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Health Impact Assessment of privatization of drinking water provision – use of epidemiological evidence

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HIA of privatization of drinking water provision

Presentation overview

1. Context, objectives
2. Methods, incl. QRA
3. Results: (probabilistic) risk estimates; relative cancer risks; expected additional cancer cases
4. Conclusions

1. Context, objectives

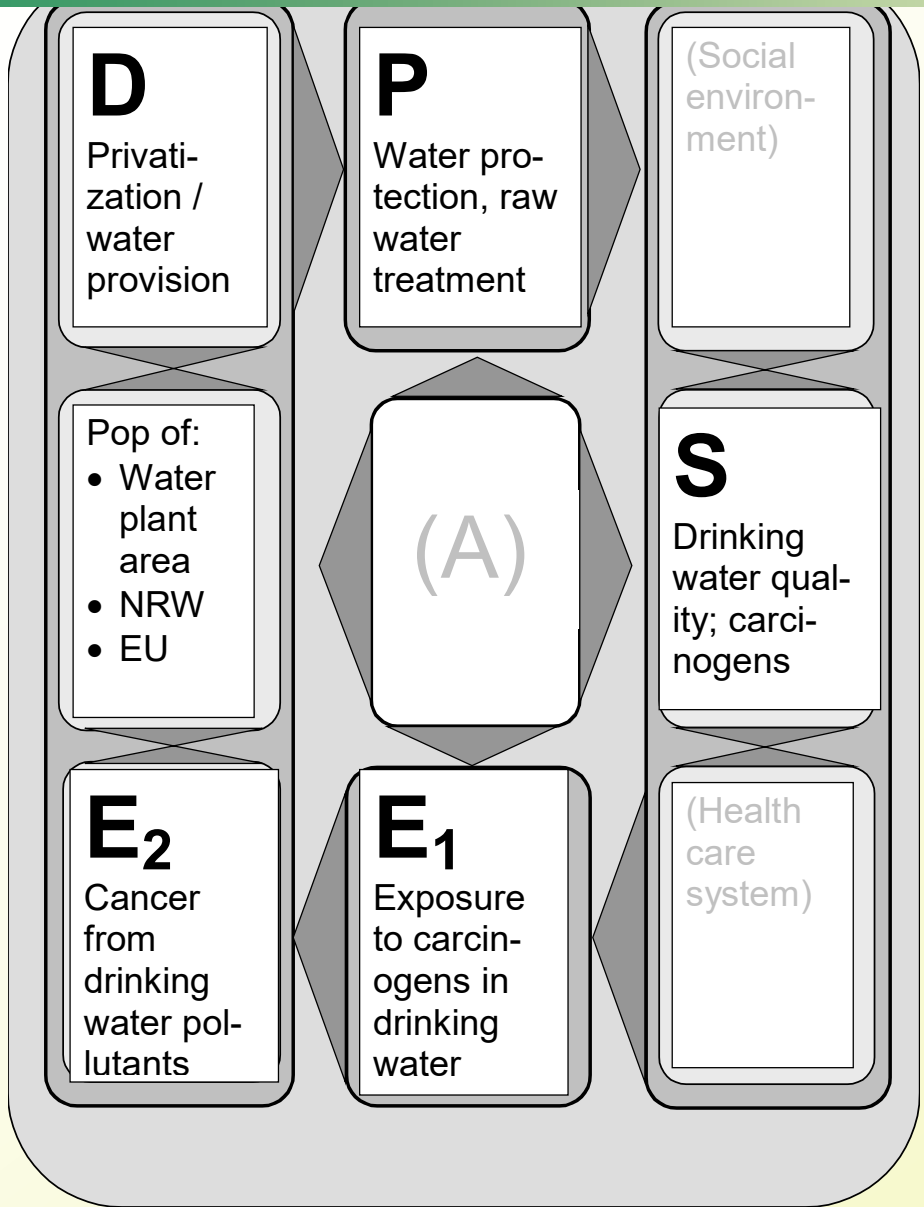
Privatization; HIA exercise

- Strong tendency towards privatization in many policy sectors, incl. drinking water provision
- Current debate on health impacts mostly qualitative
- Objective: based on HIA approaches, to contribute quantitative impact estimates from carcinogen exposures increasing within the legal limits
- Not a „final" statement on the expected impact; largely a demonstration of uncertainty involved

