Occupational Risk Assessment 2020 . . . and Beyond

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Disclaimer: The findings and conclusions in this presentation are those of the author and do not necessarily represent the National Institute for Occupational Safety and Health or the Centers for Disease Control and Prevention.

Why Assess Chemical Hazards in the Workplace?

- About a third of US workers are exposed to chemicals.
- In 2016, chemical exposures caused:
  - 12,480 nonfatal lost time illnesses or injuries.
  - 315 occupational fatalities.
- About 2-8% of cancers are believed caused by occupational exposures.

Direction and Authority

NIOSH is mandated by the *OSH Act* (1970):

"…to develop criteria dealing with toxic materials and harmful physical agents and substances which will ***describe exposure levels that are safe for various periods of employment****, including but not limited to the exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience."*

[OSH Act, 20 USC 22 (a)(3)]

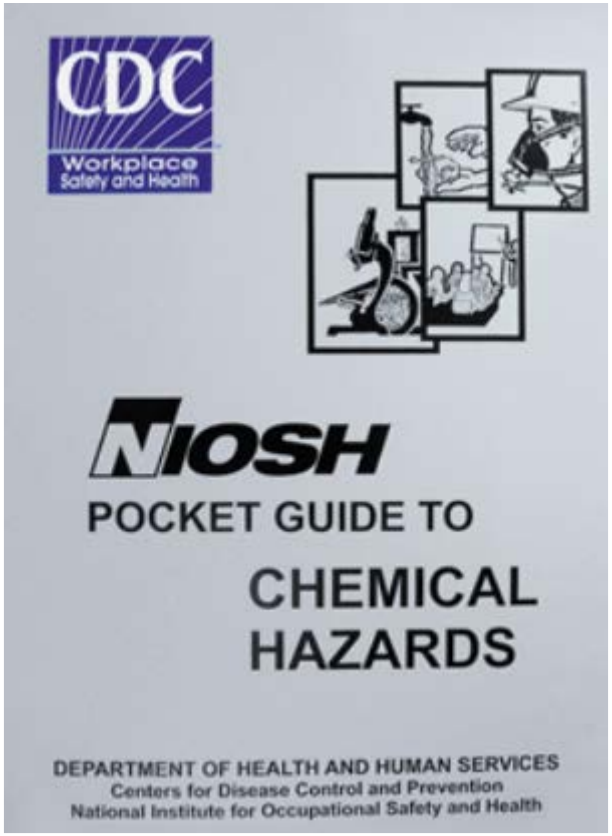
Early History of Chemical Risk Assessment at NIOSH

- 1987: Radon risk assessment
- 1990: Benzene (journal article and testimony)
- 1990: Ethylene glycol monobutyl ether and ethylene glycol monobutyl ether acetate
- 1995: Respirable coal mine dust
- 1998: Metalworking fluids
- 1998: Noise

- In the 2000's, more emphasis on methodology (RCFs, hexavalent chromium, titanium dioxide, diacetyl and 2,3-pentanedione, etc.)

NIOSH OELs

- Exposure limits
  - RELs and STELs
  - RML-CAs
- Primary Publications:
  - Criteria Documents
  - Current Intelligence Bulletins



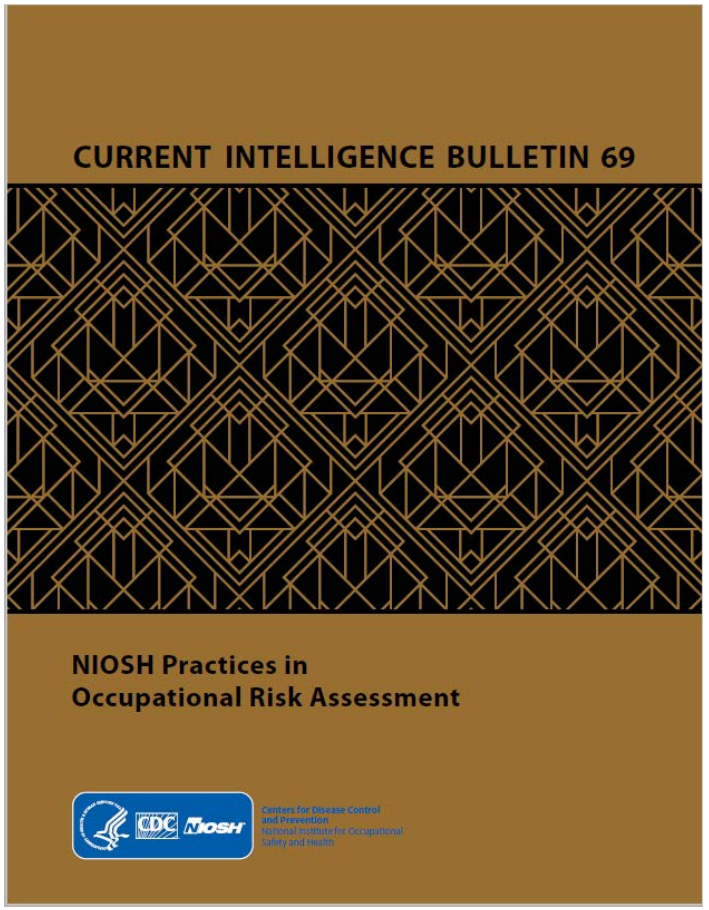
https://www.cdc.gov/niosh/npg/default.html

