Setting Priorities among Risks

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A Dream

A universally accepted risk metric,
whose calculation leads to action.

Potential Benefits

Reduced cognitive load
by summarizing data
Transparency
with explicit metrics
Comparability
with common metrics

Potential Risks

Increased cognitive load
    from decoding obscure measures
Reduced transparency
    with embedded values
Non-comparability
    due to lost data properties

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Embedded Values

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The terms of all analyses embody values that favor some interests.

When transparent, those assumptions can be controversial.

Defining “Risk of Death”

probability of premature death
vs.
expected life-year lost

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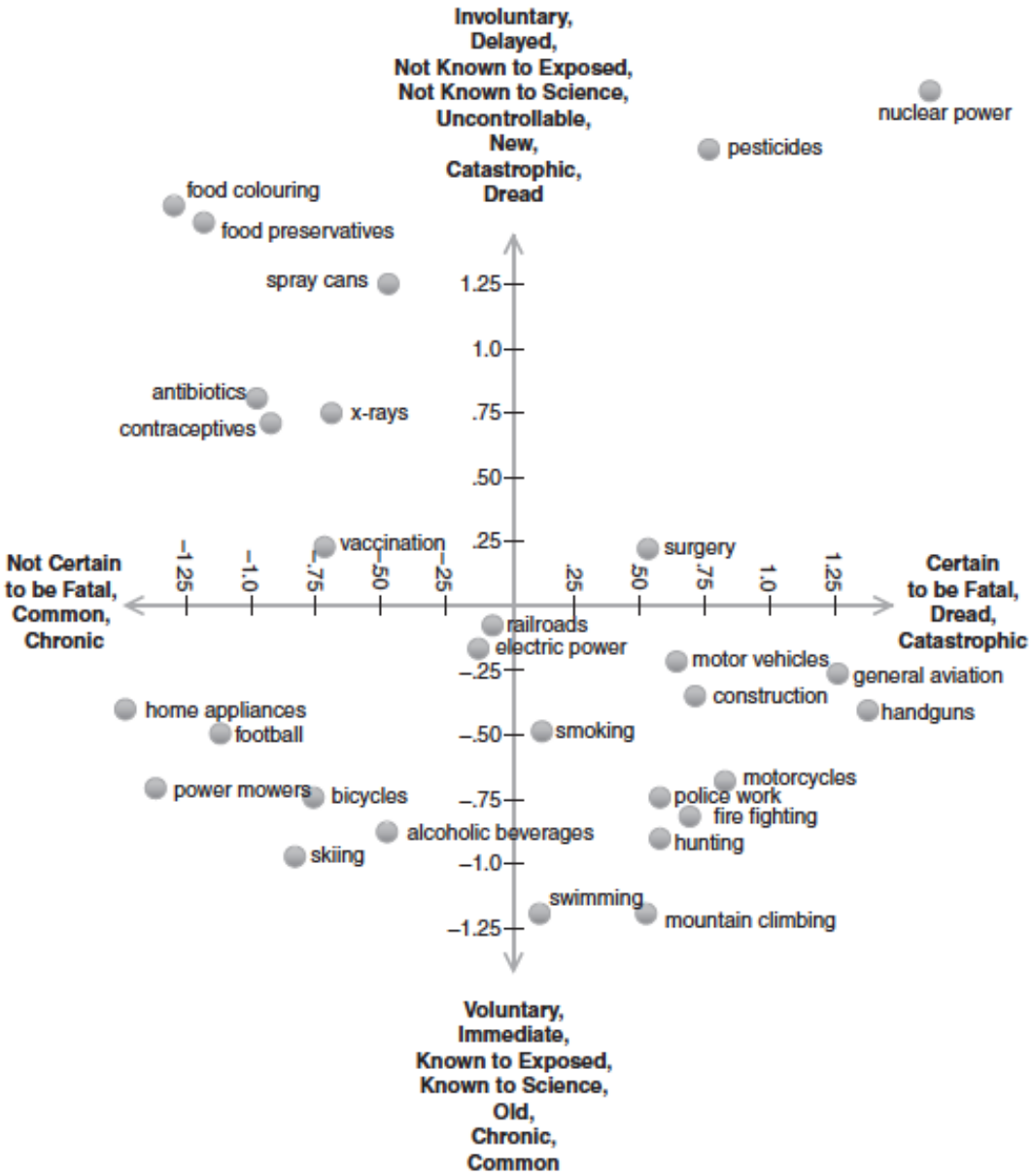
The choice of metric depends on whether a death is a death or one values deaths of young people more.

