Human Biomonitoring

Nutzen für die Politik – Herausforderung für die Wissenschaft

Political benefits – scientific challenges

# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme</td>
<td>7</td>
</tr>
<tr>
<td>Abstracts</td>
<td>12</td>
</tr>
<tr>
<td><em>Endocrine disrupters and reproductive health: a serious research challenge</em></td>
<td>12</td>
</tr>
<tr>
<td>Niels E. Skakkebaek</td>
<td></td>
</tr>
<tr>
<td>Panel discussion: Potential and limitations of HBM</td>
<td>13</td>
</tr>
<tr>
<td><em>HBM: A tool to frame the early REACH debate</em></td>
<td>13</td>
</tr>
<tr>
<td>Elizabeth Salter Green</td>
<td></td>
</tr>
<tr>
<td><em>Imprecision matters!</em></td>
<td>14</td>
</tr>
<tr>
<td>Philippe Grandjean</td>
<td></td>
</tr>
<tr>
<td><em>Don’t Panic!</em></td>
<td>15</td>
</tr>
<tr>
<td>Gabriele Leng</td>
<td></td>
</tr>
<tr>
<td><em>Yes, we can!</em></td>
<td>16</td>
</tr>
<tr>
<td>Jürgen Angerer</td>
<td></td>
</tr>
<tr>
<td><em>Not yet for Europe!</em></td>
<td>17</td>
</tr>
<tr>
<td>Reinhard Joas</td>
<td></td>
</tr>
<tr>
<td>Session 1: Lessons learned from existing programmes</td>
<td>18</td>
</tr>
<tr>
<td><em>NHANES - National Health and Nutrition Examination Survey</em></td>
<td>18</td>
</tr>
<tr>
<td>Larry L. Needham</td>
<td></td>
</tr>
<tr>
<td><em>Two cycles of the Flemish HBM programme (2002-2010): What are we learning?</em></td>
<td>19</td>
</tr>
<tr>
<td>Greet Schoeters</td>
<td></td>
</tr>
<tr>
<td><em>HBM in the Czech Republic – goals, tools, utilization and limitations</em></td>
<td>20</td>
</tr>
<tr>
<td>Milena Cerna</td>
<td></td>
</tr>
<tr>
<td><em>Environmental surveys, specimen bank and health related environmental monitoring in Germany</em></td>
<td>21</td>
</tr>
<tr>
<td>Marike Kolossa-Gehring</td>
<td></td>
</tr>
<tr>
<td>Session II: Future challenges and emerging programme</td>
<td>22</td>
</tr>
<tr>
<td><em>News and Perspectives of the French HBM programmes</em></td>
<td>22</td>
</tr>
<tr>
<td>Nadine Fréry</td>
<td></td>
</tr>
<tr>
<td><em>Introduction of Korean HBM and some of findings</em></td>
<td>23</td>
</tr>
<tr>
<td>Jong-Tae Lee</td>
<td></td>
</tr>
<tr>
<td><em>Biomonitoring of environmental chemicals in Canada - first results of the Canadian Health Measures Survey</em></td>
<td>24</td>
</tr>
<tr>
<td>Douglas Haines, J. Murray</td>
<td></td>
</tr>
<tr>
<td>Topic</td>
<td>Page</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td><strong>Biomonitoring in Israel: Past, Present, Future</strong></td>
<td>25</td>
</tr>
<tr>
<td>Tamar Berman</td>
<td></td>
</tr>
<tr>
<td><strong>Heavy metals and persistent organic pollutants in placenta and birth defects</strong></td>