What is NIOSH risk assessment?

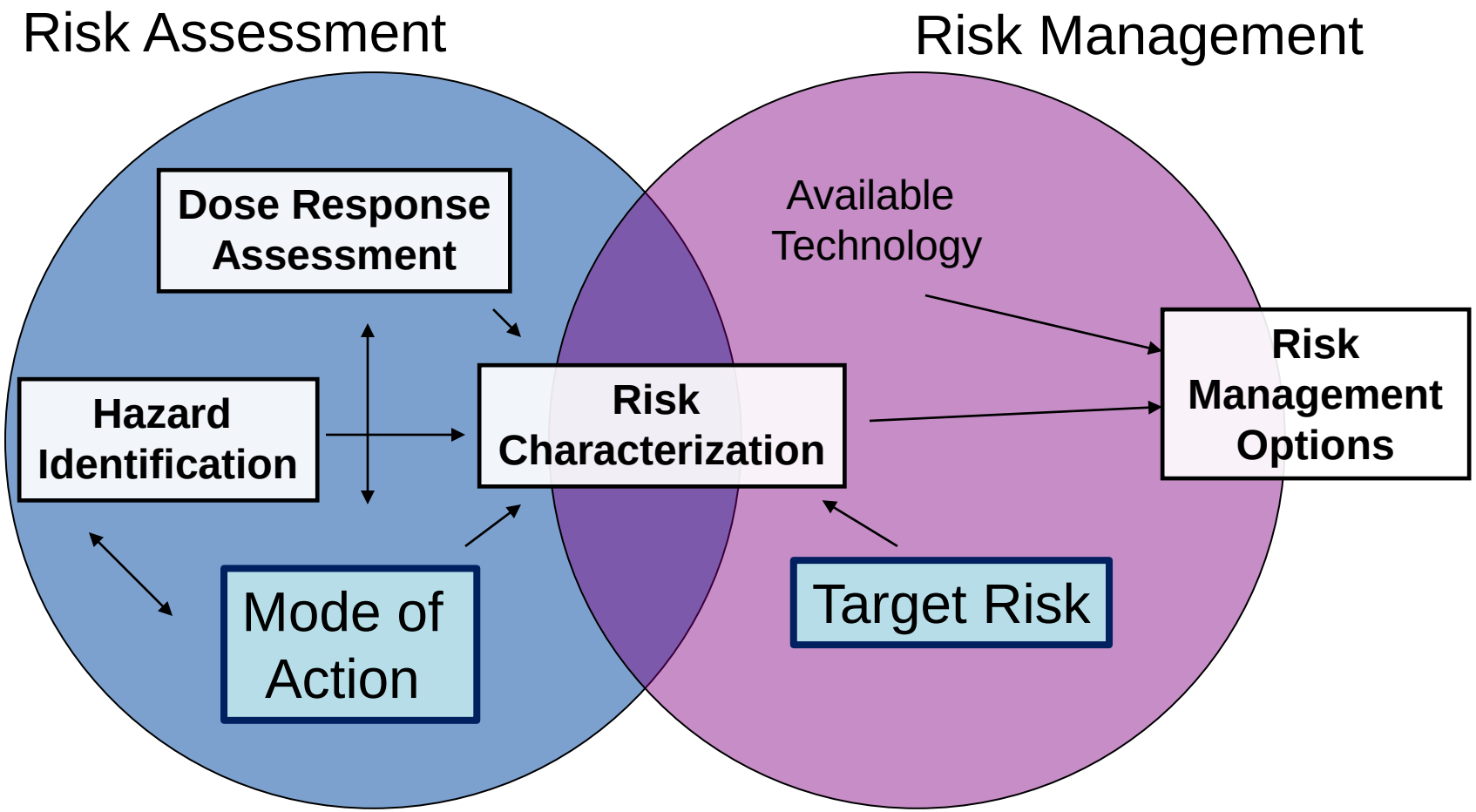
The determination of the relationship between the predicted **occupational** exposure and the adverse **health** effect(s).