2. Methods
2.1 HIA 10-step approach; steps 1 – 7

1. Subject analysis	Contents of policy, plan, or program
2. Regional analysis	Status quo of the study area potentially affected
3. Population analysis	Size, composition, health status, behavioral patterns of population potentially affected
4. Background analysis	Existing burdens incl. current levels of pollution
5. Prediction of environm. impacts	Expected emissions, e.g. chemicals, noise, microbes; expected impact on S-E development
6. Prediction of exposures & health effects	Expected health impairments and benefits resulting from the predicted changes in the physical and social environment (non-/threshold agents)
7. Summary assessment	Summary assessment of predicted impacts, using standards, expert rating, etc.

2.2 DPSEEA structure for HIA



DPSEEA components:

D Driving forces

P Pressures

S State of environment

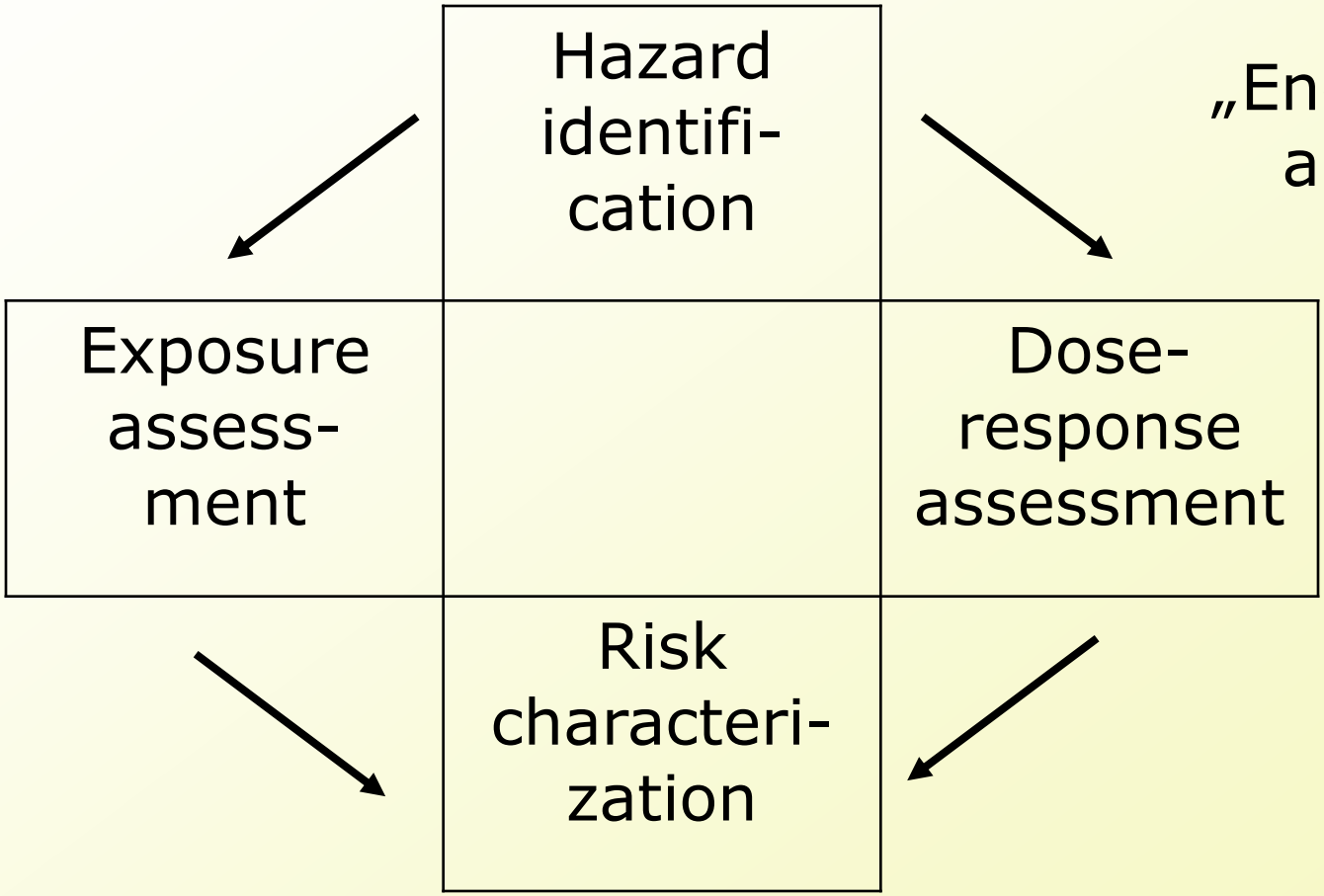
E_1 Exposures

E_2 Effects

A Activities

2.3 Quantitative Risk Assessment (QRA)

Standard QRA model



„Engineering“ approach

3. Results

3.1 Hazard identification

Selected recognized carcinogens in drinking water

Chemical	IARC	MAK	WHO guideline value (ug/l)	EU limit value (ug/l)
Acrylic amide	2A	2	0,50	0,10
Benzene	1	1	10,00	1,00
1,2-Dichloroethane	2B	2	30,00	3,00
Arsenic	1	--	10,00	10,00
Benzo(a)pyrene	2A	2	0,70	0,01
Methane trichloride	2B	4	200,00	n.a.
Bromodichloromethane	2B	--	60,00	n.a.
Vinyl chloride	1	1	5,00	0,50

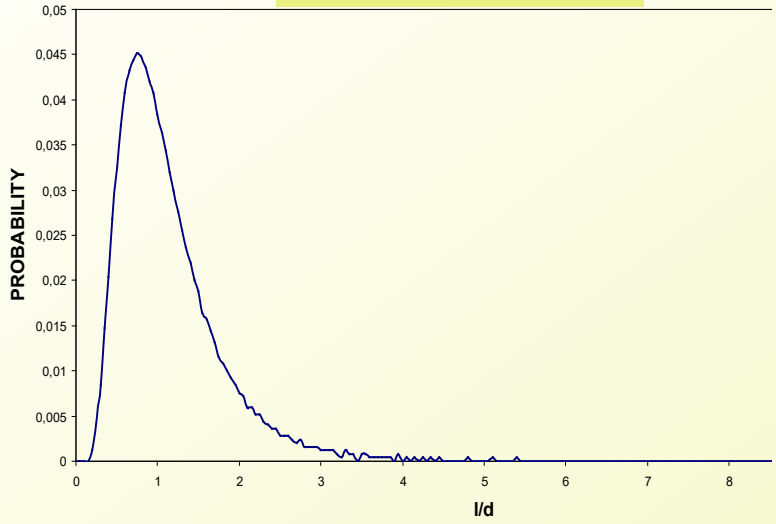
3.2 Exposure assessment

(A) Physiology

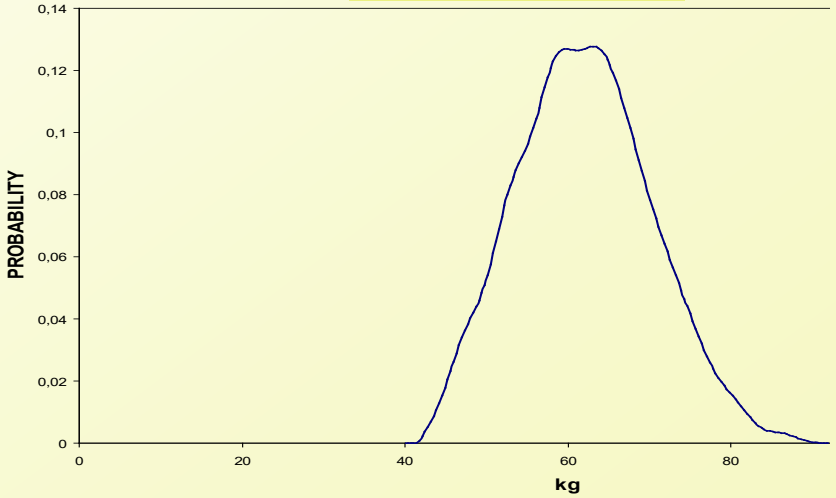
Body weight (BW), point estimate = 60 kg [AUH]