<td>26</td>
</tr>
<tr>
<td>Aiguo Ren</td>
<td></td>
</tr>
<tr>
<td><strong>Use of biomarkers to understand environmental exposure of women at high altitude in Peru</strong></td>
<td>27</td>
</tr>
<tr>
<td>Manuel Aguilar-Villalobos</td>
<td></td>
</tr>
<tr>
<td><strong>Session III: HBM and health effects</strong></td>
<td>28</td>
</tr>
<tr>
<td><strong>The use of human biomonitoring and environmental samples in the US National Children's Study</strong></td>
<td>28</td>
</tr>
<tr>
<td>James Quackenboss</td>
<td></td>
</tr>
<tr>
<td><strong>Outline of Japan Environment and Children's Study focusing on environmental chemicals and child health</strong></td>
<td>29</td>
</tr>
<tr>
<td>Hiroshi Satoh</td>
<td></td>
</tr>
<tr>
<td><strong>9 months that last a lifetime. Experience from the Danish Pregnancy/Birth Cohort</strong></td>
<td>30</td>
</tr>
<tr>
<td>Joern Olsen</td>
<td></td>
</tr>
<tr>
<td><strong>Biomonitoring, chemical exposures and human health</strong></td>
<td>31</td>
</tr>
<tr>
<td>Antonia M. Calafat</td>
<td></td>
</tr>
<tr>
<td><strong>Session IV: Risk assessment of HBM data</strong></td>
<td>32</td>
</tr>
<tr>
<td><strong>Effect biomarkers: too late for action?</strong></td>
<td>32</td>
</tr>
<tr>
<td>Ovnair Sepai</td>
<td></td>
</tr>
<tr>
<td><strong>Interpreting human biomonitoring data in a public health risk context using Biomonitoring Equivalents</strong></td>
<td>33</td>
</tr>
<tr>
<td>Sean Hays</td>
<td></td>
</tr>
<tr>
<td><strong>Guidance value derivation in HBM - scope and limits</strong></td>
<td>34</td>
</tr>
<tr>
<td>Michael Wilhelm</td>
<td></td>
</tr>
<tr>
<td><strong>Session V: Going global - do we need global HBM?</strong></td>
<td>35</td>
</tr>
<tr>
<td><strong>HBM as a tool in the assessment of climate change and health effects</strong></td>
<td>35</td>
</tr>
<tr>
<td>Jon Oeyvind Odland</td>
<td></td>
</tr>
<tr>
<td><strong>A plea for Human Biomonitoring in Africa</strong></td>
<td>36</td>
</tr>
<tr>
<td>Jerome Nriagu</td>
<td></td>
</tr>
<tr>
<td><strong>HBM as a link between health and environment in Europe</strong></td>
<td>37</td>
</tr>
<tr>
<td>Ludwine Casteleyn</td>
<td></td>
</tr>
<tr>
<td><strong>Human exposure to POPs in Vietnam: Contamination, accumulation characteristics and risk assessment for infants</strong></td>
<td>38</td>
</tr>
<tr>
<td>Pham Hung Viet</td>
<td></td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Panel discussion: The political dimension of HBM</td>
<td>39</td>
</tr>
<tr>
<td>Using human biomonitoring to help evaluate public policies</td>
<td>39</td>
</tr>
<tr>
<td>Ruth Etzel</td>
<td></td>