NIOSH Practices in Occupational Risk Assessment

- Coming soon! (Spring 2020)
- Describes current NIOSH occupational risk assessment practices
- Risk assessment support for NIOSH Recommended Exposure Limits (RELs) and Risk Management Limits for Carcinogens (RML-CAs)

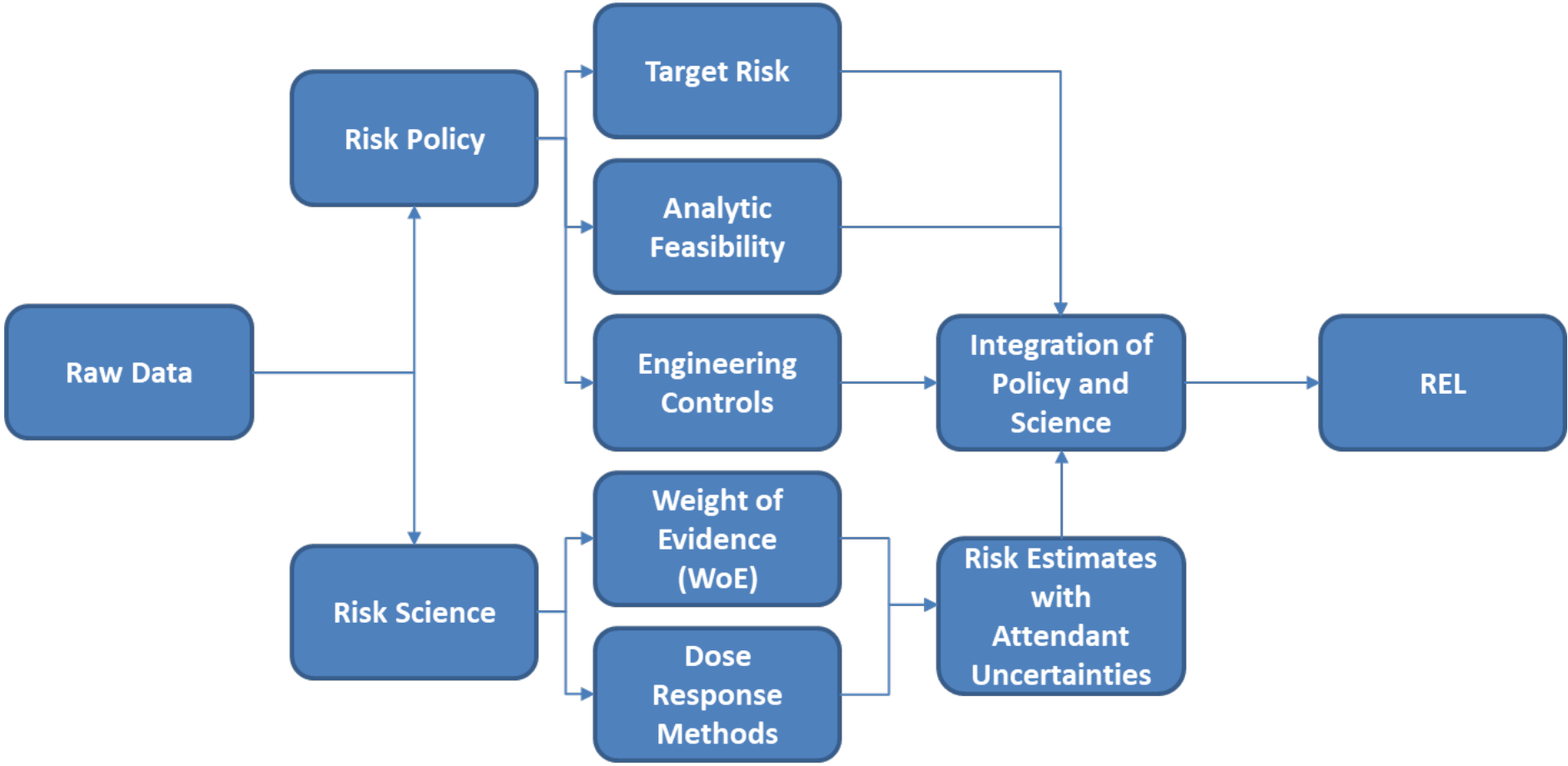


NIOSH Occupational Risk Assessment Paradigm



NIOSH Risk Assessment

- NIOSH does *not* typically estimate risks at current exposures
- NIOSH conducts dose-response assessment and compares it to a target risk level
- Exposure assessment *is* an integral part of occupational epidemiology studies, for assessment of engineering controls, etc.
- BUT, exposure assessment is not typically part of a NIOSH risk assessment



