Risk prioritization in environmental health

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There are various dimensions in prioritization

- Traffic accidents cause almost 300 deaths per year in Finland (almost 1200 in 1972)
- Accidents of passenger aircraft cause 0 deaths per most years (helicopter to Estonia 2005, 14 people died; Koivulahti, Vaasa 1961, 25 people died)
- Reason to focus in preventing road accidents and to relax with air traffic?
- Similar questions in environmental health. Safety is not only about numbers, but trust: Man must be able to breathe, drink, eat and live in the environment trusting on its safety.
On the other hand, we must prioritize

- Levels of risk vary greatly
- Prioritization is a must, but very hard to sell to the public
- We easily accept measures causing a burden to somebody else
- Resistance to change our own behaviour to reduce risks is great

<table>
<thead>
<tr>
<th>Regulation</th>
<th>Cost per premature death averted (SM, 1990)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car seat belt standards</td>
<td>0.1</td>
</tr>
<tr>
<td>Car fuel system standards</td>
<td>0.4</td>
</tr>
<tr>
<td>Car side impact standards</td>
<td>0.8</td>
</tr>
<tr>
<td>Car rear seat belt standards</td>
<td>3.2</td>
</tr>
<tr>
<td>Asbestos ban</td>
<td>110.7</td>
</tr>
<tr>
<td>Ethylene dibromide drinking water</td>
<td>5.7</td>
</tr>
<tr>
<td>1,2DCP drinking water standard</td>
<td>653.0</td>
</tr>
<tr>
<td>Atrazine/Alachlor drinking water</td>
<td>92070.0</td>
</tr>
<tr>
<td>Wood preserving chemicals, hazardous</td>
<td>57000000.0</td>
</tr>
<tr>
<td>lighting</td>
<td></td>
</tr>
</tbody>
</table>

Data from Belzer [23]. The benefits measured are of deaths or injuries averted, no attention is paid to concepts such as water quality or environmental benefit.

Colin Berry: Risks, costs, choice and rationality
Why prioritize?

- To aid in setting health service priorities
- To aid in setting health research priorities
- To aid in identifying disadvantaged groups and targeting of health interventions
- To provide a comparable measure of output for intervention, programme and sector evaluation and planning


- Prevention of disease: why not regulate everything?
Population statistics aside, individual risk level is also important

- Man must be able to breathe, drink, eat and live in the environment trusting on its safety: trust
- Individual risk level may vary remarkably: justice
  - Occupational risks (policemen, fire fighters etc)
  - Recreational (mountain climbing, careless fireworks)
  - Lifestyle (smoking, alcohol, sexual habits, diet)

Two different viewpoints:
- Population risk; perhaps low individual risk but widespread exposure (e.g. PM$_{10}$, radon)
- Individual risk (food poisoning, snake bite, solvents e.g. benzene, vinyl chloride)
Benefit vs. risk balance is difficult: POPs in fish
Restricting fish consumption would increase cardiac mortality in Europe, when the preventive effect of omega-3 fatty acids disappears. Number of reduced cancers dwarfs with this even assuming the worst case.

If risk managers assume responsibility of total health effect of salmon consumption:

- Present: Prevented cardiac deaths = 30,900
- Restrict fish consumption: Prevented cardiac deaths = 23,400

If risk managers care only for cancer due to pollutants:

- Present: Cancer = -206
- Restrict fish consumption: Cancer = -154

Tuomisto JT et al. 2004
Approaching the risk: risk is no simple matter

- **Description and analysis of the risk**
  - Cognitive and intellectual level

- **Risk perception**
  - Insight and digestion

- **Credibility**
  - Level of trust
The first difficulty is to differentiate between hazard and risk.

Hazard in the two pictures is the same, risk is not.

Hazard is the property of a substance or other factor.

Risk also includes the likelihood of the hazard to become true and therefore the same hazard may cause totally different risk in different conditions.

# Chances of dying from selected causes


<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Chances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor vehicle accident (little motivation to restrict)</td>
<td>1 in 100</td>
</tr>
<tr>
<td>Murder</td>
<td>1 in 300</td>
</tr>
<tr>
<td>Fire</td>
<td>1 in 800</td>
</tr>
<tr>
<td>Firearms accident</td>
<td>1 in 2,500</td>
</tr>
<tr>
<td>Electrocution</td>
<td>1 in 5,000</td>
</tr>
<tr>
<td>Asteroid/comet impact</td>
<td>1 in 20,000</td>
</tr>
<tr>
<td>Passenger aircraft crash (high motivation)</td>
<td>1 in 20,000</td>
</tr>
<tr>
<td>Flood</td>
<td>1 in 30,000</td>
</tr>
<tr>
<td>Tornado</td>
<td>1 in 60,000</td>
</tr>
<tr>
<td>Venomous bite or sting</td>
<td>1 in 100,000</td>
</tr>
<tr>
<td>Fireworks accident</td>
<td>1 in 1 million</td>
</tr>
<tr>
<td>Food poisoning by botulism (high motivation)</td>
<td>1 in 3 million</td>
</tr>
<tr>
<td>Drinking water with EPA limit of trichloroethylene</td>
<td>1 in 10 million</td>
</tr>
</tbody>
</table>
Extrapolation, not statistics as basis
Risk level uncertain and comparison to other risks difficult

• "A US EPA scientist remarked at a professional meeting that implementation of a risk-based regulation had resulted in the saving of 1000 lives annually.