</tr>
<tr>
<td>Contribution of the Chemical Industry to Human Biomonitoring</td>
<td>40</td>
</tr>
<tr>
<td>Gerd Romanowski</td>
<td></td>
</tr>
<tr>
<td>Integrating HBM in environment and health assessments – the EEA</td>
<td>41</td>
</tr>
<tr>
<td>perspective</td>
<td></td>
</tr>
<tr>
<td>Dorota Jarosinska</td>
<td></td>
</tr>
<tr>
<td>Statements of the European Commission</td>
<td>42</td>
</tr>
<tr>
<td>Peter Pärt</td>
<td></td>
</tr>
<tr>
<td>Dr. Karl Freese</td>
<td></td>
</tr>
<tr>
<td>Health and Environment Alliance (HEAL) Statement</td>
<td>43</td>
</tr>
<tr>
<td>Lisette van Vliet</td>
<td></td>
</tr>
<tr>
<td>UNEP’s needs for and implementation of HBM - the POPs example</td>
<td>44</td>
</tr>
<tr>
<td>Heidelore Fiedler</td>
<td></td>
</tr>
<tr>
<td>Chairs and speakers in alphabetical order</td>
<td>46</td>
</tr>
<tr>
<td>Curricula Vitae</td>
<td>48</td>
</tr>
<tr>
<td>Poster Abstracts</td>
<td>74</td>
</tr>
<tr>
<td>List of Authors</td>
<td>74</td>
</tr>
<tr>
<td>1.1 Biomonitoring of Exposure to Hazardous Materials from Foods</td>
<td>76</td>
</tr>
<tr>
<td>Consumption in Korea - Study design and baseline characteristics</td>
<td></td>
</tr>
<tr>
<td>Kyoung-Ho Lee</td>
<td></td>
</tr>
<tr>
<td>1.2 Mercury, Lead and Cadmiun levels in urine of 170 Adults living in</td>
<td>77</td>
</tr>
<tr>
<td>Madrid (Spain): A pilot Human Biomonitoring Study</td>
<td></td>
</tr>
<tr>
<td>Argelia Castaño</td>
<td></td>
</tr>
<tr>
<td>1.3 Biomonitoring Study of Children Exposed to Different Levels of</td>
<td>78</td>
</tr>
<tr>
<td>Pollution in the Hainaut Province</td>
<td></td>
</tr>
<tr>
<td>Marie-Christine Dewolf</td>
<td></td>
</tr>
<tr>
<td>1.4 Human Biomonitoring – Pollution gets Personal! Studies of the</td>
<td>79</td>
</tr>
<tr>
<td>Environment Agency Austria</td>
<td></td>
</tr>
<tr>
<td>Philipp Hohenblum</td>
<td></td>
</tr>
<tr>
<td>1.5 First Nations Biomonitoring Initiative</td>
<td>81</td>
</tr>
<tr>
<td>Stuart Wuttke</td>
<td></td>
</tr>
<tr>
<td>1.6 Human biomonitoring national programme development in Slovenia</td>
<td>82</td>
</tr>
<tr>
<td>Lucija Perharic</td>
<td></td>
</tr>
<tr>
<td>1.7 Harmonised Human Biomonitoring in Europe – activities towards an</td>
<td>83</td>
</tr>
<tr>
<td>EU HBM framework</td>
<td></td>
</tr>
<tr>
<td>Alexandra Polcher</td>
<td></td>
</tr>
<tr>
<td>1.8 The German Environmental Specimen Bank – Human specimens</td>
<td>84</td>
</tr>
<tr>
<td>Gerhard A. Wiesmüller</td>
<td></td>
</tr>
</tbody>
</table>
2.1 The perinatal archive of the German Environmental Specimen Bank: Internal exposure of the newborn with phthalate metabolites
Lorenz Dobler