Other Possible Bases for Distinguishing among Deaths

Are the risks

- distributed equitably
- assumed voluntarily
- catastrophic
- well understood
- controllable
- dread
- borne by future generations

…



4. A risk space based on ratings of 30 hazards on 9 risk attributes

Fischhoff, B., & Kadvany, J. (2011). *Risk: A Very Short Introduction*. Oxford: Oxford University Press.

“Discounting” Future Outcomes

Reasons to value future outcomes less

-- valuing them less

deliberately

unthinkingly (hyperbolic discounting)

-- opportunity costs

-- not expecting to have them provided

-- not expecting to be there to get them

-- dreading the wait

-- wanting to live with the experience

Frederick S, Loewenstein G, O’Donoghue T [2002]. Time discounting and temporal preference. Journal of Economic Literature 40: 331-401

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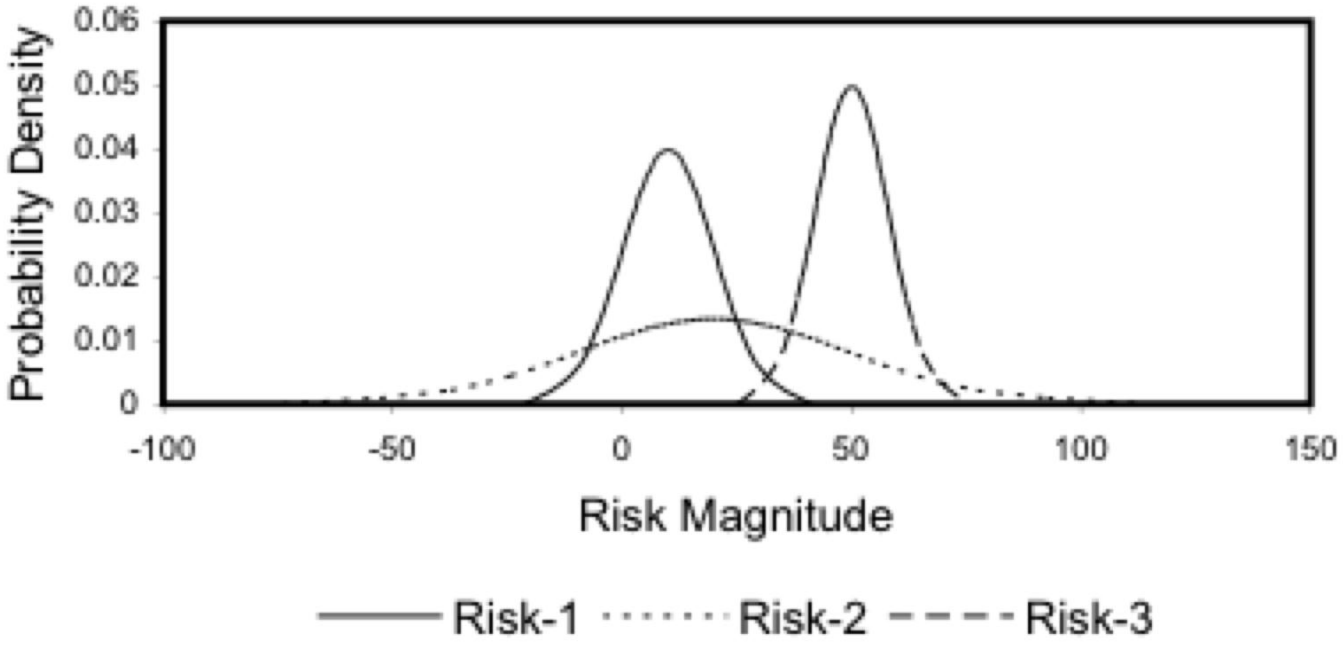
Lost Data Properties

