

Putting the “Health” in “Health Risk Assessment”

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Rethinking Health Risk Assessment: Why Now?

- Mixtures: one stressor at a time is not realistic
 - NIEHS is prioritizing mixture modeling
 - Risk assessment field recognizes need
- Data – collection, integration and use

<https://www.niehs.nih.gov/research/supported/exposure/mixtures/index.cfm>

<https://www.nap.edu/catalog/12209/science-and-decisions-advancing-risk-assessment>



COVID-19 and Community Health

- COVID has hit marginalized communities hardest
 - Housing, work conditions, “underlying” conditions, racism
- Exacerbates long-documented environmental injustices



Half a century after EPA's founding,
we haven't made progress on environmental
justice.



Executive Order 12898 of February 11, 1994

**Federal Actions To Address Environmental Justice in
Minority Populations and Low-Income Populations**

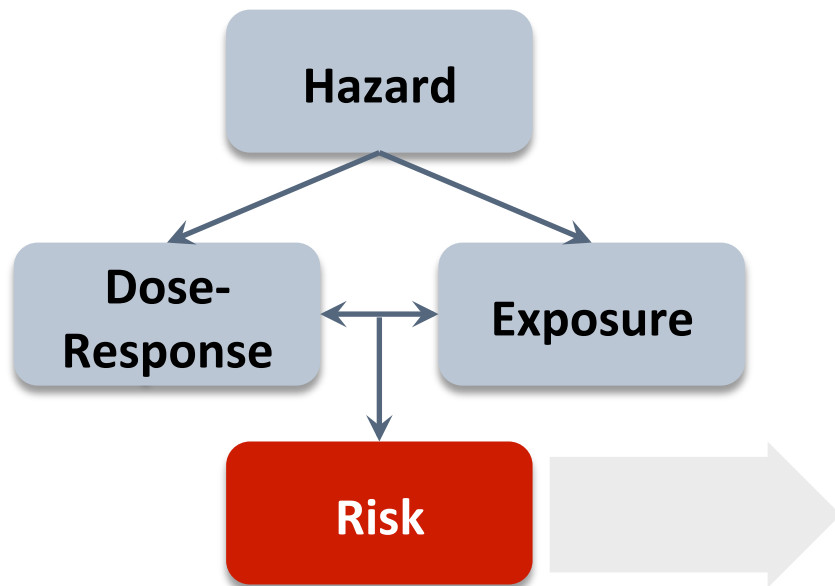


1970
EPA's founding

1994
EO 12898

Today

Risk Assessment – the Tool of Choice



When is risk assessment used?

- Prevent pollution
- Clean up hazardous waste

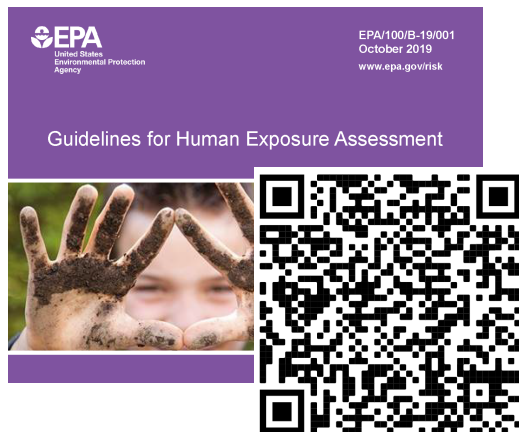
**Is it safe to drink this water?
Should we eat fish from this lake?**

Exposure Assessment

Exposure

Who is exposed? When? To how much?

- Definitions vary: “most exposed individual”, average, statistical upper percentile
- But...
 - Other exposures?
 - Always a healthy population?
 - Defining health concerns



Dose-Response Assessment

Dose-Response

What are the adverse [health] effects at different doses?

- Data sources:



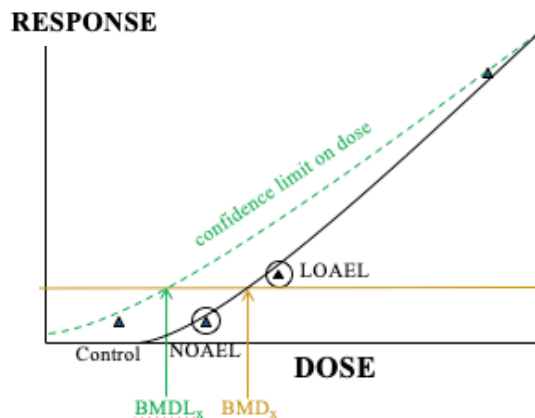
Toxicology studies (animal)



Epidemiology studies (human)

