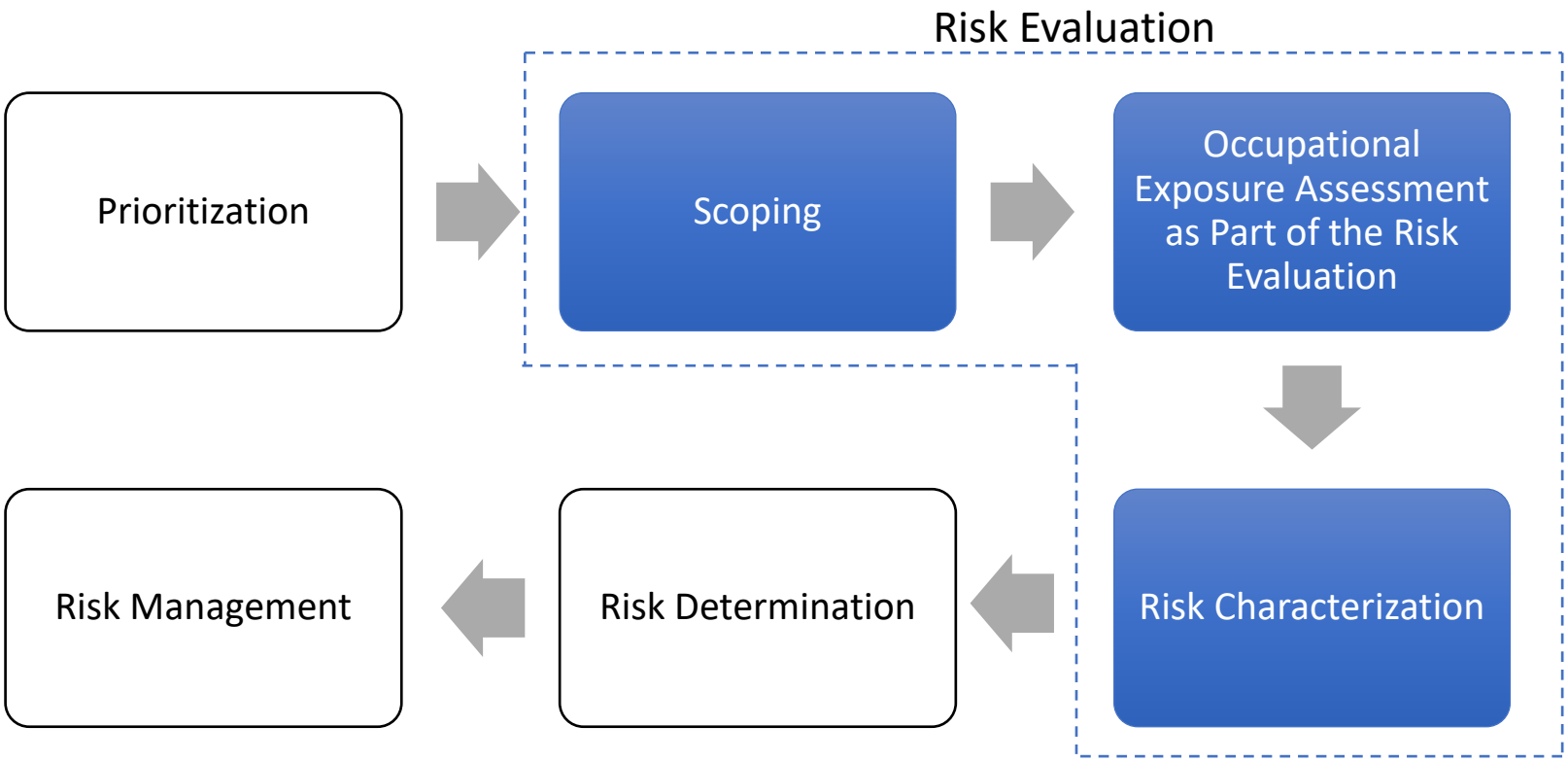
EPA evaluates the risk of adverse human health and environmental effects caused by chemical substances

- The Toxic Substances Control Act (TSCA) - 1976
- The Frank R. Lautenberg Chemical Safety for the 21st Century Act - 2016
- In commerce (“existing”) and not in commerce (“new”) chemical substances
- TSCA Inventory: ~ 87,000 chemical substances
  - ~ 42,000 chemical substances potentially active in commerce

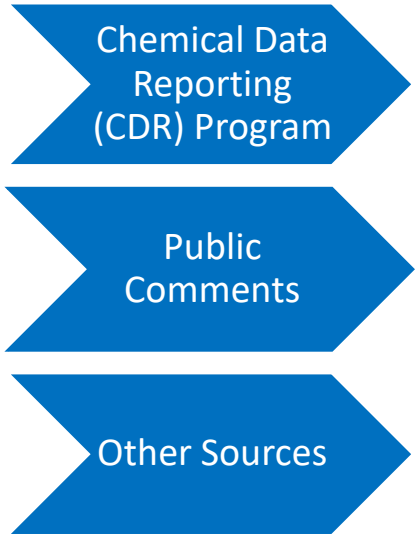
TSCA Provisions and EPA Work Process for Existing Chemicals



<u>Approach:</u> Occupational Exposure Assessment as Part of the Overall Process



Conditions of Use (COU)



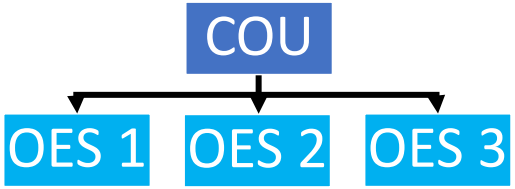
Life-Cycle Stage	Category	Subcategory
Manufacturing	…	…
Processing	…	…
Distribution in commerce	…	…
Industrial use	…	…
Commercial use	…	…
Disposal	…	…

COU Example

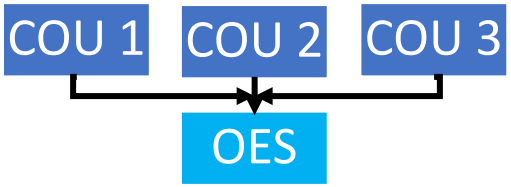
Risk Evaluation	Life Cycle	Category	Subcategory
1-BP	Industrial/ Commercial Use	Solvent (for Cleaning or Degreasing)	Batch Vapor Degreaser (e.g., Open-Top, Closed-Loop)

Conditions of Use (COU) and Occupational Exposure Scenarios (OES)

- OES are environmental release and occupational exposure scenarios associated with the COU and are determined during risk evaluation



- A COU may be associated with one or more OES:
- Example: the 1-BP COU of batch vapor degreasing → 2 OES: open-top and closed-loop degreasing



- Multiple COUs may be associated with a single OES:
- Example: the methylene chloride COU of aerosol degreaser, interior car care spot remover, and spray lubricant → 1 OES: commercial aerosol products

Goal of the Occupational Exposure Assessment

To assess worker and occupational non-user (ONU) exposure and to enable risk calculation for each OES of the risk evaluation

Example of non-cancer risk calculation:

$$\mathrm{MOE} = \frac{\mathrm{non-cancer\ hazard\ value}}{\mathrm{worker\ or\ ONU\ exposure}}$$