NIOSH RISK ASSESSMENT

Current NIOSH Chemical Risk Assessment Priorities

- 1-Bromopropane
- Glutaraldehyde
- Diethanolamine
- Manganese
- Lead

Toxic Substances Control Act: 2016 Lautenberg Amendments

Sec. 2605. Prioritization, risk evaluation, and regulation of chemical substances and mixtures

(b)(4)(F) Requirements

- In conducting a risk evaluation under this subsection, the Administrator shall—
- (i) integrate and assess available information on hazards and exposures for the conditions of use of the chemical substance, including information that is relevant to specific risks of injury to health or the environment and information on ***potentially exposed or susceptible subpopulations*** identified as relevant by the Administrator;
- (ii) describe whether aggregate or sentinel exposures to a chemical substance under the conditions of use were considered, and the basis for that consideration;
- (iii) not consider costs or other nonrisk factors;
- (iv) take into account, where relevant, the likely duration, intensity, frequency, and number of exposures under the conditions of use of the chemical substance; and
- (v) describe the weight of the scientific evidence for the identified hazard and exposure.

Lautenberg Amendments – other changes

- Unreasonable risk/no unreasonable risk determination
- Evaluate all conditions of use scenarios
- Statutory deadlines to complete risk assessments
- Designation of high and low priority chemicals
- First batch – 10 high priority chemicals
- Next batch
  - 20 high priority chemicals
  - 20 low priority chemicals

EPA's First Ten High Priority Chemicals for Risk Assessment

- Asbestos
- 1-Bromopropane
- Carbon Tetrachloride
- 1,4 Dioxane
- Cyclic Aliphatic Bromide Cluster
- N-Methylpyrrolidone
- Methylene Chloride
- Perchloroethylene
- Pigment Violet 29
- Trichloroethylene

EPA's Next 20 High Priority Chemicals

- *p*-Dichlorobenzene
- 1,2-Dichloroethane
- *trans*-1,2-Dichloroethylene
- *o*-Dichlorobenzene
- 1,1,2-Trichloroethane
- 1,2-Dichloropropane
- 1,1-Dichloroethane
- Dibutyl phthalate (DBP)
- Butyl benzyl phthalate (BBP)
- Di-ethylhexyl phthalate (DEHP)
- Di-isobutyl phthalate (DIBP)
- Dicyclohexyl phthalate
- 4,4'-(1-Methlethylidene) bis[2,6-dibromophenol] (TBBPA)
- Tris(2-chloroethyl) phosphate (TCEP)
- Phosphoric acid, triphenyl ester (TPP)
- Ethylene dibromide
- 1,3-Butadiene
- 1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hyexamethylcyclopenta[g]-2-benzopyran (HHCB)
- Formaldehyde
- Phthalic anhydride