2.2 In utero exposure to pesticides as measured in meconium – a preliminary study
Radu - Corneliu Duca

2.3 The perinatal archive of the German Environmental Specimen Bank: Body burden of the newborn
Andreas K. Günsel

2.4 Biomonitoring methods to assess exposure of infants to the mycotoxin ochratoxin A through human milk in mother-child pairs
Katherine Muñoz

2.5 Lead levels in umbilical cord blood in selected maternity units of Belgium in 2004 and 2007
Wei-Hong Zhang

3.1 Human biomonitoring to assess exposure of Norwegian infants to perfluorinated compounds
Georg Becher

3.2 Urinary isoflavone phytoestrogens in German children and adolescents - a longitudinal examination in the DONALD cohort
Gisela H. Degen

3.3 Biomonitoring of Perfluorinated Compounds (PFC) in Adults and Children Exposed to Contaminated Drinking Water in Germany – Results of the Recent Follow-up Studies
Jürgen Hölder

3.4 Human biomonitoring of endocrine disrupters and reproductive health: the Italian PREVIENI project
Cinzia La Rocca

3.5 Human biomonitoring in a case of PFC contamination of private drinking water wells
Odulf Weiß

3.6 Retrospective analysis of body burden of perfluorinated compounds in German young adults: Time trends between 1982 and 2007
Gerhard A. Wiesmüller

4.1 Environmental chemical hazards and their impact on senior citizens
Diane Langel

4.2 Decrease of internal exposure to organochlorine compounds and heavy metals in children in Baden-Württemberg between 1996/97 and 2008/09
Bernhard Link

4.3 Concentrations and determinants of organochlorine levels among pregnant woman in Eastern Spain
Sabrina Llop

4.4 Human versus environmental biomonitoring of PCB and HCB based on Saxony, Germany data
Marchela Pandelova

5.1 Use of personal care products and exposure to musks, parabens and triclosan
Elly Den Hond
5.2 External quality assessment of human biomonitoring in environmental exposure levels
Thomas Göen

5.3 Allocation of reliable analytical procedures for human biomonitoring by the Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area of the DFG
Thomas Göen

5.4 Cadmium, Mercury and Phthalates environmental exposure in Lithuania
Regina Grazuleviciene

5.5 O-Nitrophenol in Human Urine Samples - Human Biomonitoring Following a Major O-Nitroanisole Accident in Germany
Axel Hahn

5.6 PBDE in Blood of Children in Baden-Württemberg between 2002/03 and 2008/09
Bernhard Link

5.7 Determination of 2,5-toluylenediamine (2,5-TDA) and aromatic amines in urine after personal application of hair dyes – kinetics and doses
Thomas Schettgen

5.8 Use of on-line SPE-UPLC-MS-MS technique to strengthen and economize human biomonitoring studies
Koen De Cremer

6.1 Italian biomonitoring survey for metals in adults and children
Alessandro Alimonti

6.2 Human Biomonitoring (HBM) as a pragmatic tool to support risk management of chemicals under REACH
Peter J. Boogaard

6.3 Expert Judgement of Poisonings and Human Biomonitoring - The BFR 3-Level and Matrix Model
Axel Hahn

6.4 Simulation of blood and urine levels of multiple chemicals with a generic PBTK-model in MS-Excel following inhalation and/or oral intake and/or dermal exposure
Frans J. Jongeneelen

6.5 Reference values for lead, cadmium and mercury in blood of adults from the metropolitan area of Sao Paulo (Brazil)
Rubia Kuno

6.6 Combination of linear regression and decision trees for estimating variance components of internal human exposure
Antje Müller

6.7 The German Human Biomonitoring Commission – Reference and Human Biomonitoring Values
Christine Schulz

6.8 The Austrian Platform for Human Biomonitoring
Maria Uhl

List of Participants
Human Biomonitoring

Nutzen für die Politik – Herausforderung für die Wissenschaft

Political benefits – scientific challenges


Programme
**Sunday, 26 September 2010**

17:00 Registration

18:00 - 20:00 **Welcome reception with scientific appetizer**

**Welcome address**

Alexander Nies, Deputy Director General, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety /DE

*Endocrine disrupters and reproductive health: A serious research challenge*

Niels Erik Skakkebæk, University Hospital /DK

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**Monday, 27 September 2010**

8:30 Registration

9:30 **Human Biomonitoring – Its political benefits***

Dr. Norbert Röttgen, Federal Minister for the Environment, Nature Conservation and Nuclear Safety /DE (opening speech)

10:15 **Human Biomonitoring - Challenges for Science***

Jochen Flasbarth, President of the Federal Environment Agency /DE

10:30 Coffee break and poster viewing

11:00 - 12:30 **Panel discussion***: Potential and limitations of HBM

Moderation: Andreas Gies, Federal Environment Agency /DE

Elizabeth Salter Green, Chemicals, Health and Environment Monitoring Trust /UK

Philippe Grandjean, Harvard University /US

Gabriele Leng, Currenta GmbH /DE

Jürgen Angerer, Ruhr-University Bochum /DE

Reinhard Joas, BiPRO GmbH /DE

12:30 - 13:30 Lunch and poster viewing

*German/English interpretation*
Monday, 27 September 2010

13:30 - 15:20  Session I: Lessons learned from existing programmes
Chair: Michael Wilhelm, Ruhr-University Bochum /DE
Co-Chair: Jim Quackenboss, Environment Protection Agency /US