Goal of the Occupational Exposure Assessment

An example calculation of worker or ONU exposure:

$$\mathrm{ADD} = \frac{\mathrm{C} \times \mathrm{b} \times \mathrm{ED} \times \mathrm{EF} \times \mathrm{WY}}{\mathrm{BW\ X\ AT}}$$

- ADD = average daily dose used for chronic non-cancer risk calculations (mg/kg-day)
- C = inhalation exposure mass concentration (mg/m^3)
- b = breathing rate (m^3/hr)
- ED = exposure duration (hr/day)
- EF = exposure frequency (days/yr)
- WY = the number of years of a worker or ONU's lifetime during which exposure to the chemical occurs (yr)
- BW = body weight (kg)
- AT = averaging time, non-cancer risks (days)

Goal of the Occupational Exposure Assessment

For each occupational exposure scenario, the following is assessed:

- Central tendency and high-end worker exposures
- Central tendency and high-end ONU exposures

Depending on the available hazard data, each of the assessed exposures may include the following:

- Chronic (cancer and non-cancer), subchronic, and acute exposures

Elements of Occupational Exposure Assessment

Facility Information

- Process Description (including concentration)
- Operations Information
  - Production volume for the life cycle stage
  - Days of operation per year
  - Worker activities
  - Number of sites
- Industrial Hygiene Information
  - Physical form
  - Exposure routes
  - Exposure duration
  - Exposure frequency
  - Engineering controls
  - Administrative controls
  - PPE
  - Number of potentially exposed workers

Monitoring Information

- Inhalation Exposure Mass Concentration
  - Worker and ONU
  - Personal and area concentrations
  - TWA, short-term and peak values
  - Central tendency and high-end values
  - OES-specific or surrogate data
  - Exposure durations
- Dermal Applied Dose
- Dermal Percent Absorption

Modeling Information

- Throughput of the Chemical
- Use Rate of the Chemical
- Emissions Rate
- Duration of Operation or Worker Activity
- Ventilation Rate
  - Exchange rate
  - Workspace volume
- Dermal Applied Dose and Percent Absorption

Occupational Exposure Assessment Data Sources and Approach

- Data Sources:
  - Gray literature (e.g., NIOSH and OSHA data)
  - Peer reviewed literature
  - Test orders
  - Public comments

- Assessment Approaches:
  - Systematic review (data identification, quality evaluation and integration)
  - Hierarchy of data types (e.g., monitoring data of adequate quality are preferable to modeling data)
  - Risk evaluation review: internal government review, public comments, and peer review

Occupational Exposure Assessment Hierarchy of Data Types

Monitoring Data

- Personal and directly applicable
- Area and directly applicable
- Personal and potentially applicable or similar
- Area and potentially applicable or similar

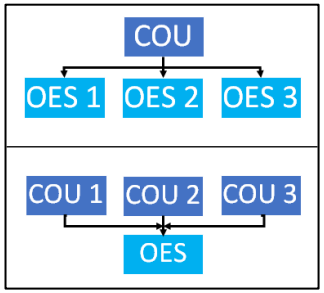
Modeling Approaches

- Surrogate monitoring data
- Fundamental modeling approaches
- Statistical regression modeling approaches

Occupational Exposure Limits

- OSHA Permissible Exposure Limits (PELs)
- Company-specific OELs (for site-specific exposure assessments)
- Voluntary limits: ACGIH TLV, NIOSH REL, Occupational Alliance for Risk Science (OARS), Workplace Environmental Exposure Level (WEEL) [formerly by AIHA]

Opportunities for Improvement: Number of Conditions of Use and Exposure Scenarios and Availability of Worker Inhalation Monitoring Data



Risk Evaluation	Number of Conditions of Use	Number of Occupational Exposure Scenarios	Number of OES Assessed Based on Worker Inhalation Monitoring Data that is Chemical and Exposure Scenario-Specific
Asbestos Part 1	7	8	6 (or ~75%)
1-Bromopropane	26	15	8 (or ~53%)
HBCD	9	14	1 (or ~7%)

Opportunities for Improvement: Select Public Comments on the Draft Risk Evaluations

Comments by Industry & NGOs

- Use of NMP in semiconductors should be separated from the other electronics uses
- Certain conditions of use of 1-BP are oversimplified, leading to missing considerations
- EPA lumps together a highly diverse set of 1,4-Dioxane uses as “industrial uses” and asserts that all such operations “are expected” to be similar. Support for this assumption should be provided.

THANK YOU

MEET THE SPEAKER

Christine Whittaker, PhD
Director, Division of Science Integration, NIOSH/CDC

- Director of the Division of Science Integration (DSI) at the National Institute for Occupational Safety and Health (NIOSH)
- DSI researches and develops NIOSH recommendations and communication products
- Previously served as Chief of the Risk Evaluation Branch within DSI

Occupational Risk Assessment at NIOSH

Christine Whittaker, Ph.D.

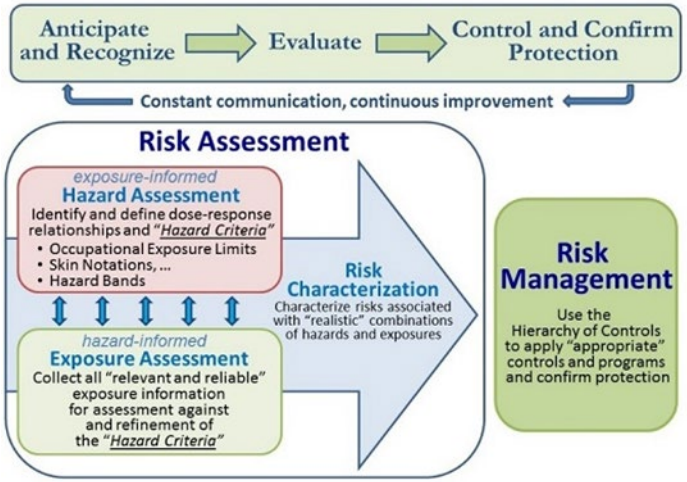
Director, Division of Science Integration

AIHA Workshop on Occupational Risk Assessment

August 25, 2022

Occupational Risk and Exposure Assessment

- **Fit for purpose**
  - Answers specific questions such as:
    - What are risks faced by workers exposed to a chemical?
    - What occupational exposure concentration corresponds to a target risk level?
    - How do specific engineering controls reduce exposures and risks?