Water intake rate (IRw), point estimate = 2.0 l/d [Roseberry & Burmaster]

IR_w (l/d)



BW(kg)



Exposure assessment

(B) Water quality

- **Current water quality:** Observed or estimated levels of pollution

  Common practice:
  If (current values < analytical threshold „AT“)
  - then use AT/2

- **Potentially decreasing water quality**

  Model increments: steps of 10% of the limit values

3.3 Dose-response assessment

Potency factors

Derivation of potency factors from WHO guideline values

Uncertainty involved in dose-response assessment, illustrated by potency factors for benzo(a)pyrene from 3 sources: WHO, NL-RIVM, US-EPA

3.4 Risk characterization

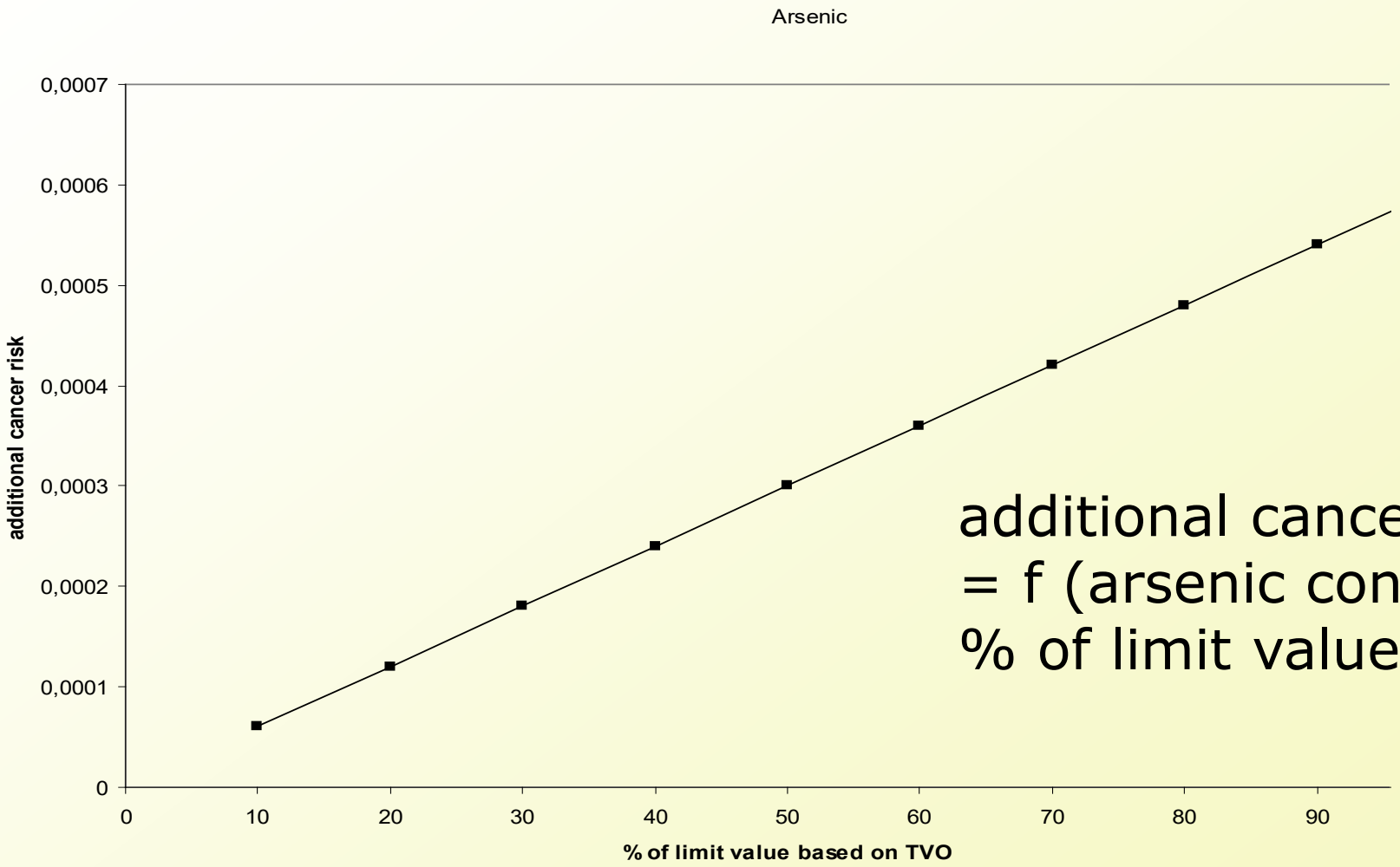
Overview

Point estimates / probabilistic estimates of additional cancer risk caused by higher exposure to carcinogens

Relative risks of cancer for increased vs. current exposure levels (Sect 3.5)

Estimated additional cancer cases from increased carcinogen exposure levels (Sect. 3.6)

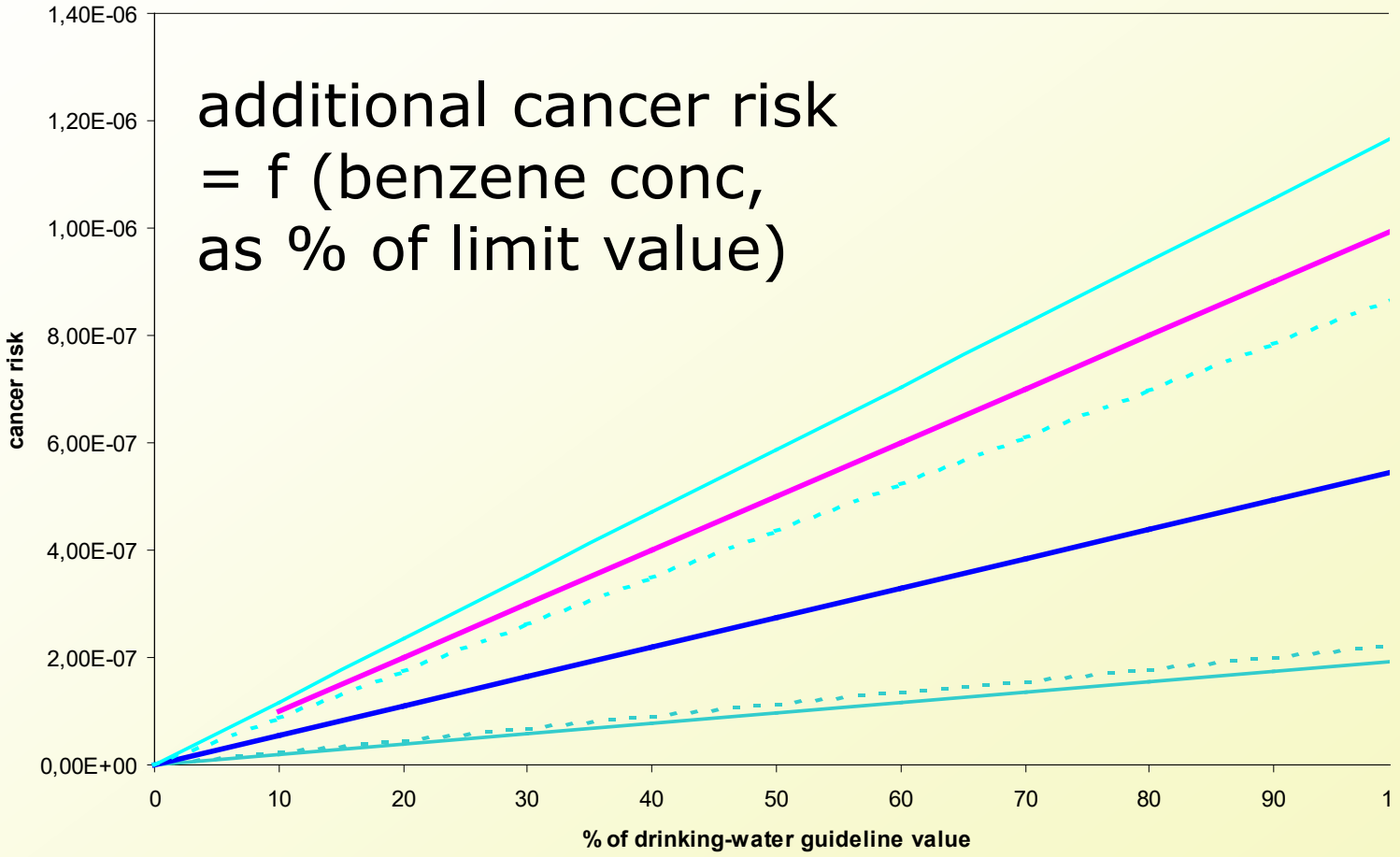
Risk characterization: Point estimates of risk