Uncertainty



Bases of Uncertainty

Variability in observations

Internal validity (how good were studies)

External validity (how well do studies generalize)

Pedigree (how good is underlying science)

Pedigree of Science

Outcome	Measure	Proxy (How well does the measure get at the key outcome?)	Empirical Basis (How strong are the best data on these measures?)	Methodological Rigor (How strong are the best methods available to the science?)	Validity (How well have results been confirmed from different sources?)

Funtowicz, SO, & Ravetz, J. (1990). *Uncertainty and Quality in Science for Policy*. London: Kluwer

Lost Data Properties

Common metrics obscure expert judgment in data interpretation.

Decision makers have no way to discover that logic or know if it matters.

A Methodology

EPA Priority Re-setting

1987 *Unfinished Business*
1990 *Reducing Risk*
1993 *Guidebook to Comparing Risks and Setting Environmental Priorities*
~ 50 state, regional, national panels

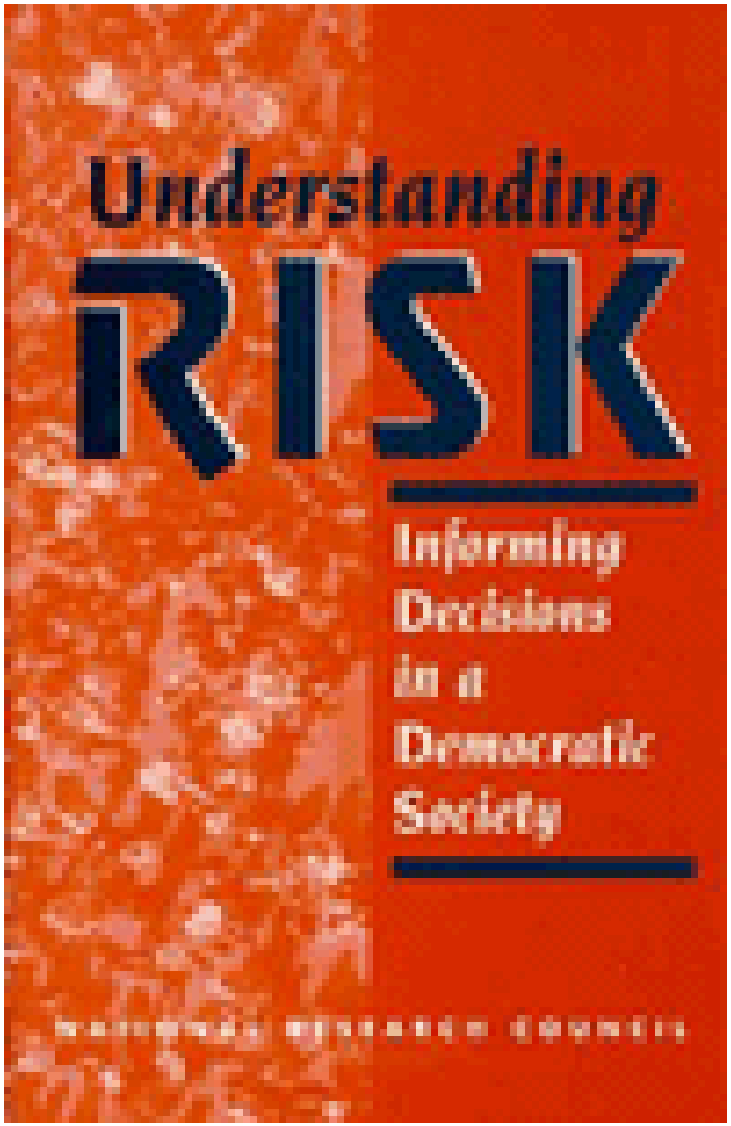
Credible Public Process

Address risks and benefits relevant to stakeholders' decisions.

