

Biomonitoring & Human Exposure to Chemicals

Ludwine Casteleyn, Katholieke Universiteit Leuven

Reinhard Joas, BiPro Munich

COPHES

European Responsible Care Conference

21-23 september 2011

Brussels

FROM OCCUPATIONAL TO ENVIRONMENTAL HEALTH



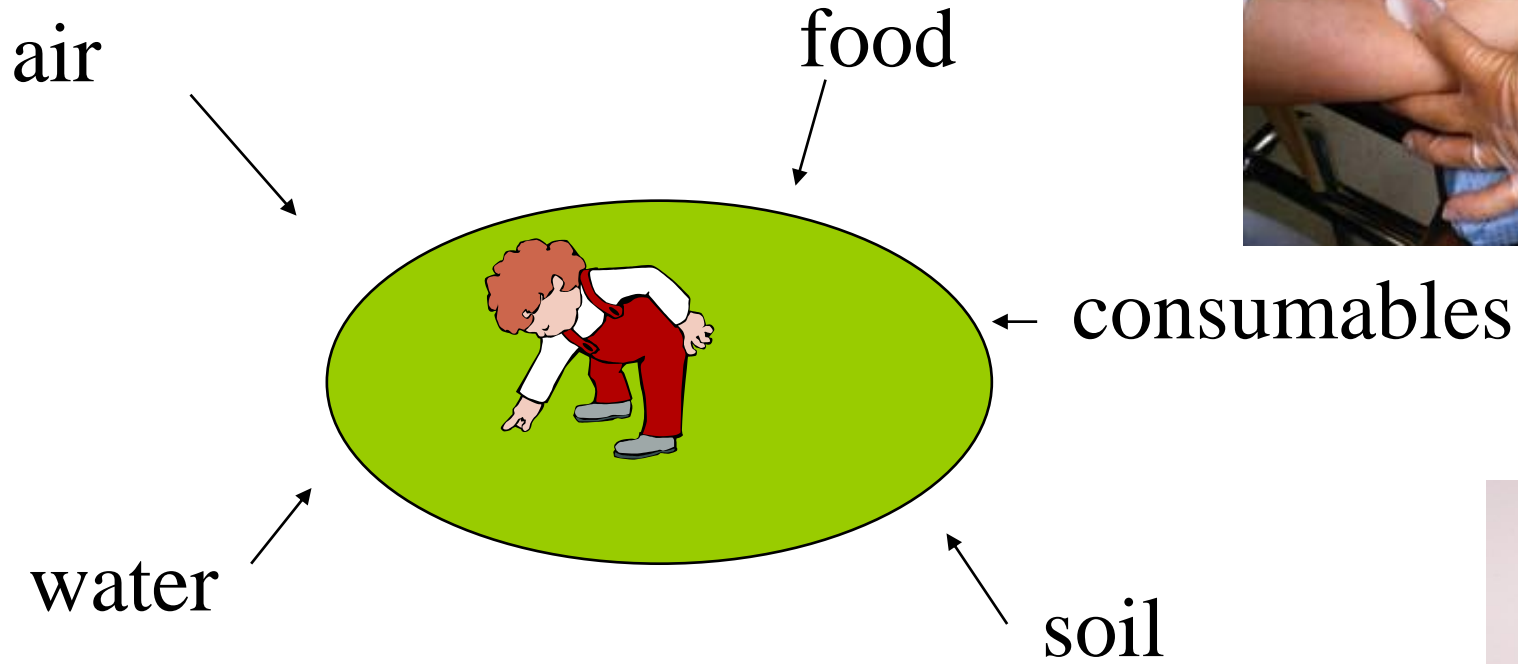
30 years ago ...

- More than 100 cows died after exposure to heavy metals close to a lead works
- Lead in children living near a battery production plant
- Lead in blood of children near a smelting works