additional cancer risk = f (arsenic conc, as % of limit value)

Risk characterization: Probabilistic modelling of exposure

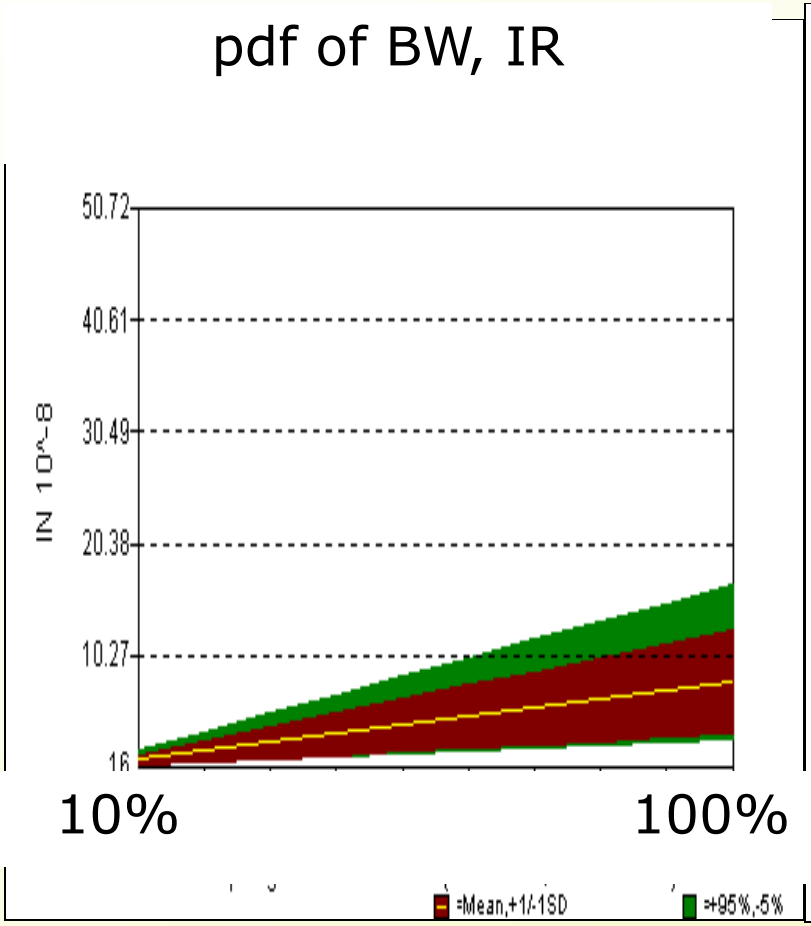
Based on pdf of body weight & intake rate



