General concepts of Quantitative risk assessment

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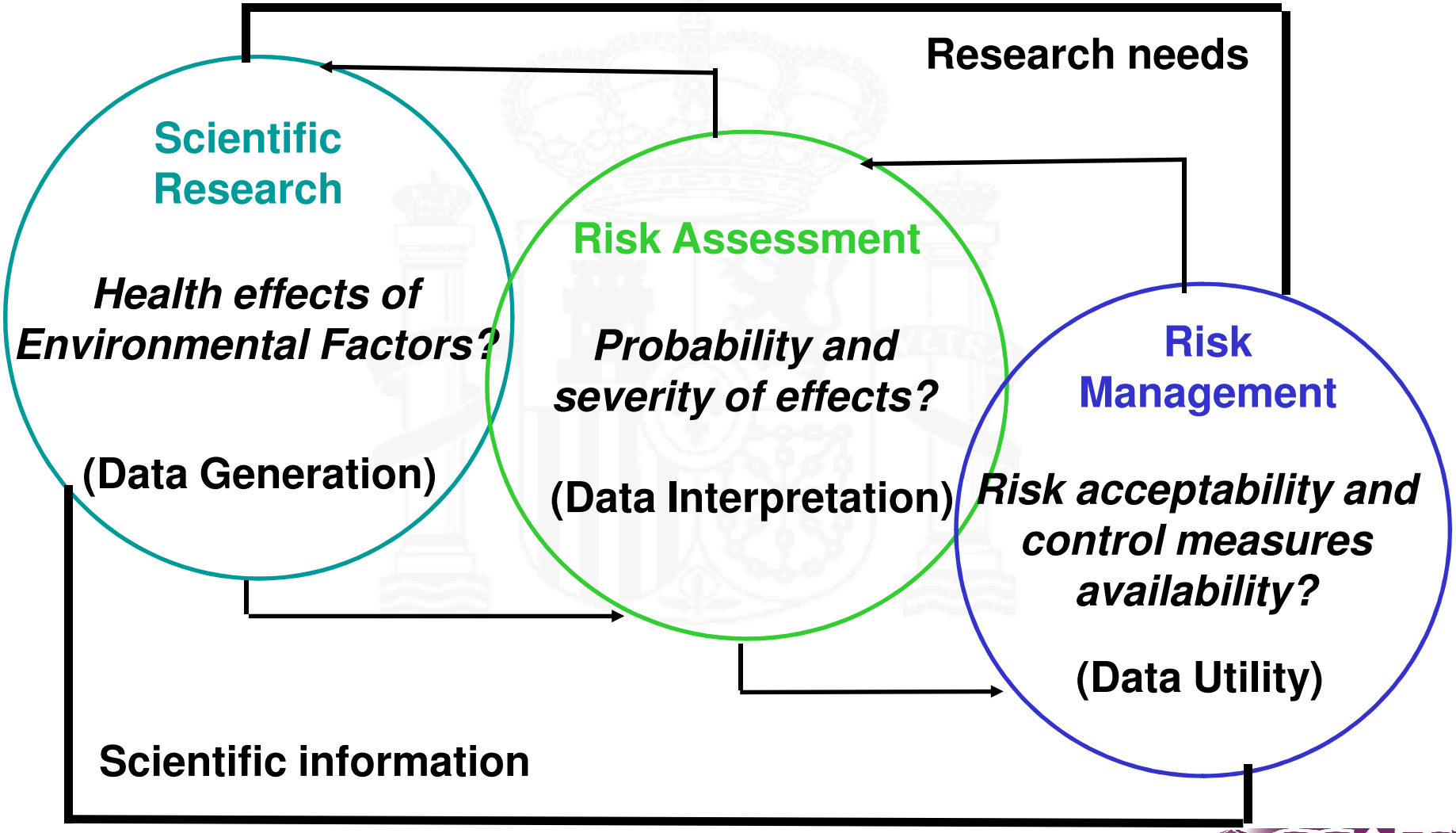
Objective

- To provide a methodological framework for a solid evidence based risk management
  - Allowing for prioritisation
- Developed for:
  - Ionising radiations
  - Carcinogens and toxics
- Applicable to all health risks?
- Applicable in other contexts?