HUMAN BIOMONITORING

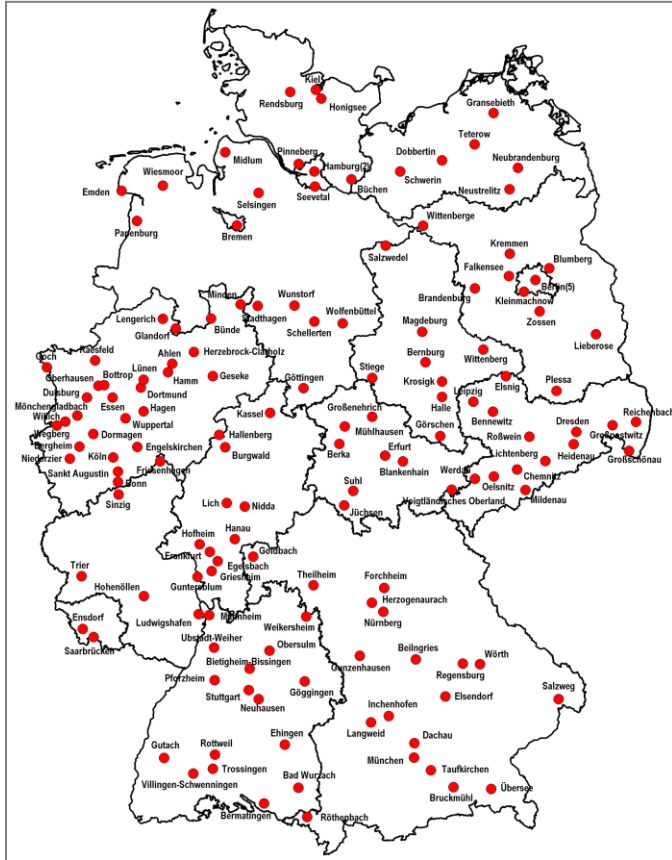
Measuring (effect of) exposure in humans



- Biomarkers of exposure
- Biomarkers of effect
- Biomarkers of susceptibility

USE IN SURVEYS

German Environmental Survey I – IV (GerES)



- Cross sectional population study
- Up to 4.800 subjects per survey
- Age between 3 - 69 years
- Around 100 -150 sampling locations
- Representative with regard to region, community size, age, gender
- Subsample of the German Health Interview and Examination Survey

USE IN RESEARCH



Avon **Longitudinal** Study of Parents and Children: (ALSPAC)* Started in 1991



department for
children, schools and families

Also known as Children of the 90s -.

More than **14,000 mothers** enrolled during pregnancy monitored health and development of their children

The ALSPAC families have provided a vast amount of **genetic and environmental information** over the years.

This resource is assisting scientists all over the world with research into a **Wide range of health problems.**