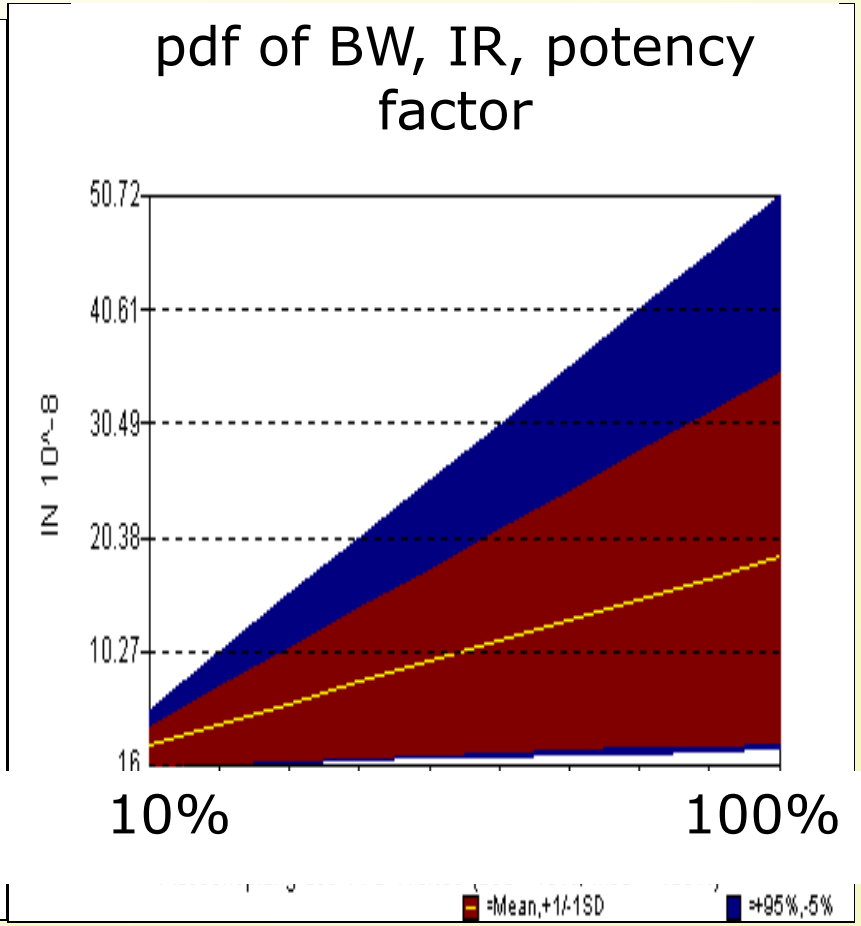
Risk characterization: Probabilistic modelling of exposure and dose-response

Cancer risk from B(a)P = f (% limit value)

pdf of BW, IR



pdf of BW, IR, potency factor



3.5 Relative risks (RR) of cancer for increased vs. current exposure levels

% of limit values	10	20	30	100
Benzene	10,0	20,0	30,0	100,0
1,2-Dichloro-ethane	n.a.	1,2	1,8	6,0
Arsenic	1,4	2,9	4,3	14,3
Benzo(a)-pyrene	2,0	4,0	6,0	20,0
Methane tri-chloride	5,0	10,0	15,0	50,0
Bromodichloro-methane	5,0	10,0	15,0	50,0

3.6 Estimated additional cancer cases from increased carcinogen exposure levels

	Water provider, pop 1.2 mill			NRW, pop 18 mill			EU, pop 376 mill.		
% of limit values	**10**	**30**	**100**	**10**	**30**	**100**	**10**	**30**	**100**
As	72	216	720	1,080	3,240	10,800	22,560	67,680	225,600
all others	1	3	9	14	41	138	287	862	2,874
total	73	219	729	1,1094	3,281	10,938	22,847	68,542	228,474

3.7 Results summary

Modeling results suggest that small or moderate increases of carcinogen levels in drinking water (10% or 30% of limit values) may lead to **noticeable impacts** (here: increases of cancer risk). For the 30% scenario, relative risk estimates reach values of RR up to 15 and even 30.

Based on the current analysis, with uniform increases of pollutant levels, one **single chemical** (As) is responsible for nearly 99% of expected additional risk; this may change if the modelling is done more comprehensively.

Uncertainty modelling: current focus on **exposure** needs to be extended towards **dose-response**.

4. Conclusions

Limitations of current approach

- Probability of increases in pollution levels = unknown; but compliance with „minimization principle" = costly
- Not covered here: additional carcinogens, non-cancer risks, microbial risks, measurement errors, system failures (havaries), illegal action, etc.
- Underestimation of dose-response uncertainty

Perspectives

- According to QRA results, exposures strictly within current limit values could cause cancer risks and case loads to increase substantially
- Need to estimate impacts more precisely, then to decide on preventive action, e.g. to improve surveillance, possibly also to tighten limit values