13:30  NHANES - National Health and Nutrition Examination Survey
Larry L Needham, Centers for Disease Control and Prevention /US

13:55  Two cycles of the Flemish HBM programme (2002-2010): What do we learn?
Greet Schoeters, Flemish Institute for Technological Research /BE

14:20  HBM in the Czech Republic – goals, tools, utilization and limitations
Milena Černá, National Institute for Public Health /CZ

14:45  Environmental Surveys, specimen bank and health-related environmental monitoring in Germany
Marike Kolossa-Gehring, Federal Environment Agency /DE

15:10  Summary: Jim Quackenboss

15:20 - 16:00  Coffee break and poster viewing

16:00 - 18:45  Session II: Future challenges and emerging programmes
Chair: Louis Bloemen, Environmental Health Service International /NL
Co-Chair: Ovnair Sepai, Health Protection Agency /UK

16:00  News from and perspectives of the French HBM programme
Nadine Frery, Institut de Veille Sanitaire /FR

16:25  The development and the current status of HBM in Korea
Jong-Tae Lee, Hayang University /KR

16:50  Biomonitoring of environmental chemicals in Canada - first results of the Canadian Health Measures Survey
Douglas Haines, Health Canada /CA

17:15  Human Biomonitoring in Israel: Past, present and future
Tamar Berman, Health Ministry /IL

17:40  Heavy metals and POPs in placentas and their impact on the health of newborns
Aiguo Ren, Peking University /CN

18:05  Use of biomarkers to understand environmental exposure of women at high altitude in Peru
Manuel F. Aguilar-Villalobos, Asociación del Aire Ambiental /PE

18:30  Summary: Ovnair Sepai

18:45  End of first day / Closing remarks
Marike Kolossa-Gehring, Federal Environment Agency /DE
Tuesday, 28 September 2010

9:00 - 10:50  Session III: HBM and health effects
Chair: Martin Schlaud, Robert Koch Institute /DE
Co-Chair: Lisbeth E. Knudsen, University of Copenhagen /DK

9:00  The use of human biomonitoring and environmental samples in the US National Children’s Study
Jim Quackenboss, Environment Protection Agency /US

9:25  Outline of Japan’s Environment and Children’s Study focusing on environmental chemicals and children’s health
Hiroshi Satoh, Tohoku University Tokio /JP

9:50  Ten years of experience with the Danish National Birth Cohort (DNBC)
Jorn Olsen, Aarhus University /DK

10:15  Biomonitoring, chemical exposures and human health
Antonia M. Calafat, Centers for Disease Control and Prevention /US

10:40  Summary: Lisbeth E. Knudsen

10:50 - 11:20  Coffee break and poster viewing

11:20 - 12:40  Session IV: Risk assessment of HBM data
Chair: Jürgen Angerer, Ruhr-University Bochum /DE
Co-Chair: Philippe Grandjean, Harvard University /US

11:20  Effect biomarkers: too late for action?
Ovnair Sepai, Health Protection Agency /GB

11:45  Interpreting biomonitoring data in a public health risk context using Biomonitoring Equivalents
Sean M. Hays, Summit Toxicology /US

12:10  Guidance value derivation in HBM - scope and limits
Michael Wilhelm, Ruhr-University Bochum /DE

12:35  Summary: Philippe Grandjean

12:45 - 13:45  Lunch and poster viewing
Tuesday, 28 September 2010

13:45 - 15:15  
**Session V: Going global - do we need global HBM?**
Chair: **Eisaku Toda**, Ministry of the Environment /JP  
Co-Chair: **Dana Boyd Barr**, Emory University /US