Focus staff on decision-relevant science.

Support interactions needed to construct stable values.

Transparently capture agreement and disagreement.



http://www.nap.edu/openbook.php?isbn=030905396X

Design Principles

Embedded Values

Include all relevant outcomes.

Describe embedded values.

Facilitate sensitivity analyses.

Standardize for consistency checks.

Design Principles

Data Properties

Include potentially relevant ones.

Explain data interpretation.

Facilitate sensitivity analyses.

Preserve pathway to detailed evidence.

Design Principles

Communication

Ground in behavioral research.

Pretest until adequate.

Aid, not replace judgment.

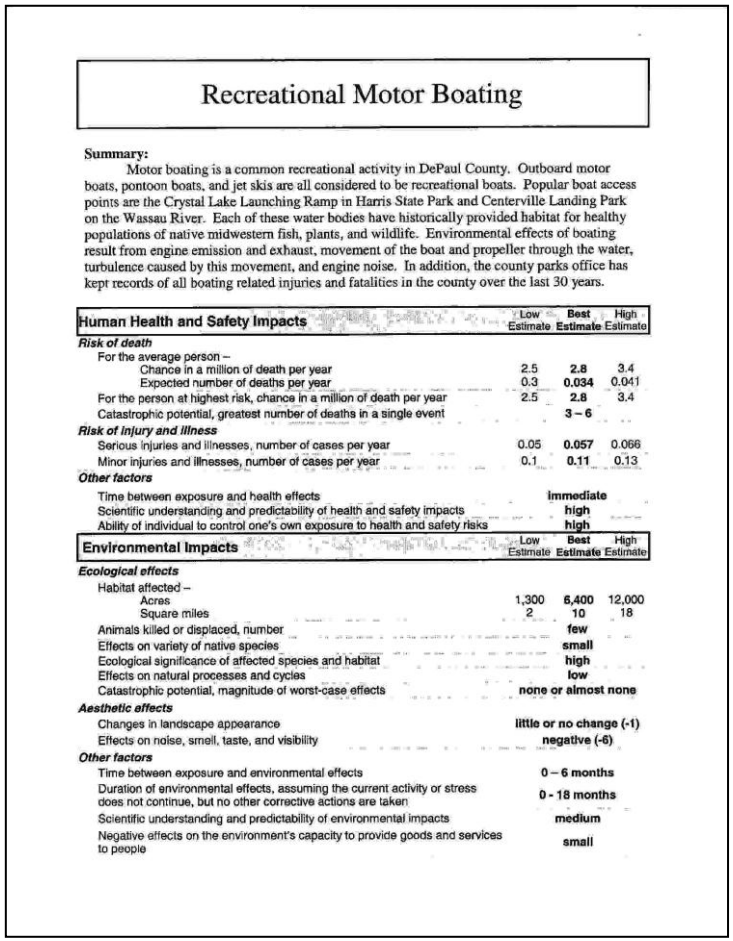
Facilitate analytical, deliberative process.

Standard Representation

School bus accident risk for Centerville Middle School*

	Low estim.	***Best estimate***	*High estim.*
Student deaths			
Number of deaths per year	.0001	**.0002**	.0004
Chance in a million of death per year for the average student	.25	**0.5**	1
Chance in a million of death per year for the student at highest risk	0.5	**1**	2
Greatest number of deaths in a single episode		**20 - 50**	
Student illness or injury			
More serious long-term cases per year	.0002	**.0006**	.002
Less serious long-term cases per year	.0004	**.0015**	.004
More serious short-term cases per year	.001	**.002**	.006
Less serious short-term cases per year	.002	**.005**	.015
Other Factors			
Time between exposure and health effects		**immediate**	
Quality of scientific understanding		**high**	
Combined uncertainty in death, illness, injury		**1.6 (low)**	
Ability of student/parent to control exposure		**moderate**	