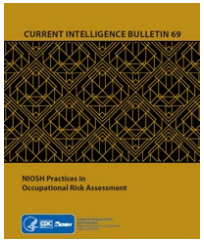
https://www.cdc.gov/niosh/programs/exap/description.html

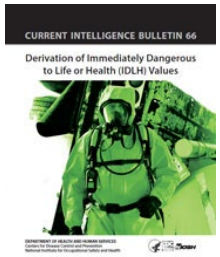
Occupational Risk and Exposure Assessment at NIOSH

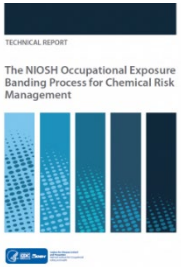
- **Several Purposes**
  - Support NIOSH recommendations to protect workers from workplace exposures to chemicals
    - Many types of workplace exposures
  - Support NIOSH evaluations for individual facilities
    - Targeted workplace exposures
  - Support NIOSH research in epidemiology and engineering control technology
    - Answer specific research questions

Occupational Risk and Exposure Assessment at NIOSH

- **NIOSH Risk and Exposure Assessments**
  - NIOSH Recommendations
    - Recommended Exposure Limits (REL)
    - Risk Management Limits for Carcinogens (RML-CA)
    - Immediately Dangerous to Life or Health values (IDLH)
    - Skin Notations (Sk)
  - NIOSH Occupational Exposure Banding
  - Site assessments as part of Health Hazard Evaluations
  - Evaluation of engineering controls
  - Epidemiological investigations

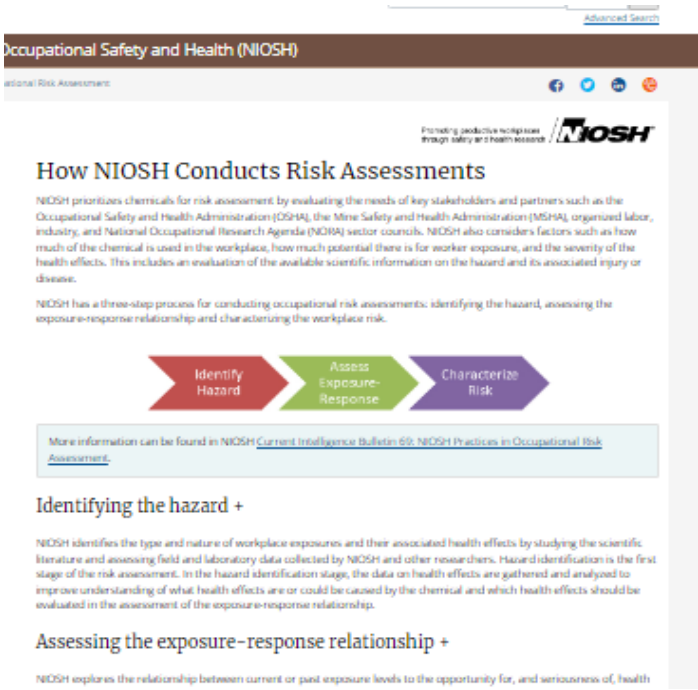






Recommended Exposure Limits and Risk Management Levels for Carcinogens

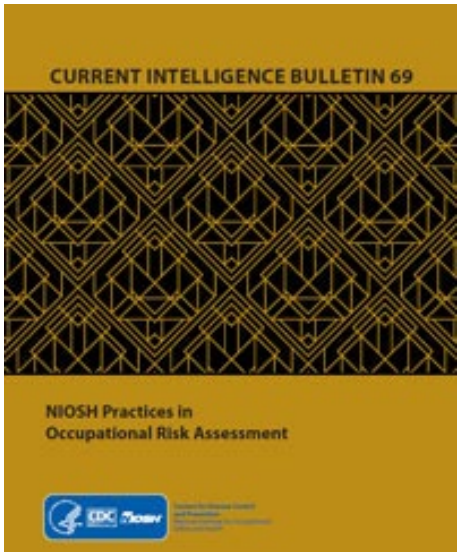
- **NIOSH Risk Assessment**
  - Designed to protect workers from occupational exposure even if exposed every day for a working lifetime (45 years)
  - Used for chronic adverse health outcomes, like cancer and respiratory disease
  - Assume cumulative risk, working lifetime exposure to constant concentration, lower 95% confidence limit on
  - Uses human epidemiology or animal toxicology data to predict the exposure level at a target risk – not necessarily current exposures.



https://www.cdc.gov/niosh/topics/riskassessment/how.html

Recommended Exposure Limits and Risk Management Levels for Carcinogens

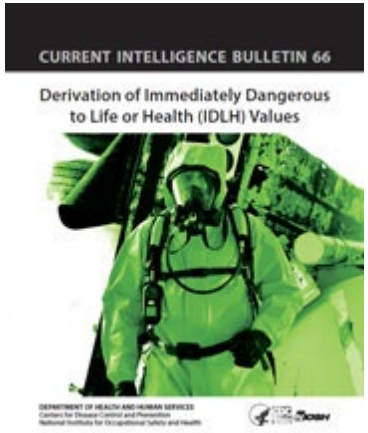
- **NIOSH Exposure Assessments**
  - to characterize current exposures to understand scope of problem
  - to evaluate potential engineering controls
  - to recommend appropriate respiratory protection



https://www.cdc.gov/niosh/docs/2020-106/default.html

Immediately Dangerous to Life or Health Values

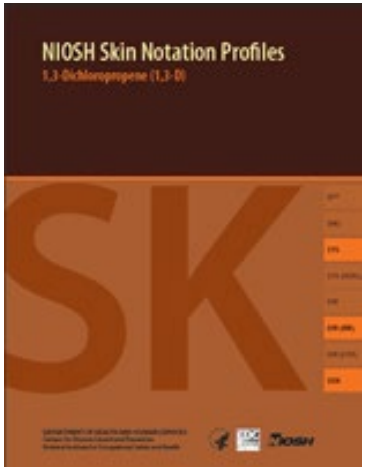
- **NIOSH Risk Assessments**
  - Aim: To protect workers from acute over-exposure to hazardous chemicals – up to 30 minutes to allow escape
  - Used for acute adverse health outcomes and escape-impairing effects
  - Health effects: eye and respiratory irritation, neurotoxicity and other acute toxicity or toxicity related to escape impairment
  - Use human acute studies or animal toxicology data to predict the exposure level at a target risk. [No exposure assessment]



https://www.cdc.gov/niosh/docs/2014-100/

NIOSH Skin Notations

- **NIOSH Hazard Identification**
  - Aim: To protect workers from dermal exposure to hazardous chemicals
  - Assigned notations for systemic, direct and sensitizing effects due to skin exposure
  - Notations for potential lethal exposures, skin irritation and corrosion
  - Notations based on physicochemical properties, human exposures and health effects, animal and in vitro testing, computational modeling techniques. [No exposure assessment]



https://www.cdc.gov/niosh/topics/skin/skin-notation_profiles.html

NIOSH Occupational Exposure Banding

- **NIOSH Semi-Quantitative Risk Assessment**
  - Aim: To provide a tool to develop guidance for chemicals with no occupational exposure limits
  - Based on health effects data from authoritative sources
  - Tool provides occupational exposure bands based on toxicity [No exposure assessment]
  - NIOSH does not provide authoritative occupational exposure bands

https://www.cdc.gov/niosh/topics/oeb/default.html

Other Exposure Assessments at NIOSH

- **Health Hazard Evaluations (HHE)**
  - Investigating health hazards by request of employees, union officials, or employers
  - Evaluating exposures and/or health effects
- **Epidemiological Evaluations**
  - Rigorous evaluation of exposures and health effects in various industrial settings
- **Evaluation of Engineering Controls**
  - As part of an HHE or research study, or to provide technical assistance

https://www.cdc.gov/niosh/hhe/default.html

Exposure Assessment Data Sources

- NIOSH epidemiology research
- NIOSH Health Hazard Evaluations
- NIOSH exposure assessment, engineering control, and field study research
- OSHA database
- Scientific literature
- Data submitted by stakeholders in industries of interest
- Occupational exposure modeling
- Other sources as appropriate

Characteristics of Useful Chemical Exposure Data

Comprised of many elements, including a clear description of:

- Time/date/duration of collection
- Personal or area monitoring
- Task-based or shift-based and work being undertaken
- Chemical being monitored
- Who was monitored, their occupation and who/how many they represent
- Equipment used for collection, as well as flow rate (if appropriate), sampling time, other parameters, etc.
- Method of analysis
- And more . . .