Approach to Environmental RA



Source: US Sciences Academy 1983

Objectives

- Organise and prepare available evidence for decision making
- Quantify de probability of specific health effects on the population
- Identify missing information, knowledge and data

Principles

- Transparency
  - Justified data selection
  - Statement of Assumptions made in the process

- Coherency
  - Coherent, documented and “stable” decision making procedures along the assessment

Situation analysis

- Identify the source of the hazard
- Establish the area at risk
- Identify target population
- Identify the potential types and modes of exposure to the hazard

Is a quantitative risk assessment pertinente in this context?

A four steps process

- Step 1: Identification of substances and associated hazards of interest
- Step 2: Selection of toxicological values of reference from available evidence
- Step 3: Estimates of population exposure
- Step 4: Risk characterization and discusion

Step 1: substances and hazards

- Substances related with health effects
  - Ammount, environmental concentration
- Health effects
  - Acute / Chronic
  - Systemic / Carcinogen
  - Human / model evidence
  - Exposure mode leading to the effect

Step 2: Reference Toxicological Values

- Dose necesary for producing the effect
  - Link to an exposure mode
  - For specific effects
  - For exposure duration

Ingestion / Inhalation

Carcinogen / Non Carcinogen

Step 2: Reference Toxicological Values

- Threshold effect (non carcinogenic)
  - Severity proportional to dose
  - MRL (Minimal Risk Level), TDI (Tolerable Daily Intake), RfD/RfC (Reference Dose/Concentration)

    Plomb intake MRL 3.5 µg/kg/day

    Vanadium air RfC 0.2 $\mu g/m^3$

- Continuous effect (mostly carcinogenic)
  - Probability proportional to the dose

Uncertainties

- Quality of the studies sources of information
- Up to date information
- Research models
- Equivalent mode and duration of exposure
- Mixture of toxics

- Play safe vs daring

Databases of interest

http://www.epa.gov	US - Environmental Protection Agency
http://www.epa.gov/iris	Integrated Risk Information System
http://www.epa.gov/tri	Toxic Release Inventory
http://www.cdc.gov	Center for Disease Control
http://www.atsdr.cdc.gov	Agency for Toxic Substances & Disease Registry
http://www.who.dk (*.int)	OMS Europe (internationale)
http://www.rivm.nl	National Institute of Public Health & Environment - The Netherlands
http://www.le.ac.uk/ieh	Institute for Environment & Health - UK
http://www.jrc.org	EC - Joint Research Center
http://www.iarc.fr	Centre International de Recherche contre le Cancer
http://www.tera.org/iter	Toxicology Excellence for Risk Assessment
http://www.inrs.fr	Institut National de la Recherche et de la Sécurité
http://www.cdc.gov/niosh/	US - National Institute for Occupational Safety & Health
http://www.ccohs.ca	Canadian Centre for Occupational Health & Safety

Step 3: Population exposure

- Estimate the dose or the concentration of exposure for the target population
- Dose: Amount of toxic crossing a biological barrier
- Exposure mode, frequency, duration, intensity
- **Exposure to the toxic**

$$DEDij = Ci \times Qj \times \theta / P$$

Ci : Toxic concentration in the vehicle

Qj : Amount of exposure to vehicle

θ : Adsorbtion rate

W : Weight (kg)

Step 4: Risk Characterisation

- Excess risk associated to the exposure
- Threshold effect

  Quotient of danger = DED / MRL
- Discusion
  - Situation analysis
  - Uncertainities and asumptions
  - Population characteristics

Conclussions

- Standardaised methodological framework
- Evidence based
- Needs strict application of principles
  - Transparency and coherency
- Useful tool for decision making in specific situations
- Key question
  - Is the quantitative risk assessment pertinent in this context?

Application to other risks / hazards

- Infectious disease dynamics models
  - SEIR / Compartimental models
- Foodborne transmited diseases
- Infection dose related effect
- Timeliness

Good qualitative can be better than a quantitative based in too many asumptions