Fuller Exposition



Recreational Motor Boating

Summary:

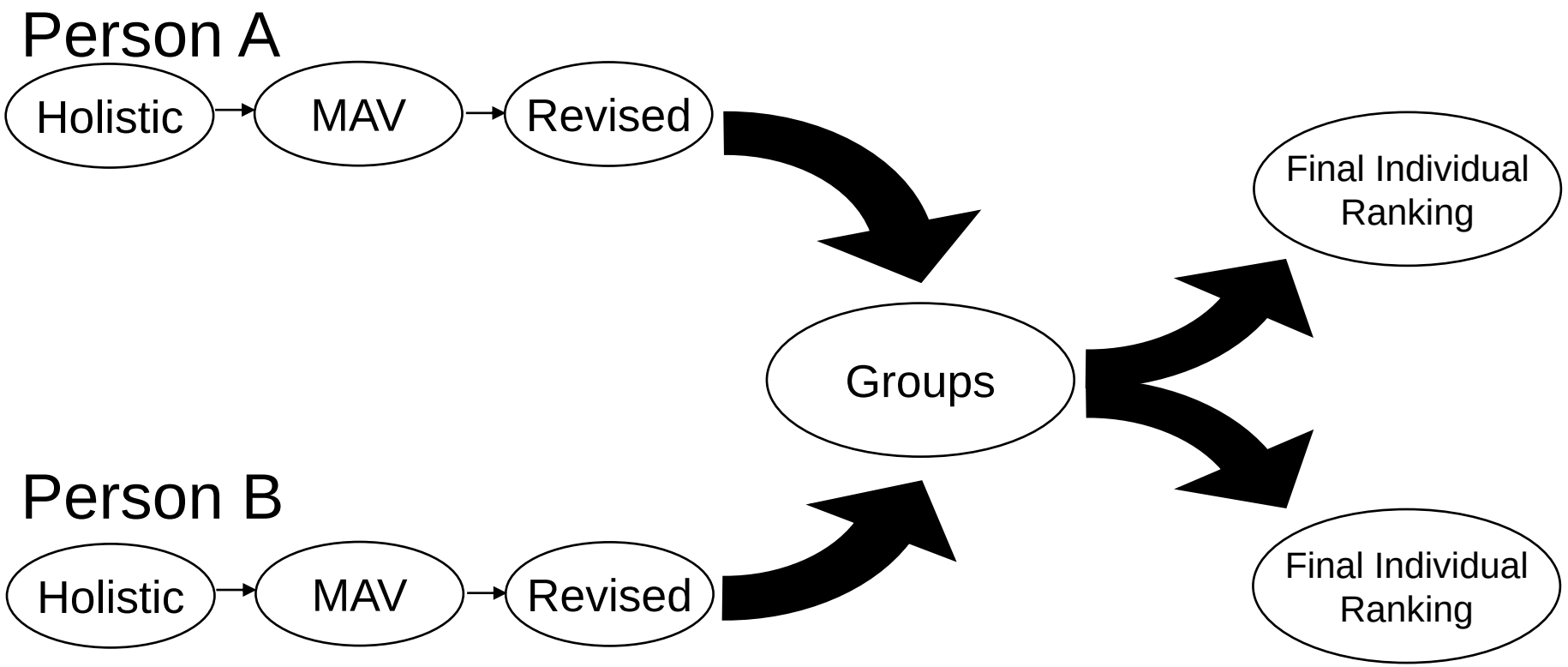
Motor boating is a common recreational activity in DePaul County. Outboard motor boats, pontoon boats, and jet skis are all considered to be recreational boats. Popular boat access points are the Crystal Lake Launching Ramp in Harris State Park and Centerville Landing Park on the Wassau River. Each of these water bodies have historically provided habitat for healthy populations of native midwestern fish, plants, and wildlife. Environmental effects of boating result from engine emission and exhaust, movement of the boat and propeller through the water, turbulence caused by this movement, and engine noise. In addition, the county parks office has kept records of all boating related injuries and fatalities in the county over the last 30 years.