(1996) Special Report: Data Elements for Occupational Exposure Databases: Guidelines and Recommendations for Airborne Hazards and Noise, Applied Occupational and Environmental Hygiene, 11:11, 1294-1311, DOI:10.1080/1047322X.1996.10389417 https://doi.org/10.1080/1047322X.1996.10389417

Occupational Risk Assessment

- Fit for purpose
  - Characterizing existing exposures versus characterizing exposures at target risk
- Relies on exposure and health data from a variety of sources
  - Good exposure information helps prioritize and inform occupational risk assessments

Thank you!

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

MEET THE SPEAKER

William Perry, CIH, retired
Former Directorate of Standards and Guidance at OSHA

- Former Director of the Directorate of Standards and Guidance at the U.S. Occupational Safety and Health Administration (OSHA)
- Also served as Deputy Director and as an Office Director in DSG.
- Oversaw regulatory and guidance development on a wide range of topics

Department of Labor
Occupational Safety and Health Administration
Directorate of Standards and Guidance
AIHA Risk Assessment Workshop
Falls Church, Virginia, August 25, 2022

OSHA Risk Assessment

William Perry, CIH (Retired, 1990-2022)

Contractor
Occupational Safety and Health Administration

OSHA® Occupational Safety and Health Administration

Promulgation of Standards Under the OSH Act

- To promulgate health standards under the OSH Act, OSHA must make the following findings:
  - That a significant risk to health exists from exposure to a hazardous substance (based dose-response analysis, not on baseline or prevailing exposures among workers);
  - That the new or revised standard is technologically and economically feasible; and
  - That the standard is cost-effective.
- Although OSHA cannot base its regulatory decisions on cost-benefit analysis, it must fairly assess costs and benefits in accordance with Executive Orders 12866 and 13563.

Technological & Economic Feasibility Analysis

- Technological feasibility, cost, and benefits evaluation:
  - Analyses of prevailing exposures among workers by industry and operation (exposure characterization);
  - Combines that with the dose-response analysis to characterize baseline risks to workers, and to estimate potential reductions in fatalities and illnesses attributable to regulation (risk characterization);
  - These analyses make use of a wide variety of existing occupational exposure data

Exposure Data

- Sources of exposure data include:
  - OSHA air sampling data from enforcement activities (OSHA's Information System, compliance case files);
  - Site visits conducted by OSHA (and its contractors);
  - NIOSH reports (HHE's, control technology assessments, others);
  - Published studies; and
  - Unpublished data provided by employers, trade associations, labor organizations
- Typically relies on personal air samples taken over nearly a full work shift

Risk Assessment Goal

- Goal is to estimate the number of workers exposed within various ranges of exposure, for each industry sector and operation.
- May combine data representing a single operation across many industries (application groups).
- Important to obtain information that explains why some exposures are low and others higher.
  - (Intrinsic to operation? Differences between facilities or processes? Use of or lack of exposure controls/work practices?)

Handling Missing Data

- Where data for an industry/operation are missing or sparse, OSHA has used data from other similar operations where materials and exposure routes are similar:
  - Example (Hex Chrome rulemaking) – OSHA relied on data describing exposures to hexavalent chromium during packing/bagging of chrome pigments to represent exposures during packing/bagging of plastic colorants.
  - Example (Crystalline silica rulemaking) – OSHA lacked specific data describing exposures during operation of small drivable milling machines, and used data from operation of large drivable milling machines to supplement, providing a credible upper bound exposure for smaller machines not equipped with dust control.

Examples of Exposure Profiles

Shows distribution of exposure data obtained for electroplating operations – data from OSHA enforcement activities and OSHA and NIOSH site visits

Table III-3. Distribution of Full-Shift Personal Exposures (8-hour TWA) for Hexavalent Chromium in the Electroplating Industry[a,b]

Job Category	Total No. of Data Points	Distribution ($\mu g/m^3$)[c] Below LOD[d]	<0.25	0.25 to <0.5	≥0.5 to <1.0	≥1.0 to <5.0	≥5.0 to <10.0	≥10.0 to <20.0	>20.0
Hard Chrome (No IMIS)	84	NA[e]	5 8%	8 16%	4 5%	47 49%	18 19%	2 3%	0 0%
Decorative Chrome	28	NA	7 29%	14 48%	0 0%	2 5%	1 2%	2 7.1%	2 10%
Job Shop Chrome Plater	50	NA	14 25%	9 22%	2 6%	6 11%	10 17%	6 11%	3 8.3%
Captive Shop Chrome Plater	33	NA	3 10%	14 38%	5 14%	4 14%	4 17%	1 3%	2 7%
Job Shop Plater	219	NA	49 25%	93 45%	7 3%	26 10%	18 7%	11 5%	15 5%
Captive Shop Plater	99	NA	19 16%	51 53%	5 6%	13 13%	7 8%	2 2%	2 2%
Anodizer	26	NA	12 41%	10 41%	1 4.5%	0 0%	2 9%	0 0%	1 4.5%
Operator	86	NA	13 19%	32 33%	5 7%	14 16%	9 13%	8 6%	5 6%
Helper/Other	128	NA	18 15%	57 59%	0 0%	31 7.5%	16 11%	4 5%	2 3%
CC Coater	21	NA	9 58%	11 37%	0 0%	1 5%	0 0%	0 0%	0 0%
Total	774	NA (0%)	149 (19%)	299 (39%)	29 (4%)	144 (18%)	85 (11%)	36 (5%)	32 (4%)

a Percentages are based on the number of facilities tested. Based on Combined IMIS, NIOSH, and OSHA Site Visit Full-Shift Occupational Exposure Data.
b Values may be affected by rounding.
c $\mu g/m^3$ = micrograms per cubic meter.
d LOD = Limit of Detection.
e NA – Not applicable. The Limit of Detection samples were assumed to be at the specified limit of detection in the report.