• While certainly an impressive statement, because of the uncertainty and conservatism in the process, the more reasonable interpretation is that no more than 1000 lives per year would be saved, almost certainly many less, and maybe zero.”


• It is important to note whether the risk is a measured or extrapolated risk
Difference between measured and extrapolated risks

- **Measured risk**: we have direct knowledge in real conditions on incidence in human populations
  - Death statistics (e.g. traffic accidents, liver cirrhosis)
  - Epidemiological studies (e.g. cancer rate in smokers vs. non-smokers, PM epidemiology)
  - Clinical experience (mushroom poisonings)

- **Extrapolated risk**: we extrapolate from other species or from high exposure levels
  - Safety margins (e.g. 100x from animal data)
  - Modeling of cancer incidence from accidents or occupational setting (model crucial: linear, threshold)
"Upper bound" maximization is a problem
Problems from different sources of information

- **Extrapolated** risk is difficult to communicate to people
- The public and even some authorities think that if a limit value is exceeded, there is a high risk
  - There is usually ample safety margin
  - Even if the risk is real, it is often statistically unlikely (e.g. cancer risk usually unmeasurable by epidemiological methods, i.e. less than 1%, but people think almost everybody will contract cancer)
  - Often risks thought to be caused by "others"
- A very real **measured** risk is not thought of as "my risk", if pleasure is involved (wood burning, alcohol, speeding in traffic): willingness to accept "self taken risks"
Problems of risk maximization and precautionary principle

• GMOs want a reversed burden of proof
  – Something is dangerous until it has been proven safe
  – Proving negative is impossible in science; we have to be satisfied with likelihoods

• Precautionary principle is misused in risk assessment; it is in fact risk management, science can only search for truth

• Both tend to minimize well-known risks and maximize poorly known risks
Prioritization is a must

- Because risk assessment methodologies vary, a common picture can only be obtained by using similar metrics.
- Wrong decisions will cause huge waste of resources (both financial and personal resources).
- Unfounded scares will cause unnecessary fears; people have the right to make their own decisions, but correct information must be available.
- Important decisions will be delayed due to false assumptions of priority (e.g. fine particulate limit values in EU, difficulty of climate change abatement).
Approaching the risk

- Description and analysis of the risk
  - Cognitive and intellectual level
- **Risk perception**
  - Insight and digestion
  - This is especially challenging in risk prioritization
- Credibility
  - Level of trust
Risk perception

• Dread is not directly correlated to magnitude of risk
• Familiar risk - unknown risk (wood smoke/industrial emissions, alcohol/gene manipulation)
• Magnitude of episode (car accident vs. accident of jumbo jet)
• Voluntary/involuntary (1000x difference?) (mountain climbing/being subject to criminal assault; note that risk-taking is also used to elevate self-respect)
• Association to psychologically sensitive issues (nuclear power/nuclear weapons, chemicals/big money)
Risk perception is especially difficult projected to future

- Climate change still arouses disagreements, because one person hardly notes a difference and years vary
- Carcinogenicity of chemicals is more likely to cause dread, because cancer as such is a dread
Approaching the risk

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Problems with credibility

• One has to earn credibility, it requires patience, one can lose it in minutes (how many years a cashier has to be honest after misappropriation?)

• The worst approach is to suggest someone just being emotional: in the present society one has also to consider different attitudes of males and females

• People are truly afraid, it should not be minimised

• Special problems with such associations as nuclear power vs. nuclear weapons
Typical differences between professionals and lay people

• "Differences among researchers", difficult to understand that they are part of scientific discussion, tendency to pick up one’s own favourite (climate change skeptics a typical case)

• Different safety margins hard to understand: limit value is not a line between safety and risk

• Familiar risks are belittled, especially if they would threaten own pleasures

• The difficulties should be recognized, but one should not be fooled to accommodate with popular beliefs
How to prioritize then?

Early attempt to use previous decisions as a basis for new recommendations: even among carcinogen limit values the scatter of EPA decisions is over 10000 fold.

The most used modern tool: DALY

- **Disability Adjusted Life Years**
- Assumes a standard expected lifetime (e.g. 80+ yrs)
- Counts years lost due to premature death
- Counts years lost during illness (i.e. even serious infection is short, so impact minor)
- Counts years lost due to disability, weighed by the degree of disability
- Age weighting (peak value between 20 and 40 years)
- May include 3 % discounting (future loss is valued lower than a loss today)
The most important environmental risks: air pollution leads, noise, radon, passive smoking, UV
Take home message

- We have many reasons to prioritize (economic, fairness, justice); it is a must
- Prioritization cannot be one and only approach (individual risk vs. population risk, public perceptions, public trust, voluntary risk behaviour)
- Man must be able to breathe, drink, eat and live in the environment trusting on its safety
- Mission of THL: To ensure the best available knowledge to people and decision-makers for their decisions
THANK YOU FOR ATTENDING