USE IN RAISING AWARENESS CAMPAIGNS

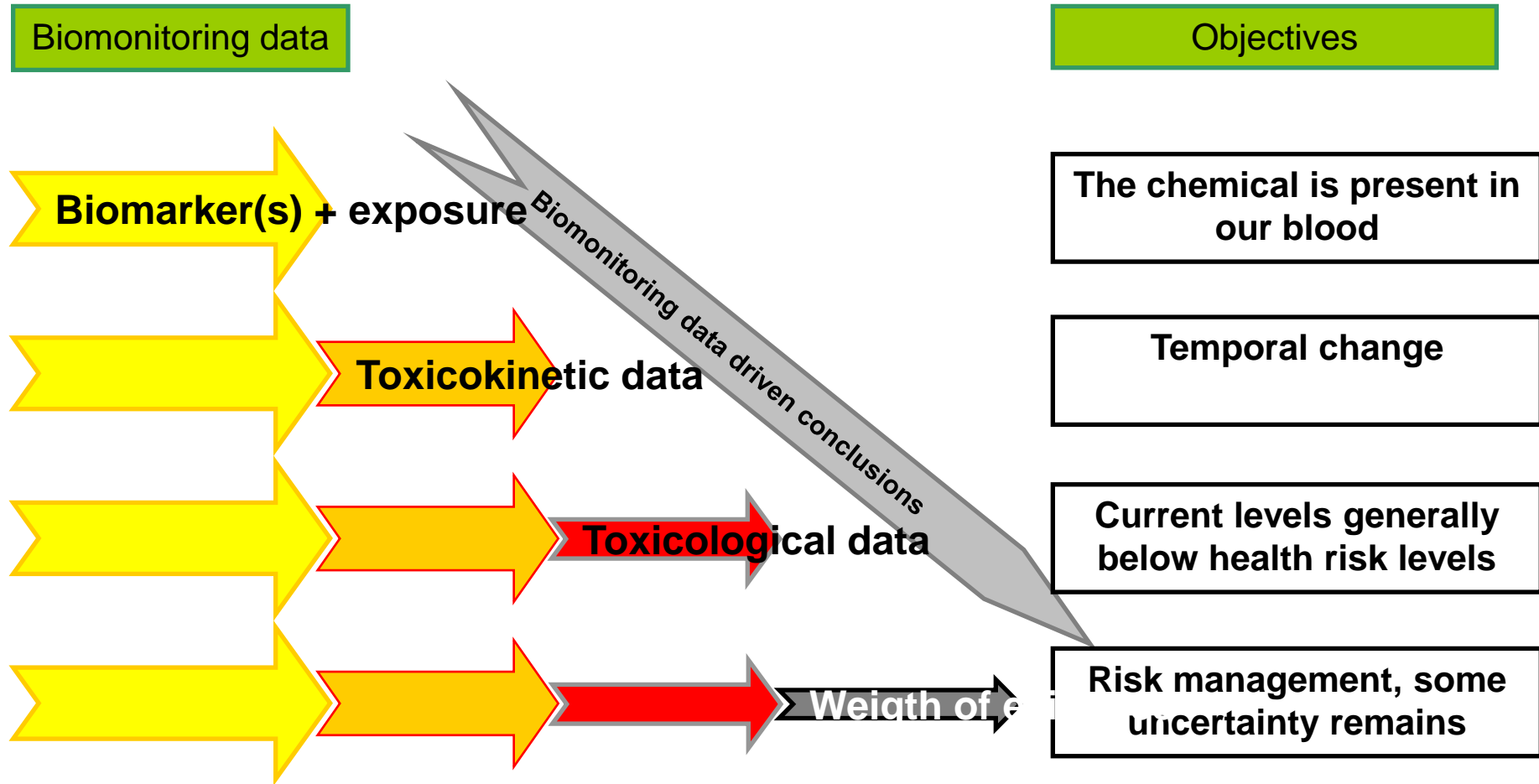


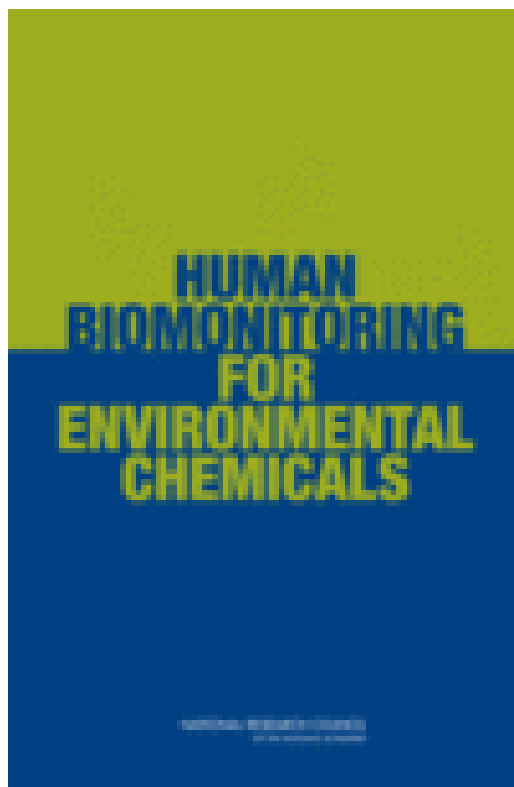
- Hair sampling & testing
- **Illustrative snapshot**
- Target group: Women (18-45), health professionals, leaders
- Volunteers from 21 countries recruited by national coordinators
 - 266 samples received
 - 252 analyzed



*European Parliamentarian
Frederique RIES*

INTERPRETATION IS A CHALLENGE





“The ability to generate new biomonitoring data often exceeds the ability to evaluate whether and how a chemical measured in an individual or population may cause a health risk or to evaluate its sources and pathways of exposure” (NRC, 2006)

Scientists, policy-makers, and the public are just beginning to grasp the tremendous **ethical and communication challenges** that the biomonitoring data are creating”.

COMMUNICATION OF RESULTS



- AT INDIVIDUAL LEVEL TO THE RESEARCH PARTICIPANT
- TO A WIDER PUBLIC
- TO THE GENERAL POPULATION
- TO POLICY MAKERS

WHO POPs SURVEY IN BREAST MILK

- HBM results show that breast milk contains many pollutants
- decrease of body burden mother
- anxious reactions in mothers and in general public.
- Breast-feeding offers many advantages to both babies and mothers: protection for allergies and sickness; comfort, physical closeness, ...

Breast-feeding is considered the preferred method of feeding babies !

Should results be communicated, at individual level, at population level? How not to overestimate the risks and downplay the benefits?

THE POWER OF HBM

- More than classical environmental measurements it gets pollution personal
- Testing is a message

10 BINNENLAND

DE STANDAARD VRIJDAG 17 JUNI 2005



transport nog via loden buizen gebeurt.

De resultaten van dit gezondheidsonderzoek komen overeen met de vervuiling die eerder (onder meer in 1999) via milieustudies in kaart is gebracht. Dat is niet het geval voor de onverwachte vervuiling die in het landelijke West- en Oost-Vlaanderen is vastgesteld.

Daar is bij de pasgeborenen een verhoogde vervuiling vastgesteld van dioxines, pcb's en pesticiden zoals DDE, een restproduct van het bekende DDT. Die bestrijdingsmiddelen zijn bij wet verboden, maar de resultaten in het landelijke Vlaanderen laten vermoeden dat DDT of andere niet-afbreekbare pesticiden nog illegaal worden gebruikt.

