CHEMICAL RISK ASSESSMENT AND REGULATORY DECISION MAKING

Chemical regulations exist to safeguard human and environmental health throughout a substance's life cycle (manufacture, intended use phase, and disposal). Regulatory decisions require scientific evaluation of potential risks to human and environmental health and thoughtful risk management:

- Risk assessment is an iterative four-step process that provides information on the probability of adverse effects following chemical exposures.
  - Hazard Identification (HI) identifies adverse effects posed by exposure.
  - Dose Response (DR) quantifies the relationship between dose and effect.
  - Exposure Assessment (EA) assesses exposure pathways, outcomes, and populations.
  - Risk Characterization (RC) integrates information from HI, DR, and EA to generate an estimate of the overall risk to human or environmental health. [NRC 2009].

Risk assessment of chemical hazards must include analysis of acute and chronic impacts, covering exposures from research and development, manufacturing, and product use, to eventual fate in the environment.

- Risk management is the determination of how best to protect human and environmental health. Selection of the most appropriate regulatory action from potential policy alternatives requires integration of scientific data derived from risk assessments with broader societal, economic, legal, and political concerns. [NRC 1983, NRC 2007]

Risk assessment and risk management are independent processes; both are necessary to evaluate, quantify, and mitigate the impacts of a hazard. While program-specific exposure evaluations are required to comply with applicable laws and regulations, adaptive approaches should be utilized to transition to a framework based on the exposure as research advances are made to evaluate the totality of lifetime exposures (i.e. environmental, consumer, and occupational). [Kalia 2020]

Principles

1. Biological responses occur following exposure to virtually all substances, both natural and synthetic. Identification of hazards to human and environmental health posed by exposures to potentially harmful substances informs regulatory decisions. Information about risk and hazard should be widely, transparently, and publicly available in stakeholder-accessible language.
2. Evaluations of chemical risk should be based on robust, reproducible science and -risk-based criteria protective of both human and environmental health.
3. Assessment and management of risk is a scientific process requiring input from researchers, regulators, consumers and manufacturers. The decisions reached have broad societal implications, particularly in fenceline or frontline communities.

The American Chemical Society (ACS) Board of Directors Committee on Public Affairs and Public Relations adopted this statement on behalf of the Society at the recommendation of the Committees on Environmental Improvement, and Corporation Associates. ACS is a non-profit scientific and educational organization, chartered by Congress, with more than 158,000 chemical scientists and engineers as members. The world's largest scientific society, ACS advances the chemical enterprise, increases public awareness of chemistry, and brings its expertise to state and national matters.

4. Government and industry play critical roles in risk assessment and regulation. Toxicological and epidemiological data and safety information must be accessible to regulators to assure safe use and maintain public trust. Baseline assumptions, reasoning, data requirements, and data underlying regulatory decisions must be transparently described. Conclusions should be accessible to all stakeholders in transparent, plain language.
5. Standardization and harmonization of hazard criteria and risk assessment language should be encouraged to ensure all parties are using a common global vocabulary.
6. Risk management decisions should consider vulnerable and marginalized populations, availability of appropriate chemical analogs/substitutes, intended uses, potential interactions, potential environmental transformations, and other relevant considerations.

Recommendations

- ACS supports a framework for risk-based decision making initially outlined by the National Academy of Sciences in *Science and Decisions: Advancing Risk Assessment*. [NRC 2009a]
- Evaluations and recommendations should be revisited at regular intervals to incorporate significant changes or update data to the original evidence-based decisions.
- ACS supports the development and use of less toxic and less persistent chemicals based on the application of risk assessment principles. ACS further supports alternatives assessment as defined by the National Research Council [2014] as a process for identifying, comparing, and selecting safer alternatives to chemicals of concern based on their hazards, comparative exposure, performance, and economic viability.
- ACS supports better understanding of critical risk assessment science in areas including:
    - Exposure assessment, which uses best practices for modeling and assessment, including robust exposure data, is essential to understand the extent to which potentially hazardous chemicals are taken up by vulnerable populations [NRC 2012].
    - Biomonitoring is used to understand the environmental and health implications of chemical exposure by linking biomarkers of exposure to biomarkers of effect for chemicals and their transformation products. Biomonitoring provides a means to evaluate the success of sustainable molecular design and safer alternatives, engineering changes and control technology, and clean-up efforts over time. It can be used to identify trends of concern as a basis for future mitigation [NRC 2006].
    - Alternative and more efficient means of toxicity testing to reduce and replace (to the extent practicable and scientifically sound), the use of vertebrate animals in chemical testing.
    - Integrated Approach to Testing and Assessment (IATA) to identify and validate New Approach Methods (NAMs) for modeling hazards and toxicity, utilizing synthesis of information from traditional and NAMs in key scientific domains including human hazard, exposure, persistence, and bioaccumulation.
    - Implementation of the recommendations of the Sustainable Chemistry working group led by the EPA's led by the Office of Science and Technology Policy, established by the Sustainable Chemistry Research and Development Act [2019].