Source: Shaw, 2006

OSHA® Occupational Safety and Health Administration

Examples of Exposure Profiles

Shows how OSHA uses distribution of exposure data to estimate numbers of workers in each job category exposed to various ranges of exposure

Table III-4. Personal Exposure Profile in the Electroplating Industry (full-shift TWA)[a,b]

Job Category[e]	Total No. of Workers[a]	Distribution ($\mu g/m^3$)[c] Below LOD[d]	<0.25	0.25 to <0.5	≥0.5 to <1.0	≥1.0 to <5.0	≥5.0 to <10.0	≥10.0 to <20.0	>20.0
Hard Chrome	2,590	NA	200	424	139	1,261	496	69	0
			8%	16%	5%	49%	19%	3%	0%
Decorative Chrome	1,850	NA	529	881	0	88	44	132	176
			29%	48%	0%	5%	2%	7.1%	10%
Job Shop Chrome Plater	3,330	NA	833	740	185	370	570	355	278
			25%	22%	6%	11%	17%	11%	8.3%
Captive Shop Chrome Plater	2,683	NA	278	1,018	370	370	370	93	185
			10%	38%	14%	14%	17%	3%	7%
Job Shop Plater	13,600	NA	3,365	6,083	416	1,409	924	671	732
			25%	45%	3%	10%	7%	5%	5%
Captive Shop Plater	7,494	NA	1,165	3,975	457	1,005	594	183	114
			16%	53%	6%	13%	8%	2%	2%
Anodizer	1,943	NA	795	795	88	0	177	0	88
			41%	41%	4.5%	0%	9%	0%	4.5%
Operator	5,180	NA	954	1,751	373	842	636	342	282
			19%	33%	7%	16%	13%	6%	6%
Helper/Other	6,938	NA	990	3,975	0	688	765	347	173
			15%	59%	0%	7.5%	11%	5%	3%
CC Coater	21,247	NA	12,301	7,828	0	1,118	0	0	0
			58%	37%	0%	5%	0%	0%	0%
Total	66,857	NA	21,409	27,471	2,028	7,152	4,577	2,191	2,028
		(0%)	(32%)	(41%)	(3%)	(11%)	(7%)	(3%)	(3%)

a For electroplaters, "Total No. of Workers" includes plating and coating machine setters, operators, and tenders (metal and plastics).

b Percentages are based on the number of facilities sampled. Values may be affected by rounding.

c µg/m3 = micrograms per cubic meter.

d LOD = Limit of Detection.

e For electroplaters, job shops are all establishments in NAICS 332813 (20,610 employees) and captive shops are all other NAICS codes (25,000 employees). For CC coaters, job shops are all establishments in NAICS 332813 (9,827 employees) and captive shops are all other NAICS codes (11,421 employees).

Source: Shaw, 2006

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Examples of Exposure Profiles

From the silica rulemaking, an exposure profile for a general industry sector and a construction operation. Note the distinctions made on the construction profile in environmental conditions and dust controls.

Table IV.4.15-B
Personal Respirable Crystalline Silica Exposure Range and Distribution of Results for Workers in the Pottery Industry (NAICS 327111, 327112, 327113)

	Exposure Summary			Exposure Range		Exposure Profile				
Pottery Industry	**N**	**Mean (µg/m³)**	**Median (µg/m³)**	**Min (µg/m³)**	**Max (µg/m³)**	**< 25 (µg/m³)**	**≥ 25 and ≤ 50 (µg/m³)**	**> 50 and ≤ 100 (µg/m³)**	**> 100 and ≤ 250 (µg/m³)**	**> 250 (µg/m³)**
Material Handler	*11*	*149*	*41*	*20*	*1,101*	*3 (27.3%)*	*3 (27.3%)*	*3 (27.3%)*	*1 (9.1%)*	*1 (9.1%)*
Forming Line Operator	*36*	*42*	*31*	*6*	*238*	*15 (41.7%)*	*10 (27.8%)*	*9 (25%)*	*2 (5.6%)*	*0 (0%)*
Finishing Operator	*10*	*26*	*21*	*10*	*55*	*6 (60%)*	*2 (20%)*	*2 (20%)*	*0 (0%)*	*0 (0%)*
Coatings Preparer	*12*	*305*	*82*	*24*	*983*	*1 (8.3%)*	*1 (8.3%)*	*5 (41.7%)*	*1 (8.3%)*	*4 (33.3%)*
Coatings Operator	*18*	*81*	*53*	*12*	*507*	*5 (27.8%)*	*3 (16.7%)*	*6 (33.3%)*	*3 (16.7%)*	*1 (5.6%)*
Pottery Industry Total	87	98	40	6	1,101	30 (34.5%)	19 (21.8%)	25 (28.7%)	7 (8%)	6 (6.9%)

Notes: All samples are personal breathing zone (PBZ) results representing 8-hour time-weighted average exposures.
Job categories are intended to represent job functions; actual job titles might differ, and responsibilities might be allocated differently, depending on the facility.
Percentages may not add to 100 percent due to rounding.
Sources: Document ID 1720; 3958; 0027; 0106; 0143; 0174; 0195; 0211; 1436.

Table IV.5.5-B
Personal Respirable Crystalline Silica Exposure Range and Distribution of Results for Construction Workers: Demolition Workers Using Jackhammers and Other Powered Handheld Chipping Tools

	Exposure Summary			Exposure Range		Exposure Profile				
Demolition Workers Using Jackhammers and Handheld Power Chipping Tools	**N**	**Mean (µg/m³)**	**Median (µg/m³)**	**Min (µg/m³)**	**Max (µg/m³)**	**< 25 (µg/m³)**	**≥ 25 and ≤ 50 (µg/m³)**	**> 50 and ≤ 100 (µg/m³)**	**> 100 and ≤ 250 (µg/m³)**	**> 250 (µg/m³)**
Outdoor - baseline	66	194	148	12	624	11 (16.7%)	7 (10.6%)	10 (15.2%)	15 (22.7%)	23 (34.8%)
Outdoor with water applied	5	226	140	12	639	1 (20%)	0 (0%)	0 (0%)	3 (60%)	1 (20%)
Indoor - baseline	32	404	111	12	2,350	7 (21.9%)	0 (0%)	8 (25%)	8 (25%)	9 (28.1%)
Indoor with water applied	11	328	260	12	880	3 (27.3%)	0 (0%)	1 (9.1%)	1 (9.1%)	6 (54.5%)
Other	20	152	13	12	1,144	11 (55%)	1 (5%)	2 (10%)	3 (15%)	3 (15%)
Demolition Workers Using Jackhammers and Handheld Power Chipping Tools Total	**134**	**250**	**126**	**12**	**2,350**	**33 (24.6%)**	**8 (6%)**	**21 (15.7%)**	**30 (22.4%)**	**42 (31.3%)**

Notes: All samples are personal breathing zone (PBZ) results and represent 8-hour time-weighted average exposures.
Job categories are intended to represent job functions; actual job titles might differ, and responsibilities might be allocated differently, depending on the site.
Percentages may not add to 100 percent due to rounding.

Sources: Document ID 1720; 3958; 0016; 0019; 0021; 0029; 0044; 0045; 0079; 0088; 0101; 0109; 0177; 0179; 0183; 0197; 0219; 0226; 0027; 0798; 0846; 0850; 0857; 0874; 0911; 0912; 1143.

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Examples of Exposure Profiles

Estimates of exposed workers drawn from the exposure profiles for pottery operations and jackhammering operations.