13:45  
**HBM as a tool in the assessment of climate change and health effects**  
**Jon Oejvind Odland**, University of Tromsö /NO

14:05  
**A plea for HBM in Africa**  
**Jerome Nriagu**, University of Michigan /US

14:25  
**HBM as a link between health and environment in Europe**  
**Ludwine Casteleyn**, Katholieke Universiteit Leuven /BE

14:45  
**Human exposure to POPs in Vietnam: Contamination, accumulation characteristics, and risk assessment for infants**  
**Pham Hung Viet**, Research Centre for Environmental Technology and Sustainable Development /VN

15:05  
**Summary: Dana Boyd Barr**

15:15 - 15:45  
Coffee break and poster viewing

15:45 - 17.00  
**Panel discussion*: The political dimension of HBM**
**Ruth A. Etzel**, World Health Organisation (WHO)  
**Gerd Romanowski**, Chemical Industry Association (VCI) /DE  
**Dorota Jarosinska**, European Environment Agency  
**Peter Pärť**, European Commission, Joint Research Centre /IT  
**Karl Freese**, European Commission /LU  
**Lisette van Vliet**, Health and Environment Alliance /BE  
**Heidelore Fiedler**, United Nation Environment Programme (UNEP)

17:00  
**Summary: Jochen Flasbarth**

17:15 - 17:30  
**Conclusions of the conference*:**  
**Hubert Steinkemper**, Director General, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety /DE

* German/English interpretation
Human Biomonitoring

Nutzen für die Politik – Herausforderung für die Wissenschaft

Political benefits – scientific challenges


Abstracts
Human biomonitoring of environmental agents becomes meaningless unless it is associated with research in health problems, e.g. acute and chronic diseases, cancer, congenital malformations, developmental problems and reproductive health problems. Endocrine Disrupting Chemicals (EDCs) are currently under investigation with regard to their possible role for widespread incidence of reproductive health problems, including infertility, which is now very common in many industrial countries. In Denmark approximately 8% of all children are born after assisted reproductive techniques (ART) and more than 20% of young men have semen quality in infertile or subfertile range. Therefore, we must expect that the increasing need for ART will continue. In spite of the high number of children born after ART the total number of births is all too low to sustain the population. The low birth number is not due to more induced abortions. In fact, there has also been a drastic reduction in rates of induced abortions. A crucial question is whether the decreasing rates of normal conceptions are due to socio-economic factors alone, or whether biological factors like poor semen quality and female subfertility also play a role. The increasing incidences of testicular cancer, which may be considered a ‘biomarker’ of reproductive health problems in a population, and the recent reports of widespread poor semen quality, suggest that male subfertility may contribute to the low number of children born in Europe and other industrialized countries. The causes of male infertility are most often unknown, but recent animal research suggest that dysgenesis of the developing testis due to endocrine disrupters may not only result in congenital malformations of genitalia, but also in late reproductive effects, e.g. infertility. A similar syndrome, including also testicular cancer, can occur in humans where it has been named Testicular Dysgenesis Syndrome (TDS). The possible etiological role of EDCs for TDS remains to be determined.
Panel discussion: Potential and limitations of HBM

**HBM: A tool to frame the early REACH debate**

Elizabeth Salter Green  
Chemicals Health and Environment Monitoring Trust (CHEM Trust), London, United Kingdom  
(Formerly Director of WWF Toxics Programme)

The WWF HBM campaign began in the UK, then spread to other EU countries, running from 1999 to 2006.

The HBM campaign was a lobbying tool; to raise public awareness and positively influence the EU chemicals review from an environmental and human health perspective.

There were risks; criticism because the numbers analysed were small and accusation of 'scaremongering'.

In 2001, when the Commission’s White Paper had been published, all the media coverage in the UK concerned job losses, driving innovation to the Far East and loss of income. A counter-balance to this one-sided view was needed. There was no thought re chemicals and human health and/or the environment. Surely the EU is there to protect citizens and the environment, and what use are goods and manufacturing if children are not healthy?