EPA's Next 20 Low Priority Chemicals

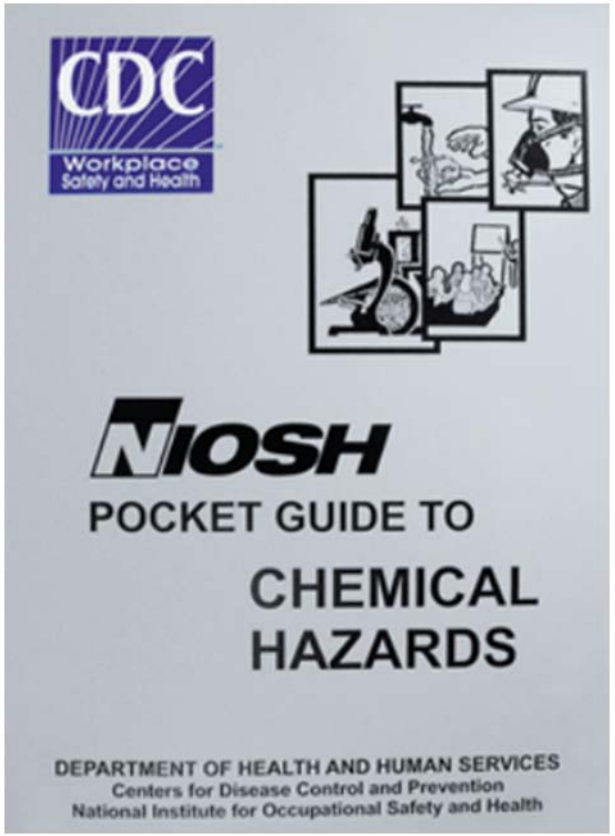
- 1-Butanol, 3-methoxy-, 1-acetate
- D-gluco-Heptonic acid, sodium salt (1:1), (2.xi.)-
- D-Gluconic acid
- D-Gluconic acid, calcium salt (2:1)
- D-Gluconic acid, .delta.-lactone
- D-Gluconic acid, potassium salt (1:1)
- D-Gluconic acid, sodium salt (1:1)
- Decanedioic acid, 1,10-dibutyl ester
- 1-Docosanol
- 1-Eicosanol
- 1,2-Hexanediol
- 1-Octadecanol
- Propanol, [2-(2-butoxymethylethoxy) methylethoxy]-
- Propanedioic acid, 1,3-diethyl ester
- Propanedioic acid, 1,3-dimethyl ester
- Propanol, 1(or 2)-(2-methoxymethylethoxy)-, acetate
- Propanol, [(1-methyl-1,2-ethanediyl)bis(oxy)]bis-
- 2-Propanol, 1,1'-oxybis-
- Propanol, oxybis-
- Tetracosane, 2,6,10,15,19,23-hexamethyl-

What does NIOSH occupational risk assessment look like in the age of Lautenberg?

Perhaps . . .

- Fewer single chemical risk assessments
- Increase focus on acute/ catastrophic hazards
- Assess chemicals with limited data
- Increase focus on endpoints such as irritation
- Integrating TSCA risk assessments with NIOSH guidance
- Occupational exposure banding
- Real-time monitoring and risk
- Beyond chemical risks – biological, psychosocial, etc.

Irritation and occupational risk assessment



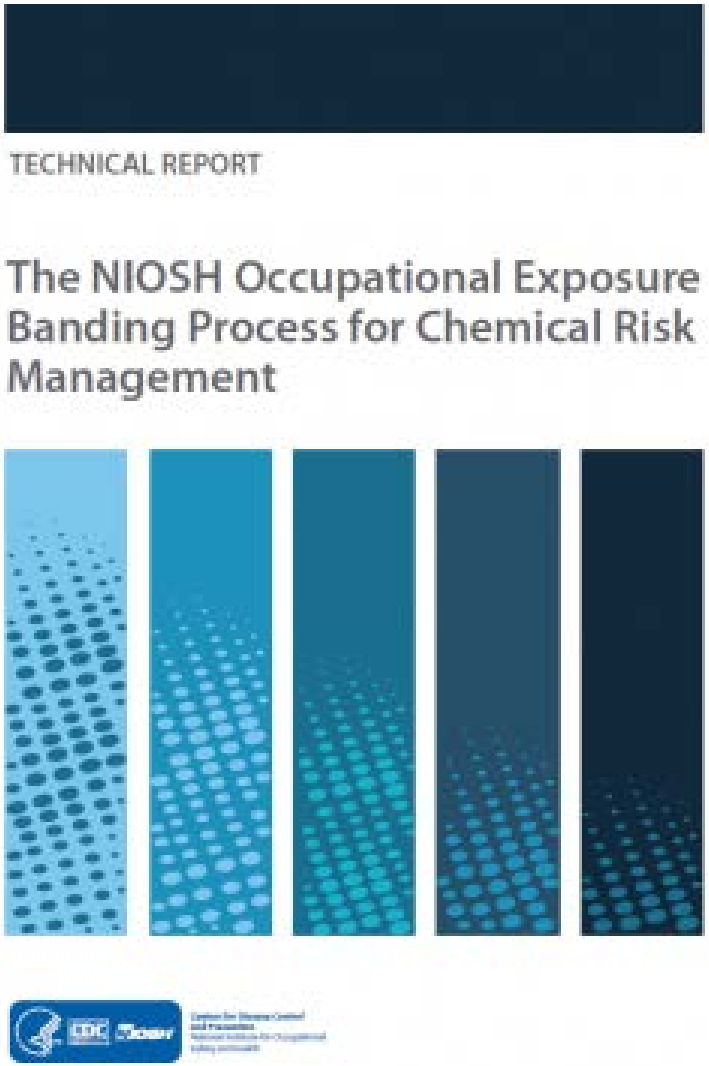
- ~50% of the RELs in the NPG based on irritation
- Besides a health issue, this is an important economic issue
- No standardized method for assessing irritation endpoints (RD_{50})