Table III-9: Numbers of Workers Exposed to Silica (by Affected Industry and Exposure Level (μg/m³))

				Number of Employees Exposed to Silica				
NAICS	Industry	Number of Establishments	Number of Employees	>=0	>=25	>=50	>=100	>=250
Construction								
236100	Residential Building Construction	151,034	519,070	210,773	132,901	102,275	61,678	24,625
236200	Nonresidential Building Construction	41,018	521,112	209,136	117,311	91,266	56,168	24,155
237100	Utility System Construction	18,686	466,099	190,044	97,838	78,748	51,241	24,122
237200	Land Subdivision	6,182	53,045	5,726	3,061	2,414	1,616	831
237300	Highway, Street, and Bridge Construction	10,043	251,065	148,254	58,604	45,462	28,110	14,153
237900	Other Heavy and Civil Engineering Construction	4,222	79,390	37,611	18,389	14,994	9,837	4,739
238100	Foundation, Structure, and Building Exterior Contractors	85,801	657,508	324,954	216,714	167,943	113,372	65,852
238200	Building Equipment Contractors	170,002	1,629,581	326,154	212,327	152,945	77,880	17,104
238300	Building Finishing Contractors	102,700	608,945	140,813	89,565	67,634	40,922	16,650
238900	Other Specialty Trade Contractors	63,214	475,127	259,906	89,844	73,598	45,621	21,705
221100	Electric Utilities	10,401	509,704	6,541	3,050	2,133	1,088	238
999200	State governments [d]	Not Applicable	Not Applicable	33,558	12,743	10,889	7,418	3,514
999300	Local governments [d]	Not Applicable	Not Applicable	123,946	44,639	37,414	24,240	10,815
	Subtotals - Construction	663,303	5,770,646	2,017,417	1,096,986	847,715	519,190	228,503
General Industry and Maritime								
213112	Support Activities for Oil and Gas Operations	10,872	272,357	16,960	13,819	11,207	8,671	5,280
324121	Asphalt Paving Mixture and Block Manufacturing	1,362	14,353	4,737	48	48	0	0
324122	Asphalt Shingle and Coating Materials Manufacturing	223	9,074	3,158	3,158	1,410	672	0
325510	Paint and Coating Manufacturing	1,161	35,328	2,511	515	386	386	258
327110	Pottery, Ceramics, and Plumbing Fixture Manufacturing	655	13,096	6,269	3,989	2,496	767	257
327120	Clay Building Material and Refractories Manufacturing	586	20,985	7,893	4,915	3,198	1,756	520
327211	Flat Glass Manufacturing	85	8,990	221	134	126	67	30
327212	Other Pressed and Blown Glass and Glassware Manufacturing	442	13,434	674	411	386	206	90
327213	Glass Container Manufacturing	74	13,684	686	419	394	209	92
327320	Ready-Mix Concrete Manufacturing	5,377	66,196	27,123	20,690	19,941	18,611	12,156
327331	Concrete Block and Brick Manufacturing	817	14,896	7,182	2,902	2,045	1,217	521

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BREAK

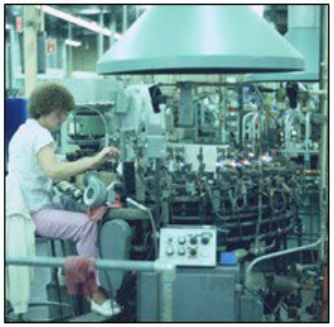
MEET THE SPEAKER

Fred Boelter, CIH, PE, BCEE, FAIHA
Boelter Risk Sciences and Engineering LLC

- Industrial hygiene and environmental engineering professional since 1973
- Consults with clients throughout the United States, the UK, Europe and beyond
- Expertise in risk characterization, risk communication, and risk management in occupational and public health

Non-Ferrous Foundry

Welding



Neon Bulb Manufacturing

Butter Flavoring

Spray Painting

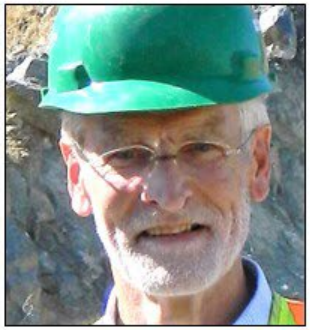
The Many Aspects of Occupational Risk Assessment: Understanding Differing Approaches and Goals

Employer, Employee, Place of Work, Occupied Spaces, Natural World

AIHA Webinar

Thursday, August 25, 2022

Fred W Boelter, CIH, PE, BCEE, FAIHA
Boelter Risk Sciences and Engineering LLC
Chicago, Illinois, USA
boelterinc@gmail.com, 312-560-9113



Judging Data
Hazard ≠ Risk

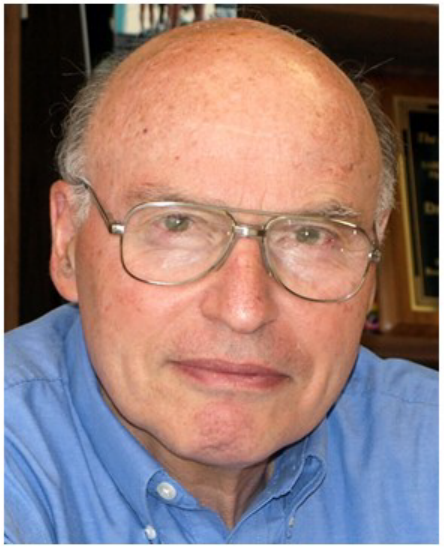
Example: TCE Criteria in Indoor Air (µg/m3)

• OSHA PEL (8-hr TWA)	535,000
• CAL/OSHA PEL	135,000
• ACGIH TLV (8-hr TWA)	54,000
• Cal OEHHA RSL[1]	600
• EPA Region 4 RSL[2]	3
• EPA Region 4 RSL[3]	0.5
• EPA TSCA 6(b)(4) (July 2022)[4] unreasonable risk of injury to health	10^{-x}?

[1] California Office of Environ Health Hazard Assess Ref Exposure Level for air (non-cancer endpoints)
[2] EPA Regional Screening Level for industrial air (cancer endpoint)
[3] EPA Regional Screening Level for residential air (cancer endpoint)
[4] Existing Chemical Exposure Limit (ECEL)

Risk, Safe, Compliant - Context Matters

Is Risk Real? And, to Whom?