Human Health and Safety Impacts	Low Estimate	Best Estimate	High Estimate
Risk of death			
For the average person –			
Chance in a million of death per year	2.5	**2.8**	3.4
Expected number of deaths per year	0.3	**0.034**	0.041
For the person at highest risk, chance in a million of death per year	2.5	**2.8**	3.4
Catastrophic potential, greatest number of deaths in a single event		**3 – 6**	
Risk of injury and illness			
Serious injuries and illnesses, number of cases per year	0.05	**0.057**	0.066
Minor injuries and illnesses, number of cases per year	0.1	**0.11**	0.13
Other factors			
Time between exposure and health effects		**immediate**	
Scientific understanding and predictability of health and safety impacts		**high**	
Ability of individual to control one's own exposure to health and safety risks		**high**	

Environmental Impacts	Low Estimate	Best Estimate	High Estimate
Ecological effects			
Habitat affected –			
Acres	1,300	**6,400**	12,000
Square miles	2	**10**	18
Animals killed or displaced, number		**few**	
Effects on variety of native species		**small**	
Ecological significance of affected species and habitat		**high**	
Effects on natural processes and cycles		**low**	
Catastrophic potential, magnitude of worst-case effects		**none or almost none**	
Aesthetic effects			
Changes in landscape appearance		**little or no change (-1)**	
Effects on noise, smell, taste, and visibility		**negative (-6)**	
Other factors			
Time between exposure and environmental effects		**0 – 6 months**	
Duration of environmental effects, assuming the current activity or stress does not continue, but no other corrective actions are taken		**0 - 18 months**	
Scientific understanding and predictability of environmental impacts		**medium**	
Negative effects on the environment's capacity to provide goods and services to people		**small**	

Florig, H.K., Morgan, M.G., Morgan, K.M., Jenni, K.E., Fischhoff, B., Fischbeck, P.S., & DeKay, M. (2001). A deliberative method for ranking risks (1): Overview and test bed development. *Risk Analysis, 21*, 913-922

A Process for Preference Construction



(MAV = multi-attribute value assessment)

Morgan, K.M., DeKay, M.L., Fischbeck, P.S., Morgan, M.G., Fischhoff, B., & Florig, H.K. (2001). A deliberative method for ranking risks (2): Evaluation of validity and agreement among risk managers. *Risk Analysis, 21*, 923-938

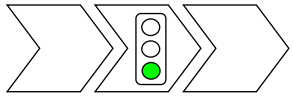
Psychometric Evaluation

- Individual-level consistency
  - *convergent validity* among rankings elicited with different methods
- Group agreement
  - common understanding of risks could reveal latent agreement or disagreement
- Acceptability
  - participant satisfaction
  - transparency

Some Examples


CABINET OFFICE
Risk: Improving government's capability to handle risk and uncertainty
Summary report
STRATEGY UNIT REPORT – NOVEMBER 2002

Decisions on managing risks to the public



CBA, including…

Deaths	Harm

‘Baseline’ WTP

Societal Concerns

Concern factors	Expert views	Public views
1 Familiarity		
2 Understanding		
3 Equity		
4 Dread		
5 Control		
6 Trust		

Decision making

HMTreasury. *2005). *Improving risks to the public*. London: Author.