Irritation work at NIOSH

- Immediately Dangerous to Life and Health (IDLH) values
- Short term exposure limits (STEL)
- Building off earlier research in mode of action for irritants
- Animal studies improving the RD_{50} method
- Comparing histopathology and RD_{50}
- Evaluating the time assumptions

Occupational Exposure Banding

- Brainstorming about Banding 2.0
- Emergency response banding
- Dermal exposure banding
- Improving the automation of the eTool



CDC Workplace Safety and Health

NIOSH

Tox 21 Data and Occupational Risk Assessment

- Predicting dose-response curves based on QSAR/ machine learning techniques
- Success with gene expression, unclear about higher level toxicity testing data
- Investigating new advances in read across, QSAR and combinations
- Small data set problem remains for validation

Time is of the essence . . .

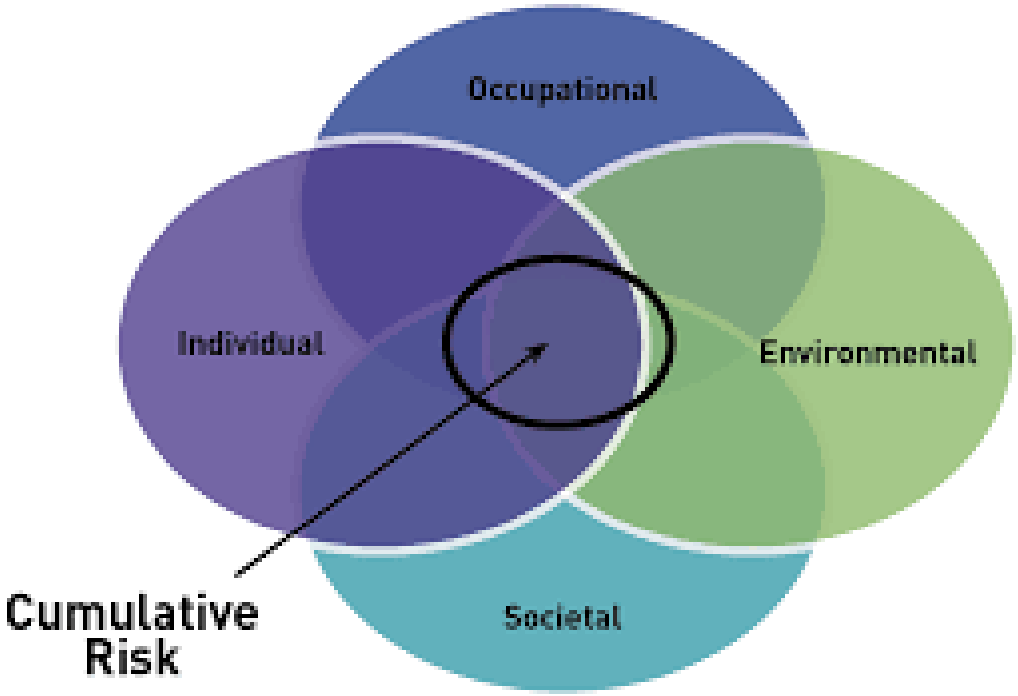
- 8-hour time-weighted average
- 15-minute STEL
- 30-minute maximum exposure to IDLH concentration

- ***What does it mean when an exposure limit is exceeded in a shorter period of time?***

Biological risk assessment

- Transmission of infectious diseases in the workplace
  - People to people (flu, corona virus, staph)
  - Animals to people (staph infections, swine flu, bird flu)
  - Modeling surface contamination, air transmission in confined spaces
- Many similarities to chemical risk assessment

Cumulative Risk Assessment



- Part of the Total Worker Health initiative at NIOSH
- Mixed exposures at work
- Combinations of personal and occupational risk factors
- Developing frameworks to better understand how to study the risks

Future of Work

- Increasing presence of robotics
- Emerging hazards (nanomaterials, synthetic biology)
- Gig economy – impact on exposures, training, risks
- 30 hour work week?

NIOSH Risk Assessment in the Age of Lautenberg

- Less emphasis on individual chemical risk assessments (though there will continue to be some).
- More emphasis on other impacts of chemical exposures
- More emphasis on more complex challenges in risk assessment – limited data, changing time scales, complex exposure patterns

Thank you!