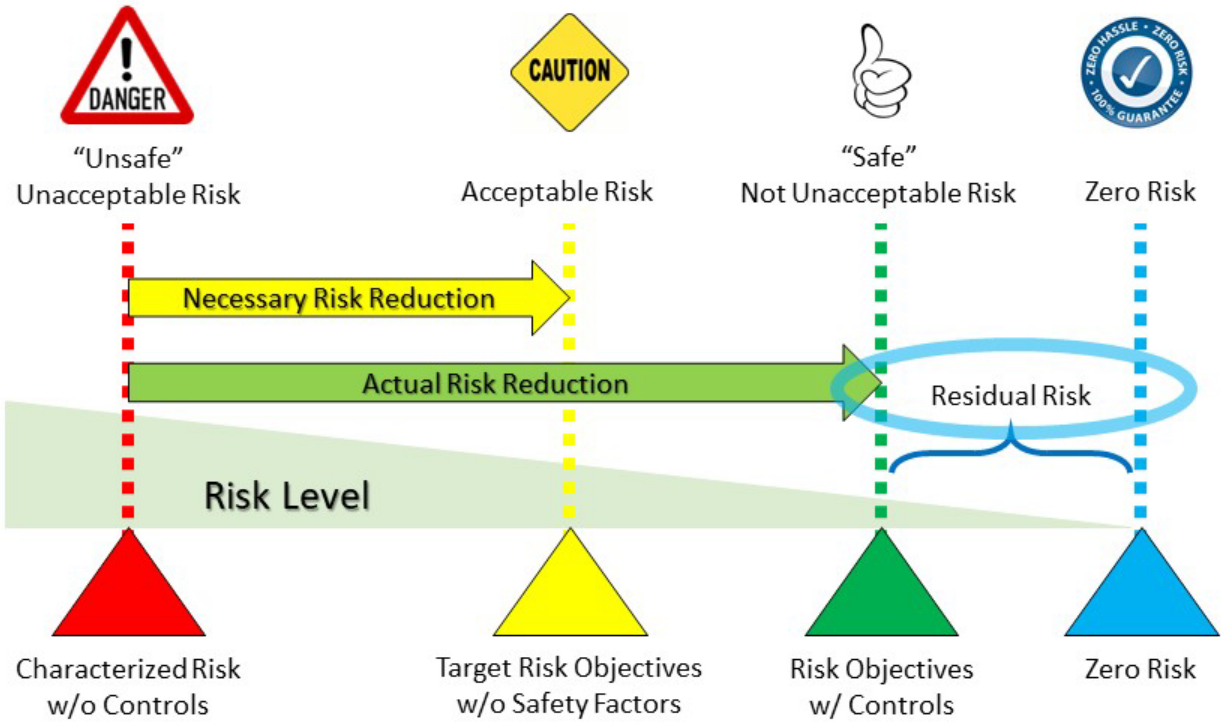


Paul Slovic

Luminary and trailblazer in risk science

"Risk does not exist out there, independent of our minds and culture, waiting to be measured. Human beings have invented the concept of risk to help them understand and cope with the dangers and uncertainties of life. Although these dangers are real, there is no such thing as real risk or objective risk."

Safe = Not Unacceptable Risk



AIHA Risk Committee
Five Buckets of Risk

DMMR Genesis

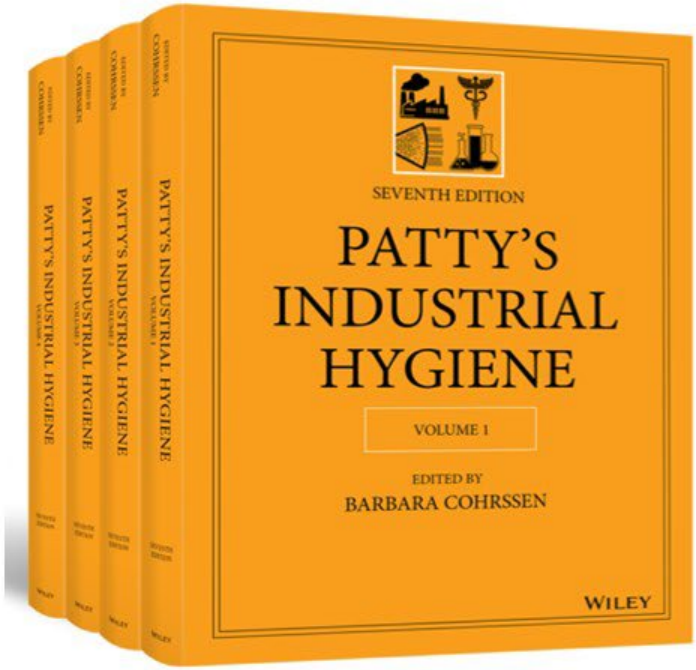
Patty's Industrial Hygiene, 7th Edition

Decision Making in Managing Risk

April 2021

Co-authors – Charles Redinger, Fred Boelter, John Howard, Mary O'Reilly, and Glenn Barbi

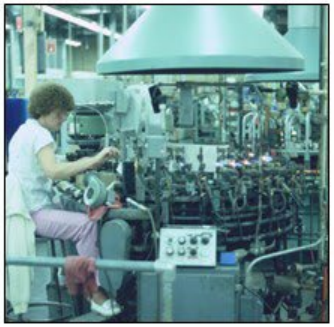
First time DMMR is in Patty's



Hazard, Compliance, Exposure, Dose, Risk, Safe


Non-Ferrous Foundry


Welding


Neon Bulb Manufacturing


Butter Flavoring


Spray Painting


Area sampling
Public Health

$$D_{pot} = \int C(t)\, IR(t)\, dt$$

Can be transformed to the following general formula:

$$D_{pot} = C \bullet IR \bullet ED$$

Where:

- D_{pot} = Dose Potential outside the body
- **C** = Average concentration (8-hr TWA over working year)
- **IR** = Average intake rate (breathing rate)
- **ED** = Exposure duration (years)

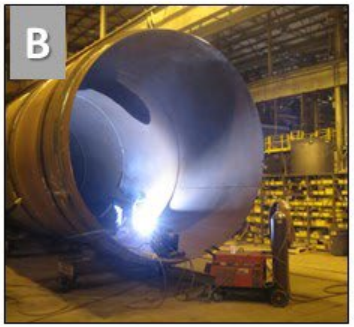
Inhalation route of entry, reduces to:

$$E_{Total} = C \times ED \propto D_{Pot}$$

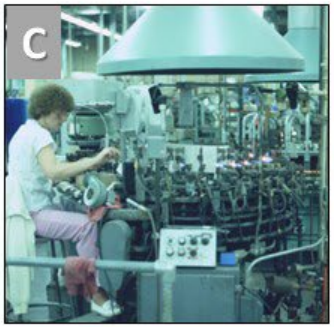

Personal sampling
Occupational Health

POLL – Rank These Five Scenarios

Non-Ferrous Foundry



Welding



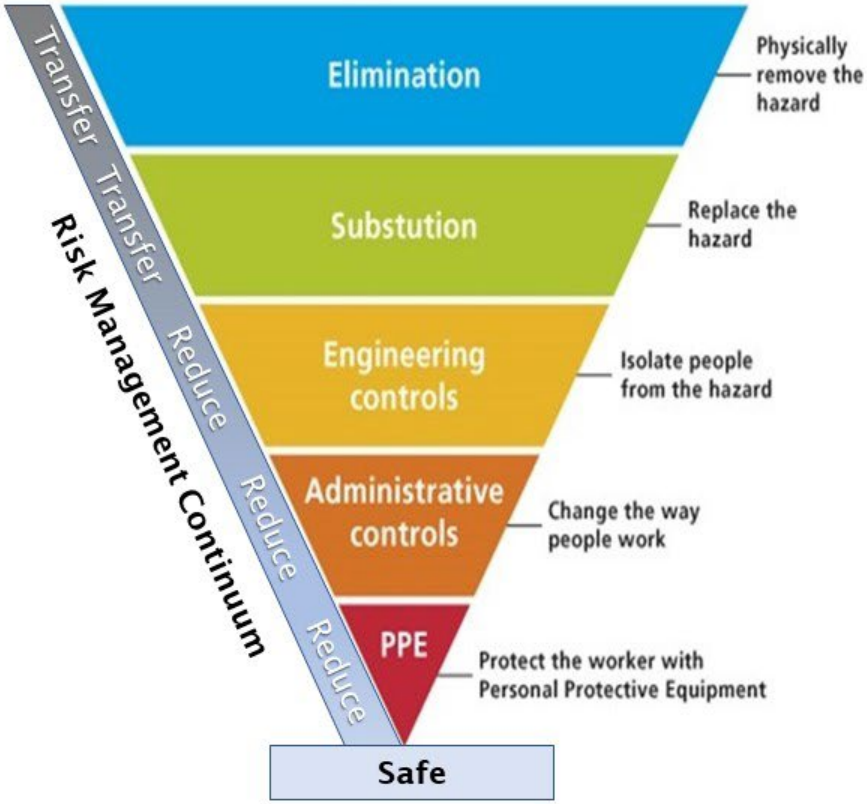
Neon Bulb Manufacturing

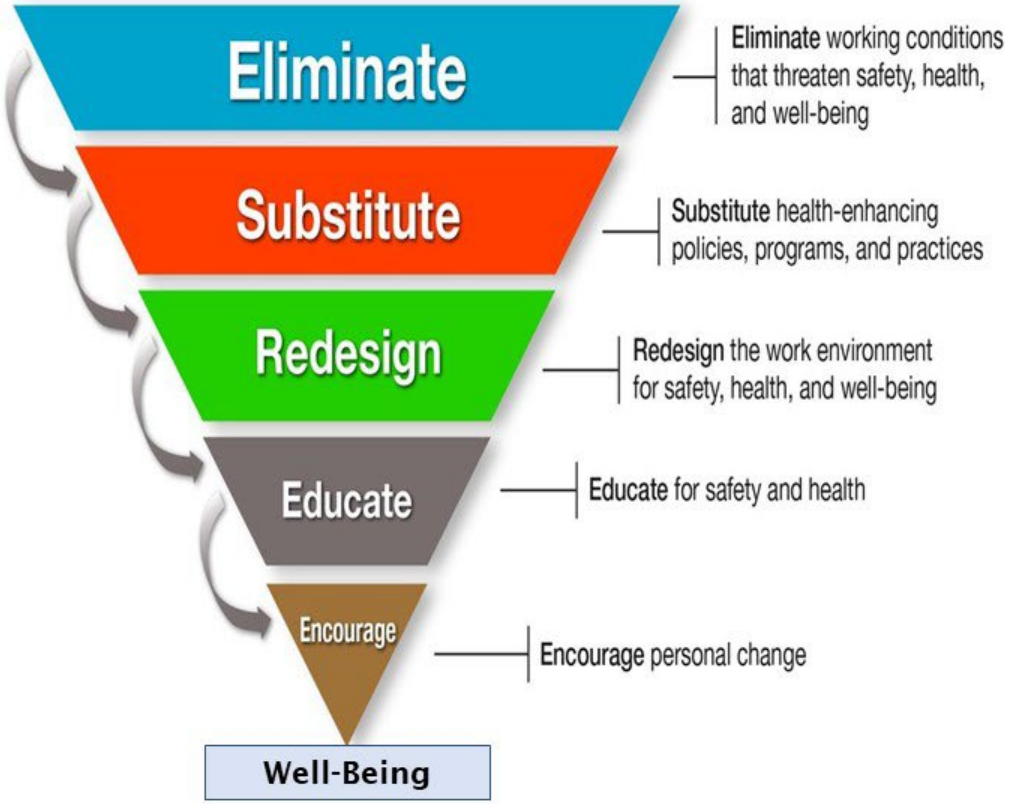
Butter Flavoring

Spray Painting

PHOTO	DESCRIPTION	RISK RANK (1-5)
A	Non-Ferrous Foundry	
B	Welding	
C	Neon Bulb Manufacturing	
D	Butter Flavoring	
E	Spray Painting	

Classic Hierarchy of Controls Applied to NIOSH TWH





In Summary

- **There are reasons for differences:**
  - EPA, NIOSH, OSHA have defined missions and purposes
  - But, also overlapping and intersecting interests

- **Context matters:**
  - Tools are designed for specific jobs and tasks

- **Have clarity on why you do what you do:**
  - Philosophical, tactical, applicable

Occupational health?

Protecting self?

Acute risk?

Clinical treatment?

Personal choice?

The person in front of me on a plane in 2022

Public health?

Protecting others?

Chronic risk?

Precautionary Principle?

Social responsibility?

The Many Aspects of Occupational Risk Assessment: Understanding Differing Approaches and Goals

Sans respirator

Thank you

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Sans hardhat

DISCUSSANT PANEL

- Brenda Finter (OSHA and IH expertise)
- John Henshaw (former OSHA and risk assessment management)
- MaryAnn Hoff (chemical industry IH expertise)
- Steve Jahn (DoE experience and AIHA EASC)
- Silvia Maberti (Chemical industry and REACH experience)
- Paul Price (Former EPA and exposure and risk expertise)
- Rebecca Reindel (IH expert and organized labor experience)

POLL QUESTION #1

- How often do you consult risk assessment documents from other domains before engaging in risk assessment activities for your scenario?
  - For example: When starting an exposure assessment, do you search for existing data from any/all of these sources: OSHA, NIOSH, and EPA?
    - Always
    - Usually
    - Rarely

DISCUSSION QUESTION #1

- How do the different risk assessment methods the speakers described enable the use of inputs/outputs across domains?
  - What characteristics of these approaches enable uses for other purposes?
  - How do the varying “purposes” of different methods limit the uses of such data?
  - What are some examples of extrapolating data collected for one purpose/type to another?

POLL QUESTION #2

- When you've sought out data from other sources, how often have you encountered barriers in obtaining or using that data or information?
  - For example, you identified existing inhalation exposure data, but the annotation was not sufficiently detailed to determine its applicability for your specific use.
    - Rarely
    - Sometimes
    - Often

DISCUSSION QUESTION #2

- What are the most effective ways to share information and data among stakeholders?
  - Are there current avenues in place?
  - What are the barriers to effective information transfer?
  - How can we avoid misapplication or misinterpretation of the outcomes of specific risk assessment processes?

DISCUSSION QUESTION #3

- As we look to the future, how do we envision the evolution of occupational risk assessment?
  - How are the drivers of different risk assessment domains shifting?
  - What are the barriers to incorporating these changes into existing risk assessment processes?
  - What are the highest priorities for enhancing occupational risk assessment methods?
- For participants: Please consider submitting your thoughts to the Workshop Evaluation

NEXT STEPS

- Complete your evaluation (will automatically come up when zoom ends)
- Consider joining us for one of the other planned workshop topics (date/time TBA)
  - Data Quality and Integrity: Methods and Practices
  - OEHS Data Identification and Analytics and Similar Exposure Groups
  - Occupational Exposure Models: Options and Opportunities
  - Dermal Exposure Assessment Methods and Data Gaps
  - Risk Characterization, Communication, and Management Strategies

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THANK YOU