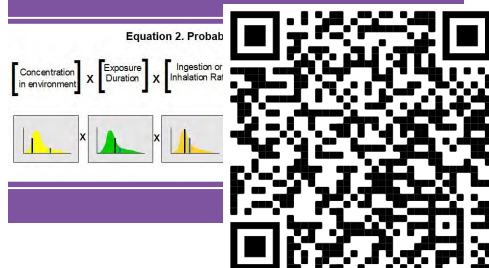


Laboratory studies (in vitro)



Dose-Response Assessment

Dose-Response



Needs to evolve:

- Exposure to toxic substances increases vulnerability & disease burden
- More complete definition of “health”
- Use data to reflect variability and uncertainties

<https://www.epa.gov/sites/production/files/2014-12/documents/raf-pra-white-paper-final.pdf>

Risk Characterization

Risk

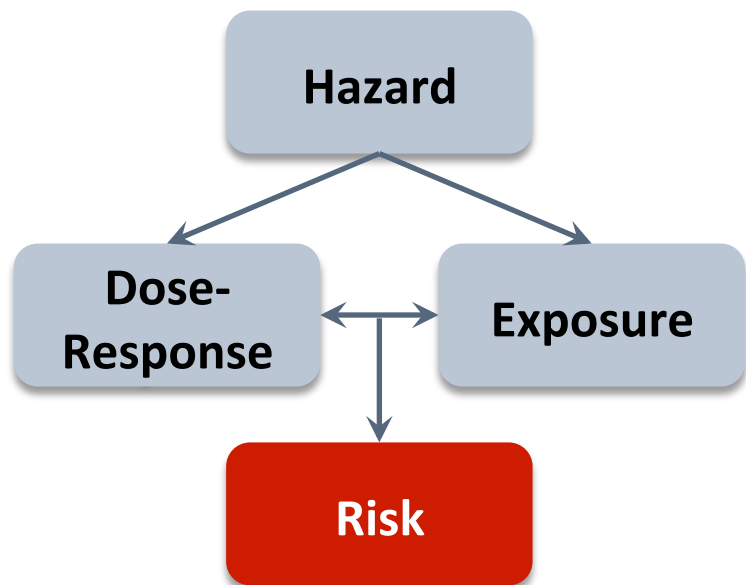


Combines exposure and dose-response:

- Considers one chemical at a time
- Provides no information below selected “dose”

**Does a site need to be cleaned up?
Should people avoid eating fish from this river?
Should this chemical be regulated or used in
commerce?**

Conclusions



Risk assessment can be useful, but must be modified

- Must consider community exposures
- Must look at >one chemical at a time and bring the D-R into the 21st century
- Must consider quality of life beyond the conventional idea of “health”

References

- Axelrad DA, Bellinger DC, Ryan LM, Woodruff TJ. Dose–Response Relationship of Prenatal Mercury Exposure and IQ: An Integrative Analysis of Epidemiologic Data. *Environ Health Perspect*. 2007;115(4):609-615. doi:10.1289/ehp.9303
- Chiu WA, Axelrad DA, Dalaijamts C, et al. Beyond the RfD: Broad Application of a Probabilistic Approach to Improve Chemical Dose–Response Assessments for Noncancer Effects. *Environ Health Perspect*. 2018;126(6):067009. doi:10.1289/EHP3368
- President Bill Clinton. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations. *Fed Regist*. 1994;59(32):1-5.
- Ginsberg GL. Cadmium Risk Assessment in Relation to Background Risk of Chronic Kidney Disease. *J Toxicol Environ Heal Part A*. 2012;75(7):374-390. doi:10.1080/15287394.2012.670895
- Hattis D, Baird S, Goble R. A straw man proposal for a quantitative definition of the RfD. *Drug Chem Toxicol*. 2002;25(4):403-436. doi:10.1081/DCT-120014793
- National Academy of Sciences. *Science and Decisions: Advancing Risk Assessment*. Washington, D.C.: National Academies Press; 2009. doi:10.17226/12209
- National Institute of Environmental Health Sciences. *Mixtures*. <https://www.niehs.nih.gov/research/supported/exposure/mixtures/index.cfm>. Published 2020.
- US Environmental Protection Agency (USEPA). *Risk Assessment Forum White Paper: Probabilistic Risk Assessment Methods and Case Studies*. EPA/100/R-14/004. 2014;(July):98. <https://www.epa.gov/osa/risk-assessment-forum-white-paper-probabilistic-risk-assessment-methods-and-case-studies>.
- US Environmental Protection Agency (USEPA). *EJ 2020 Action Agenda: The U.S. EPA's Environmental Justice Strategic Plan for 2016-2020.*; 2020.
- WHO. *Guidance Document on Evaluating and Expressing Uncertainty in Hazard Characterization*. 2014:160. http://www.who.int/ipcs/methods/harmonization/uncertainty_in_hazard_characterization.pdf.