- ACS supports government agencies adopting a tiered approach to risk assessment that encourages the use of NAMs, analog data, and data derived from traditional *in vivo* testing when validated animal alternatives are unavailable. Agencies should model transparency in baseline assumptions, reasoning, minimum data set requirements and data utilized when assessing risk. Likewise, industry needs to provide information for technical purposes and clear, accessible guidance to consumers and regulators.
- ACS encourages agencies to have clear operational mandates to minimize overlap in responsibilities.

References

1. Committee on the Institutional Means for Assessment of Risks to Public Health; Commission on Life Sciences; National Research Council. (1983). *Risk Assessment in the Federal Government: Managing the Process*. Washington, DC: National Academy Press. ISBN: 978- 0-309-03349-7, DOI: 10.17226/366.

1. Committee on Improving Risk Analysis Approaches Used by the U.S. EPA; Board on Environmental Studies and Toxicology; Division on Earth and Life Studies; National Research Council. (2009). *Science and Decisions: Advancing Risk Assessment*. Washington DC: National Academies Press. ISBN: 978-0-309-12046-3, DOI: 10.17226/12209.

2. Committee on Toxicity Testing and Assessment of Environmental Agents; Board on Environmental Studies and Toxicology; Institute for Laboratory Animal Research; Division on Earth and Life Studies; National Research Council. (2007). *Toxicity Testing in the 21st Century: A Vision and Strategy*. Washington DC: National Academies Press. ISBN: 978-0-309-15173-3, DOI: 10.17226/11970.

3. Committee on Human Biomonitoring for Environmental Toxicants; Board on Environmental Studies and Toxicology; Division on Earth and Life Studies; National Research Council. (2006). *Human Biomonitoring for Environmental Chemicals*. Washington DC: National Academies Press. ISBN: 978-0-309-10272-8, DOI: 10.17226/11700.

4. Committee on Human and Environmental Exposure Science in the 21st Century; Board on Environmental Studies and Toxicology; Division on Earth and Life Studies; National Research Council. (2012). *Exposure Science in the 21st Century: A Vision and A Strategy*. Washington DC: National Academies Press. ISBN: 978-0-309-26468-6, DOI: 10.17226/13507.

5. Committee to Develop a Research Strategy for Environmental, Health, and Safety Aspects of Engineered Nanomaterials; Board on Environmental Studies and Toxicology; Board on Chemical Sciences and Technology; Division on Earth and Life Studies; National Materials and Manufacturing Board; Division on Engineering and Physical Sciences; National Research Council. (2012). *A Research Strategy for Environmental, Health, and Safety Aspects of Engineered Nanomaterials*. Washington DC: National Academies Press. ISBN: 978-0-309-25328-4, DOI: 10.17226/13347.

6. Committee on the Design and Evaluation of Safer Chemical Substitutions: A Framework to Inform Government and Industry Decision; Board on Chemical Sciences and Technology; Board on Environmental Studies and Toxicology; Division on Earth and Life Studies; National Research Council. (2014). *A Framework to Guide Selection of Chemical Alternatives*. Washington DC: National Academies Press. ISBN: 978-0-309-31013-0, DOI: 10.17226/18872.

7. Kalia, Vrinda, Robert Barouki, and Gary W. Miller. "The Exposome: Pursuing the Totality of Exposure." A New Paradigm for Environmental Chemistry and Toxicology. Springer, Singapore, 2020. 3-10 ISBN: 978-981-13-9447-8, DOI: 10.1007/978-981-13-9447-8v.
1. World Health Organization. (2017). *WHO Guidelines on Protecting Workers from Potential Risks of Manufactured Nanomaterials*. Geneva: World Health Organization. ISBN-13: 978- 92-4-155004-8.