Environmental Decisions in the Face of Uncertainty

Committee on Decision Making Under Uncertainty

Society of Toxicology
Risk Assessment Specialty Section (RASS)
Monthly Webinar
June 11, 2014
Committee Charge

Based upon available literature, theory, and experience, the committee will provide its best judgment and rationale on how best to use quantitative information on the uncertainty in estimates of risk in order to manage environmental risks to human health and for communicating this information.
Committee Charge: Specific Questions

1. How does uncertainty influence risk management under different public health policy scenarios?

2. What are promising tools and techniques from other areas of decision making on public health policy? What are benefits and drawbacks to these approaches for decision makers at EPA and their partners?

3. Are there other ways in which the EPA can benefit from quantitative characterization of uncertainty (e.g., value of information techniques to inform research priorities)?

4. What approaches for communicating uncertainty could be used to ensure the appropriate use of this risk information? Are there communication techniques to enhance the understanding of uncertainty among users of risk information like risk managers, journalists and citizens?

5. What implementation challenges would EPA face in adopting these alternative approaches to decision making and communicating uncertainty? What steps should EPA take to address these challenges? Are there interim approaches that EPA could take?
Committee Process

• Committee contained diverse expertise, including:
  - Risk Assessment
  - Health Economics
  - Environmental & Public Health Law
  - Decision Analysis
  - Public Policy
  - Public Health

• Committee members represent themselves in committee work and not their employers or other organizations with whom they may be affiliated
• Entered the project with an open mind
• Five meetings, including two open sessions to hear different perspectives and research, including:
  - EPA and other government agencies
  - Environmental groups
  - Academic researchers
  - Former industry representatives
  - Nonprofit research institutes
Approach to the Charge

• EPA considers a number of factors in its decisions.
• Considered each as source of uncertainty:
  • estimates of human health risks;
  • economics;
  • technology availability; and
  • other factors (social factors [e.g., environmental justice] and political context.
• Focused on factors more readily analyzed and quantified:
  • human health risk estimates,
  • economics and
  • technology availability.
HUMAN HEALTH RISK ESTIMATES

• EPA a leader in developing quantitative uncertainty analysis approaches
• Those analyses and concerns sometimes delayed rulemaking
• Analyses do not always help with the decision
• How they influence decision not always explained.
• Magnitude of uncertainty in risk estimates not always large enough to influence the decision
• Uncertainty in the other factors might overshadow that in risk estimates
FACTORS OTHER THAN RISK ESTIMATES

- Some (but not many) of EPA’s technological feasibility and cost–benefit analyses assess uncertainty.
- Contribution of uncertainties in other factors, such as social factors and the political context receive little or no attention.
- Agency offers little guidance on assessing uncertainty in factors other than health risks or how it considers that uncertainty in its decisions.
OTHER PUBLIC HEALTH SETTINGS

• Other public health entities conduct complex uncertainty analyses using similar tools and techniques as EPA.

• Other public health arenas: no promising tools and techniques, but illustrate utility for decisions:
  • target analyses to decision by assessing regulatory options (BSE RA).
  • involve stakeholders and experts early in process, and identify targeted risk-mitigation strategies (Listeria monocytogenes RA).
  • utility of a simple risk assessment and uncertainty analysis (Melamine RA).
  • communicate complex disagreements and uncertainty (Avandia® decision).
  • systematically incorporating uncertainty and iterative approaches under deep uncertainty (Vaccinating during the 1976 pandemic scare).
UNCERTAINTY AND DECISIONS

• Incorporate uncertainty analysis in each phase of decision.
• Analysis depends on types, sources and magnitude of uncertainty, and decision context:
  • health risk estimates: weigh decrease in risk against effort to reduce it;
  • technology: differentiate between established technologies with known costs and ones not yet used for purposes at hand;
  • cost–benefit: characterize disagreements about effects on economy.
• Decisions in the presence of deep uncertainty are particularly challenging.
  • Scenario analysis, and value-of-information and robust decision methods useful under those circumstances.
• Success of decision depends on:
  • Analysts understanding context and information needs of decision makers;
  • Decision makers understanding evidence base, and its uncertainty; and
  • Decision makers explaining role of uncertainties in decisions.
COMMUNICATING UNCERTAINTY

• Communication research focuses on uncertainty in health risks estimates and highlights
  • importance of input from regulatory agency and stakeholders and
  • early engage: helps consider perspectives, identify uncertainties, and increase social trust.
• Appropriate communication (numerical, verbal, and graphical presentation) depends on:
  ● Who communication is with;
  ● Source and types of uncertainty;
  ● Context of decision; and
  ● Purpose of communication.
• People’s biases can affect interpretation and framing of uncertainty.
  ● Acknowledging biases critical to communication.
• More communication needed about sources of uncertainty in decisions and effects on decision.
• Documenting nature and magnitude of uncertainty is at time of decision and when later revisited or evaluated.
COMMITTEE
FINDINGS AND RECOMMENDATIONS
Finding 1
- Decision documents often lack robust discussion of uncertainties.
- Should be clear from communications that uncertainty is inherent in science, including the science that informs EPA decisions.
- Providing information and fostering discussion of uncertainties could lead to greater public understanding of uncertainty in decision making.