WORDT ER NOG ILLEGAAL DDT GEBRUIKT?

De fruitstreek van Limburg is inmiddels overgeschakeld op meer milieuvriendelijke, afbreekbare bestrijdingsmiddelen. Dat blijkt ook uit de resultaten: daar is geen verhoogde vervuiling vastgesteld.

Over het algemeen is de vervuiling door chloorverbindingen (dioxine, pcb's) de jongste jaren gedaald in Vlaanderen. Ze ligt lager dan in de andere landen van Europa. Minister Peeters schrijft dat toe aan de strengere uitstootnormen voor bedrijven en verbrandingsovens. Toch „blijft waakzaamheid geboden”, onder meer omdat in het bloed van de moeders vervuilende stoffen zijn aangetroffen die dicht toen of zelfs licht boven de aan-

In industriegebieden is de concentratie vervuilende stoffen bij baby's niet hoger dan gemiddeld. © Wim Kempenaers

ANTWERPSE AGGLOMERATIE EN LANDELIJK VLAANDEREN ZIJN STERKST VERVUILD

Vlaamse baby's hebben veel cadmium in bloed

CHALLENGES FOR COMMUNICATION

- How to deal with the 'right to know' of the study participants when the links with health risks, especially at the individual level, are not well defined?
- How to feed public debate/raise awareness, without raising unnecessary alarm?
- How to report (uncertainty) to the relevant authorities?
- How to assure accurate translation of results into policy?



DATA PROTECTION IS HIGHLY DEVELOPED IN THE EU

Central piece: [Directive 95/46/EC](#)

Regulates the protection of individuals with regard to the processing of personal data and the free movement of such data.

Framework law,

Implemented into national laws

applies to all EU MS, as well as to Iceland, Liechtenstein and Norway.



RIGHTS OF THE STUDY SUBJECT

RIGHT OF INFORMATION

whether or not the data have been obtained directly from the data subject

- that their personal data are processed and for which purpose.
- the identity of the controller
- the purpose(s) of the processing
- the recipients
- as well as the existence of the **right of access to data and the right to rectify the data.**