FDA Benefit-Risk Framework

Capture FDA's evaluation of evidence and regulatory decision making.
Clarify potential reasons for disagreement.
Reasonable demands on FDA experts.
PDUFA V commitment

Fischhoff, B. (2012). Good decisions require good communication. *Drug Safety*, *35*, 983-993

Decision Factor	Evidence and Uncertainties	Conclusions and Reasons
Analysis of Condition	**Summary of evidence**:	**Conclusions (implications for decision):**
Unmet Medical Need	**Summary of evidence**:	**Conclusions (implications for decision):**
Clinical Benefit	**Summary of evidence**:	**Conclusions (implications for decision):**
Risk	**Summary of evidence**:	**Conclusions (implications for decision):**
Risk Management	**Summary of evidence**:	**Conclusions (implications for decision):**


OCEAN HEALTH INDEX
GOALS
COMPONENTS
INDEX BY COUNTRY
Ocean Health is Our Health
The ocean touches nearly every aspect of our lives – making it essential to the economic, social, and ecological well-being of everyone, everywhere.

Is Systematic Priority Setting Useful?

Benefits

- express explicit policy
- privilege readily quantified outcomes
- facilitate public deliberation

Risks

- spread resources thin
- detach from planning and design
- suppress pubic deliberation

National Research Council. (2007). *Scientific Review of the Proposed Risk Assessment Bulletin from the Office of Management and Budget*. Washington, DC: National Academy Press.

Systematic vs. Systemic Priority Setting

Relative efficiency may depend on

- initial disorder
- “nomination” process
- cost of learning
- precision needed
- availability of expertise

Long, J., & Fischhoff, B. (2000). Setting risk priorities: A formal model. *Risk Analysis, 20*, 339-351.

Books

Fischhoff, B., Brewer, N., & Downs, J.S. (eds.). (2011). *Communicating risks and benefits: An evidence-based user's guide*. Washington, DC: Food and Drug Administration. http://www.fda.gov/AboutFDA/ReportsManualsForms/Reports/ucm268078.htm

Fischhoff, B., & Chauvin, C. (eds.). (2011). *Intelligence analysis: Behavioral and social science foundations*. Washington, DC: National Academy Presshttp://www.nap.edu/catalog.php?record_id=13062

Fischhoff, B., & Kadvany, J. (2011). *Risk: A very short introduction*. Oxford: Oxford University Press.

Fischhoff, B., Lichtenstein, S., Slovic, P., Derby, S. L. & Keeney, R. L. (1981). *Acceptable risk*. New York: Cambridge University Press. (NUREG/CR-1614).

Kahneman, D. (2011). *Thinking, fast and slow*. New York: Farrar Giroux & Strauss.

Morgan, M.G., Henrion, M. (1990). *Uncertainty*. New York: Cambridge University Press.

Slovic, P. (ed.) (2000). *Perception of risk*. London: Earthscan.

Research Articles

Bruine de Bruin, W., Parker, A., & Fischhoff, B. (2007) Individual differences in adult decision-making competence (A-DMC). *Journal of Personality and Social Psychology. 92*, 938-956.

Fischhoff, B. (1992). Giving advice: Decision theory perspectives on sexual assault. *American Psychologist*, 47, 577-588.

Fischhoff, B. (2011). Communicating the risks of terrorism (and anything else). *American Psychologist, 66*, 520-531.

Fischhoff, B. (2012, Summer). Communicating uncertainty: Fulfilling the duty to inform. *Issues in Science and Technology*, *29*, 63-70 ,

Fischhoff, B., Bruine de Bruin, W., Guvenc, U., Caruso, D., & Brilliant, L. (2006). Analyzing disaster risks and plans: An avian flu example. *Journal of Risk and Uncertainty*, 33, 133-151.

http://www.hss.cmu.edu/departments/sds/src/faculty/fischhoff.php

Carnegie Mellon Electricity Center: http://wpweb2.tepper.cmu.edu/ceic/

Center for Climate and Environmental Decision Making: http://cedm.epp.cmu.edu/index.php

Center for Risk Perception and Communication: http://sds.hss.cmu.edu/risk/

Center for Human Rights Science: http://www.cmu.edu/chrs/