Recommendation 1
To better inform the public and decision makers, EPA decision documents and other communications to the public should systematically:
- include information on what uncertainties in the health risk assessment are present and which need to be addressed;
- discuss how the uncertainties affect the decision at hand; and
- include an explicit statement that uncertainty is inherent in science, including the science that informs EPA decisions.
Finding 2
• Generally less attention to uncertainties in factors other than health effects, such as economic and technological factors, and other factors not easily quantified (e.g., environmental justice).

Recommendation 2
EPA should develop methods to systematically describe and account for uncertainties in decision-relevant factors in addition to estimates of health risks—including technological and economic factors—in its decision-making process. When influential in a decision, those new methods should be subject to peer review.
Finding 3
• Lack of transparency regarding uncertainty analyses in cost–benefit assessments.
• Analyses often shape regulatory decisions and should be useful and interpretable for decision maker and stakeholders.
• Needs of technical and non-expert audiences differ, but set of decision documents and supporting analyses could explain sources of uncertainties to non-expert and provide links to detailed descriptions.

Recommendation 3
Analysts and decision makers should describe in decision documents and other public communications uncertainties in cost-benefit analyses that are conducted, even if not required by statute for decision making, and the analyses should be described at levels that are appropriate for technical experts and non-experts.
Finding 4
• Role of uncertainty in costs and benefits, and availability and feasibility of control technologies not well understood.
• Evaluating case studies of past rulemaking and developing directed research program on technology availability might help understanding robustness of technology feasibility assessments and economic assessments, and potential for technology innovation.

Recommendation 4
EPA should fund research, conduct research, or both to evaluate the accuracy and predictive capabilities of past assessments of technologies, and costs and benefits for rulemaking in order to improve future efforts. This research could be conducted by EPA staff or else by nongovernmental policy analysts, who might be less subject to biases. This research should be used as a learning tool for EPA to improve its analytic approaches to assessing technological feasibility.
Finding 5

- No specific guidance for assessing uncertainties other factors that affect decision making or examples of their systematic consideration in decisions.
- Ecological risk assessments include contingent valuation for policy development.
- Research needed into methods to characterize uncertainty in those other factors and to communicate it to decision makers and public.

Recommendation 5

EPA should continue to work with stakeholders, particularly the general public, in efforts to identify their values and concerns in order to determine which uncertainties in other factors, along with those in the health risk assessment, should be analyzed, factored into the decision-making process, and communicated.
Finding 6
• Regulated industry, local business communities, and environmental activists are more likely to be engaged in communications.
• General public is less likely to participate effectively without encouragement or assistance.
• Formal research program could help understand public’s values.

Recommendation 6
EPA should fund or conduct methodological research on ways to measure public values. This could allow decision makers to systematically assess and better explain the role that public sentiment and other factors that are difficult to quantify play in the decision-making process.
Finding 7
• Choice of uncertainty analysis depends on decision context (nature or type of uncertainty, factors considered in decision), and available data.
• Most problems require multiple approaches to uncertainty analysis.
• Quantitative uncertainty analyses only when they are important and relevant to decision.
  • If decision would stay the same for all states of information and analysis results, would not be worth conducting analysis.

Recommendation 7
Although some analysis and description of uncertainty is always important, how many and what types of uncertainty analyses are carried out should depend on the specific decision problem at hand. The effort to analyze specific uncertainties through probabilistic risk assessment or quantitative uncertainty analysis should be guided by the ability of those analyses to affect the environmental decision.
Finding 8
• Structured format for public communication of basis of decisions would facilitate transparency and work with stakeholders.
• EPA decision documents should be it clear that uncertainties are in line with expectations in guidelines, etc.
• Recommendations support full discussion of difficulties of decision making, including when social factors and political context play a large role.

Recommendation 8.1
EPA senior managers should be transparent in communicating the basis of the agency’s decisions, including the extent to which uncertainty may have influenced decisions.

Recommendation 8.2
EPA decision documents and communications to the public should include a discussion of which uncertainties are and are not reducible in the near term. The implications of each to policy making should be provided in other communication documents when it might be useful for readers.
Finding 9
• Decision makers vary in technical background; variety of communication tools need.
• Public increasingly wants to understand decisions.
• Communicating relevance of the uncertainties important for it to be meaningful to decision-making process and audience(s).

Recommendation 9.1
EPA, alone or in collaboration with other relevant agencies, should fund or conduct research on communication of uncertainties for different types of decisions and to different audiences, develop a compilation of best practices, and systematically evaluate its communications.

Recommendation 9.2
As part of an initiative evaluating uncertainties in public sentiment and communication, EPA senior managers should assess agency expertise in the social and behavioral sciences (for example, communication, decision analysis, and economics) and ensure it is adequate to implement the recommendations in this report.
SUMMARY

• The committee was impressed by the technical advances in uncertainty analysis used by EPA scientists in support of EPA’s human health risk assessments.

• The committee believes that EPA can lead the development of uncertainty analyses in economic and technological assessments that are used for regulatory purposes as well as the development of ways to characterize and account for public sentiment and political context.

• Leading in this way will require a targeted research program as well as disciplined attention to how those uncertainties are described and communicated to a variety of audiences, including the role that uncertainties have played in a decision.
Questions?