RIGHTS OF THE STUDY SUBJECT

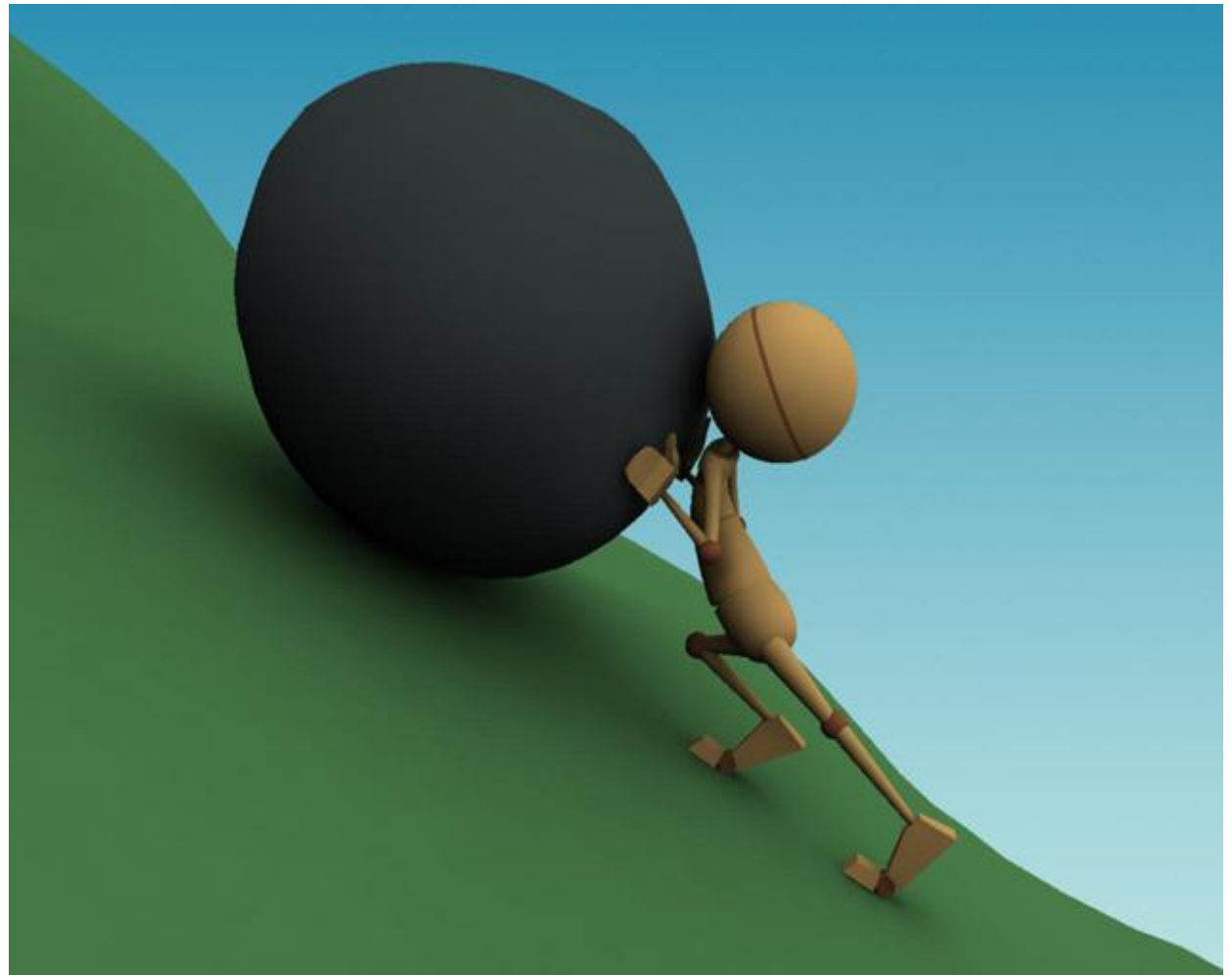
RIGHT OF ACCESS

- the confirmation that data related to him/her are being processed
- the purpose(s)
- *communication in an intelligible form of the data undergoing processing and of information regarding the processing.*

RIGHT OF RECTIFICATION

- the right to obtain from the controller the rectification without delay of inaccurate or incomplete personal data
- an essential complement to the right of access and important to maintain a high level of data quality.

STEPS FORWARD IN FILLING THE GAPS



German Initiative to Support Human Biomonitoring

German Chemical
Industry Association
(VCI)

Federal Ministry for
the Environment,
Nature Conservation
and Nuclear Safety

Federal
Environment
Agency

Steering Group:
representatives from industry,
ministry and agency

Expert Group:
scientists from research
institutes, industry and
federal agencies

Communication team:
representatives from
industry, ministry and
agency

German Initiative to Support Human Biomonitoring II

- **Goal:** to increase the knowledge on the internal exposure to chemicals of the general population
- **New analytical methods** for 50 chemicals during 10 years
- **Substances** with
 - a) a potential health relevance or
 - b) to which the general population might potentially be exposed to a considerable extent.
- **VCI:** development of new HBM methods,
- **BMU:** applying methods in population based HBM studies
- 3 year pilot phase
- Agreement signed in February 2010

The first 5 substances to start with

- Plasticiser **di(2-propyl heptyl)phthalate (DPHP)**
- Phthalate substitute **DINCH**
- Flame retardant **hexabromocyclododecane (HBCD)**, PBT
- Plastic stabiliser **2,2',6,6'-Tetra-tert-butyl-4,4'-methylendiphenol**
- Lubricant additive **dodecylphenol**, a close relative of restricted nonylphenol ethoxylate

Background Incidence of Key Biomarkers of Chemical Exposure -General UK population



Len Levy (len.levy@cranfield.ac.uk), Institute of Environmental Health and
John Cocker (john.cocker@hsl.gov.uk) Health Safety Laboratory*

**sponsored by the Cefic (European Chemical Industry Council)
Long-range Research Initiative (LRI-D2.1-MRCI-0405)*

- **Biological Monitoring by post**
- **Approved by Ethics Committee**
- **Volunteers selected from electoral register (>18 years old)**
- **>5500 invitation letters sent**
- **Lifestyle questionnaire**
- **Urine samples from 358 (8.3%)**
- **Results published 2009**

Chemical	Urinary biomarker
Benzene	S-Phenylmercapturic acid (S-MA)
Cadmium	Cadmium
Caffeine	Caffeine
Chlorinated hydrocarbons	Trichloroacetic acid (TCAA)
Dithio-carbamates	Ethylene thiourea (ETU)
Mercury	Mercury
Naphthalene	1-Naphthol, 2-Naphthol
Nicotine	Cotinine
Di-(2-ethylhexyl) phthalate (DEHP)	Secondary phthalate metabolites – Mono (2-Ethyl-5-Hydroxyhexyl) Phthalate (5OH-MEHP), Mono-(2-Ethyl-5-Oxohexyl) Phthalate (5oxo-MEHP)
Pyrethroids, synthetic	Cis- and trans-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylic acid (c/t-Cl ₂ CA) 3-Phenoxybenzoic acid (3-PBA)
Xylene	Methyl-hippuric acid (MHA)

Ovnair Sepai, HPA

PARTNERSHIP ACADEMIA INDUSTRY GOVERNMENT

Credibility of the communicator is key
(perceived as) trustworthy - impartial

Hampered by some bad experiences such as



- the denial of smoking causing lung cancer
- the denial of asbestos causing mesothelioma and cancer
- opposition to lowering the benzene exposure limit value for workers in the USA

**PARTNERSHIP ACADEMIA INDUSTRY GOVERNMENT AND
COMMUNITY**

CONSENSUS CONFERENCE

December 11, 2006

Measuring Chemicals in People – What Would *You* Say?

