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
Potential Risks

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

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
Defining “Risk of Death”

probability of premature death vs. expected life-year lost

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
“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

Embedded Values

The terms of all analyses embody values that favor some interests. When transparent, those assumptions are controversial. As a result, common metrics obscure value issues, unless adopted by a credible public process.
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The terms of all analyses embody values that favor some interests. When transparent, those assumptions are controversial. As a result, common metrics obscure value issues, unless adopted by a credible public process.
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

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

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.
Transparencyly capture agreement and disagreement.
Understanding Risk: Informing Decisions in a Democratic Society
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.
### School bus accident risk for Centerville Middle School

#### Student deaths

<table>
<thead>
<tr>
<th>Number of deaths per year</th>
<th>Low estimate</th>
<th>Best estimate</th>
<th>High estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.0001</td>
<td>.0002</td>
<td>.0004</td>
</tr>
</tbody>
</table>

| 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

<table>
<thead>
<tr>
<th>More serious long-term cases per year</th>
<th>.0002</th>
<th>.0006</th>
<th>.002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less serious long-term cases per year</td>
<td>.0004</td>
<td>.0015</td>
<td>.004</td>
</tr>
<tr>
<td>More serious short-term cases per year</td>
<td>.001</td>
<td>.002</td>
<td>.006</td>
</tr>
<tr>
<td>Less serious short-term cases per year</td>
<td>.002</td>
<td>.005</td>
<td>.015</td>
</tr>
</tbody>
</table>

#### Other Factors

<table>
<thead>
<tr>
<th>Time between exposure and health effects</th>
<th>Immediate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of scientific understanding</td>
<td>High</td>
</tr>
<tr>
<td>Combined uncertainty in death, illness, injury</td>
<td>1.6 (low)</td>
</tr>
<tr>
<td>Ability of student/parent to control exposure</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
A Process for Preference Construction

(MAV = multi-attribute value assessment)

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
Decisions on managing risks to the public

CBA, including...

Deaths

Harm

‘Baseline’ WTP

Societal Concerns

<table>
<thead>
<tr>
<th>Concern factors</th>
<th>Expert views</th>
<th>Public views</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Familiarity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Understanding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Equity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Dread</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Trust</td>
<td></td>
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</tr>
</tbody>
</table>

Decision making

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

<table>
<thead>
<tr>
<th>Decision Factor</th>
<th>Evidence and Uncertainties</th>
<th>Conclusions and Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis of Condition</td>
<td>Summary of evidence:</td>
<td>Conclusions (implications for decision):</td>
</tr>
<tr>
<td>Unmet Medical Need</td>
<td>Summary of evidence:</td>
<td>Conclusions (implications for decision):</td>
</tr>
<tr>
<td>Clinical Benefit</td>
<td>Summary of evidence:</td>
<td>Conclusions (implications for decision):</td>
</tr>
<tr>
<td>Risk</td>
<td>Summary of evidence:</td>
<td>Conclusions (implications for decision):</td>
</tr>
<tr>
<td>Risk Management</td>
<td>Summary of evidence:</td>
<td>Conclusions (implications for decision):</td>
</tr>
</tbody>
</table>
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 public deliberation

Systematic vs. Systemic Priority Setting

Relative efficiency may depend on
initial disorder
“nomination” process
cost of learning
precision needed
availability of expertise

**Books**
http://www.fda.gov/AboutFDA/ReportsManualsForms/Reports/ucm268078.htm
http://www.nap.edu/catalog.php?record_id=13062

**Research Articles**

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/