A Boston Consensus Conference on Biomonitoring

Boston University School of Public Health

www.biomonitoring06.org

We, the members of the lay panel of the Boston Consensus Conference on Biomonitoring, have spent the last two months considering the exposure of people to chemicals and the related risks associated with them.

PARTNERSHIP ACADEMIA INDUSTRY GOVERNMENT AND COMMUNITY

We recognize the many difficult questions biomonitoring presents. Therefore, we have identified and agreed on the following five priority areas of concern as warranting further exploration and consideration as the use of human biomonitoring expands. They include:

- *Establishing responsible surveillance programs;*
- *Using biomonitoring data to influence corporate*
- *and government behavior;*
- *Educating the general public about biomonitoring*
- *Addressing the issues of ethics, confidentiality and*
- *disclosure; and*
- *Final thoughts on public policy.*

STEPS TOWARDS EU HARMONISATION



Starting point

HBM Studies in some countries

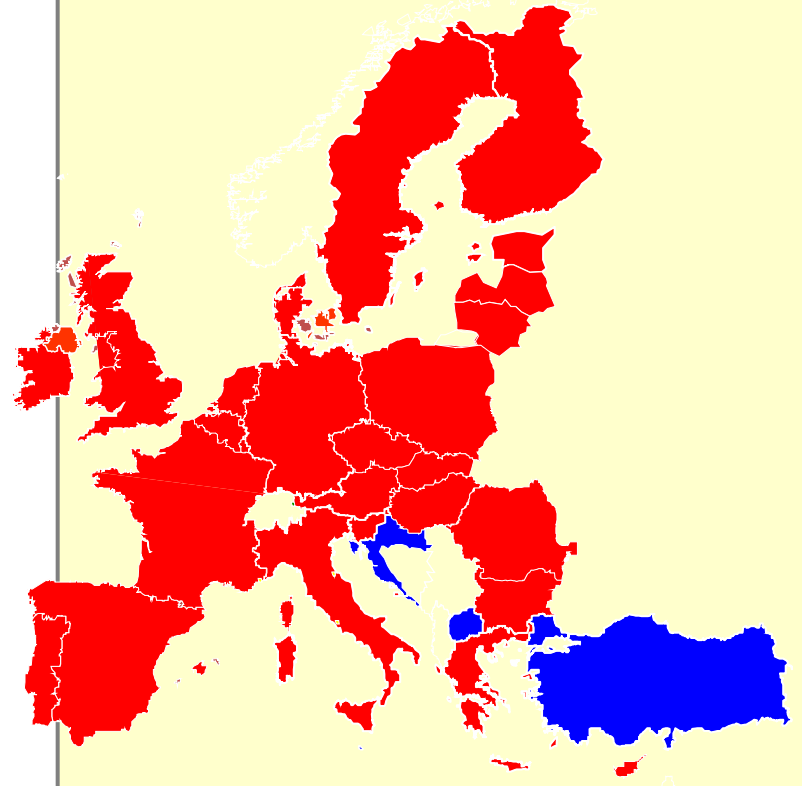
- different chemicals
- different methods
- different objectives
- different population samples
- different study designs
- different questionnaires



- no comparable data
- insufficient knowledge
- **not co-ordinated or harmonized**

EU = Community of 27

different Member States



map of EU: wikimedia commons

A EU-HBM-PILOT STUDY

Aim: test the hypothesis that HBM can be performed in a coherent and harmonized approach

- develop **guidelines**, scientific tools
- produce reliable and **comparable** data
- use **resources** efficiently

Biomarkers selected

Cotinine in urine

Cadmium in urine

Phthalate metabolites in urine

Mercury in scalp hair

Partnership

Academia

NGO's

Industry

Governments

STUDY DESIGN

- **Target group:** children 6-11 years, mother-child-pairs
- N = 120 from each Member State
- **Instruments:** specimen samples, questionnaires
- **Sampling area:** rural and urban (?)
- **Selection:** population registries / schools
- **Immigration status:** according to language ability

Umweltbundesamt
ROBERT KOCH INSTITUT

Studie zur Umweltbelastung von Kindern in Deutschland

Interviewgesteuerter Fragebogen an die Eltern

ICM: Kind(er)stiftung

Datum der Befragung: .../.../200...

Begleithe: .../.../...

Wohnort und Wohnung

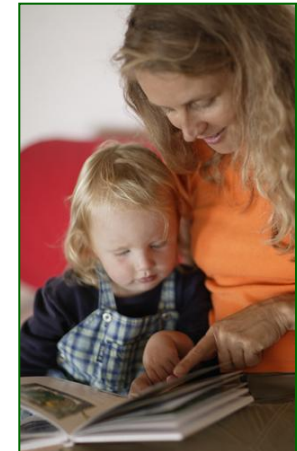
1. Seit wann wohnt Ihr Kind in ...?

Interviewer: Gemeinde / Stadt eintragen und nachlesen!

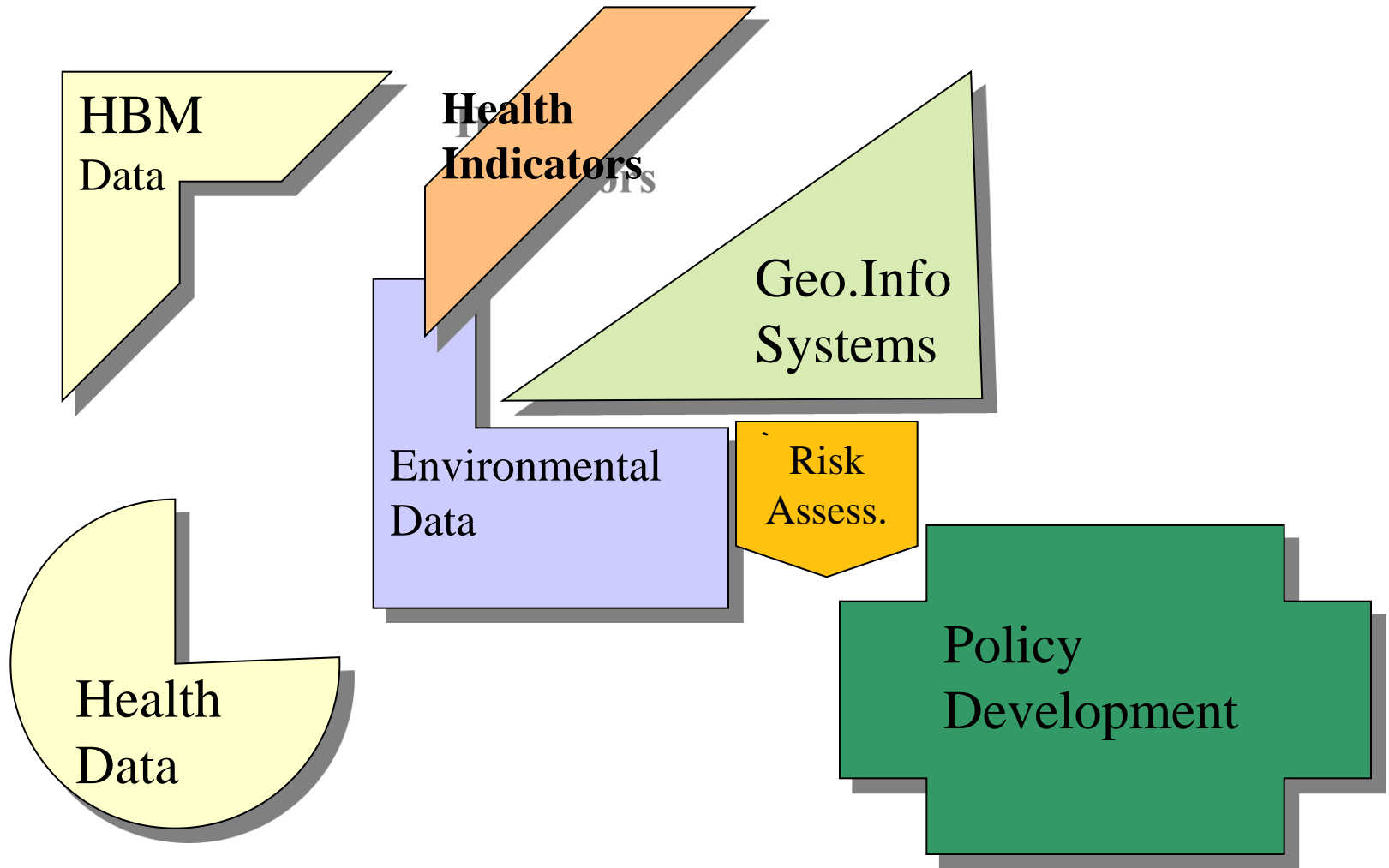
seit ... Jahren ...

2. Seit wann besuchst Ihr Kind diese Vorklasse/Grundschule?

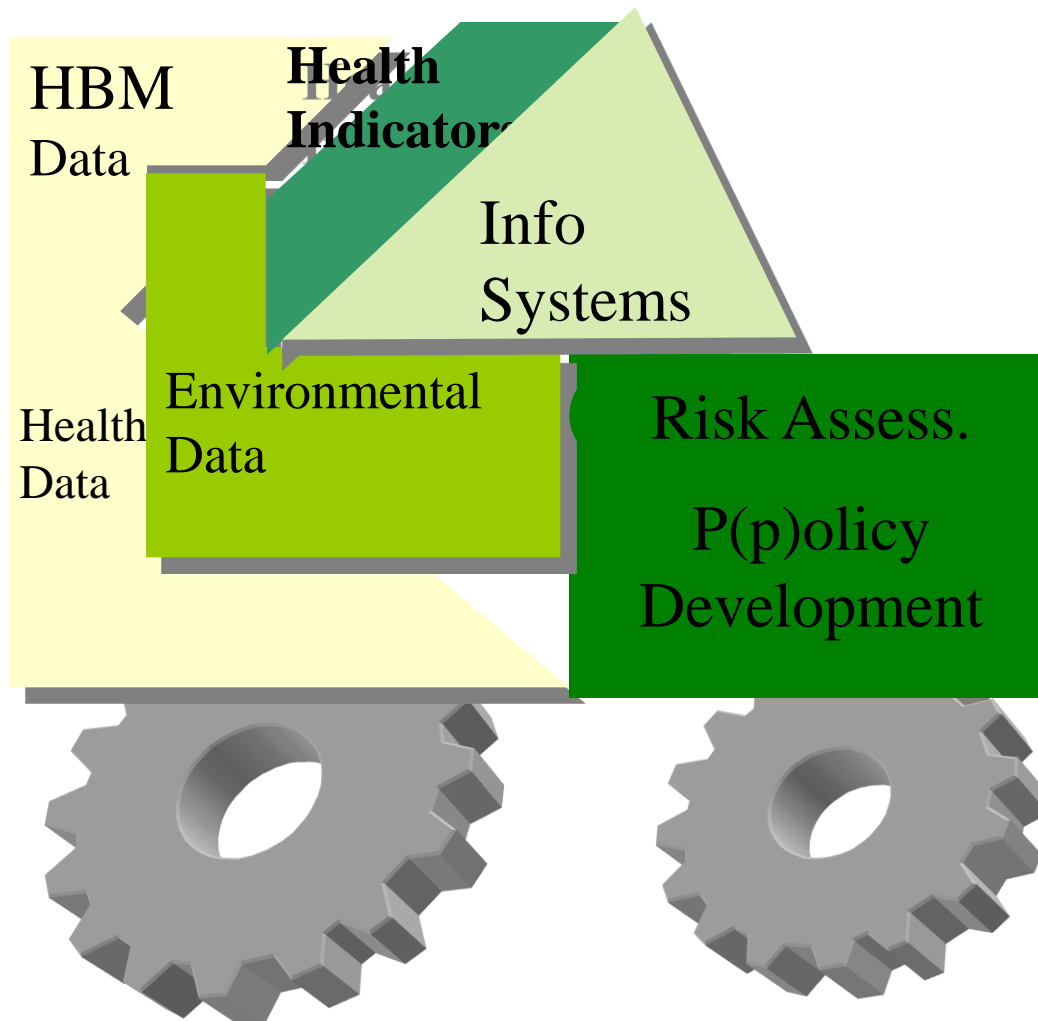
seit ... Jahren ...



CONCLUSION (1)



VISION - Integrated approach



CONCLUSION (2)

- PARTNERSHIP
- TRUST AND CONFIDENCE
- TRANSPARENCY
- (....)



Thank you for your attention !

Acknowledgments to partners in COPHES/DEMOCOPHES

Special thanks to
Marike Kolossa – Gehring (UBA)
Ovnair Sepai (HPA)

www.eu-hbm.info

www.eu-humanbiomonitoring.org

[ludwine,casteleyen@med,kuleuven,be](mailto:ludwine,casteleyen@med.kuleuven.be)

COPHES and DEMOCOPHES are funded by the
European Commission (FP7 grant agreement 244237)
and LIFE+ (grant agreement LIFE09 ENV/BE/000410)



Consortium to Perform
Human Biomonitoring on a
European scale