WWF’s goal was to show a link between a) consumer product use and b) the food we eat and widespread human contamination with 2 key classes of chemicals; PBTs and hormone disruptors. Our message was ‘we are all unwittingly contaminated’.

Decision-makers began to take and interest. The industry response was muted; they had no response to the clear exhibition of fundamental, broad human contamination.

The external feedback is that WWF’s HBM campaign was an effective tool; leveling the playing field to ‘balance’ the ‘jobs & money’ versus ‘environment & health’ argument during the REACH negotiations.
Imprecision matters!

Philippe Grandjean
Harvard University, Department of Environmental Health, Boston, MA, USA

Quality assurance of exposure biomarkers usually focuses on laboratory performance only, although this is not the only source of variability. Using a large set of data on methylmercury, we have calculated the total imprecision of common exposure biomarkers. From about 1,000 births, we measured mercury concentrations in cord blood, cord tissue, and maternal hair. The exposure biomarkers correlated well with one another, although the cord blood mercury concentration showed the best associations with neurobehavioral deficits in the children when tested at age 7 years, thus suggesting that this parameter is the best risk indicator. Because we had three exposure parameters available, we could conduct factor analysis and structural equation modeling to determine the total imprecision of each biomarker. Cord blood was indeed the best exposure biomarker, as the total imprecision was only 25-30%, while it was almost twice as much for maternal hair. However, both thereby greatly exceeded the normal laboratory variability of less than 5%. Thus magnitude of imprecision can cause underestimation of dose-related toxicity. All exposure biomarkers should therefore be considered proxy indicators of the true exposure, and data analysis should include sensitivity analyses to adjust for this problem. Ignoring preanalytical imprecision may cause serious bias.
Don’t Panic!

Gabriele Leng
Currenta GmbH & Co. OHG, Institute of Biomonitoring, Leverkusen, Germany

Human biomonitoring measures the total body burden of a chemical substance or its metabolites in blood or urine. HBM does not provide information about the source of an exposure, how long a substance has been in the body or what effect, if any, a substance may have on human health. Thus, biomonitoring cannot provide information about the risk or safety of a substance. To interpret biomonitoring data, a comprehensive knowledge of substances including thresholds and reference values is required.

The human body is made up of chemical substances and is exposed to a wide range of naturally occurring and synthetic substances in its environment. Many harmful substances are taken in voluntarily, e.g. through smoking or alcohol consumption. Others are ingested with food or in the course of various leisure activities. In view of all this, it is therefore hardly surprising that a large number of substances can be detected in every human body (blood, urine, etc.). But this does not necessarily mean a health risk. So, Don’t Panic: Detection of a chemical does not automatically mean health risk or hazard – it is the dose which counters.

In the last years many programs the German environmental survey or the US CDC report has been performed to learn more about the presence of different chemical substances. With the help of these data the background level of the population can be found (reference value). Moreover, it is the aim to establish the toxicological based HBM-values. But by now only a handful could be established because of lack of data. Therefore the majority of chemicals found in the body cannot be evaluated. On the individual basis, biomonitoring values without evaluation may leave the individual alone with his values or even may develop anxiety, often reforced by the media.
Human Biomonitoring (HBM) is the determination of chemical substances and their metabolites in human biological material with the aim
- to determine internal exposure and health risk
- to compare results with reference and limit values
- and if necessary to take corrective actions

This definition has been adopted by the EU. According to this definition HBM is a tool
- exposure assessment
- risk assessment
- and risk management

To use HBM for these purposes was an overwhelming success in the 1970ties in connection with the Council Directive on the biological screening of the population for lead (77/312/EEC). At that time, there were hardly a dozen of substances, for which HBM could have been performed. The situation today:
- There are reliable analytical methods to determine practically every biomarker.
- There are reference and limit values for many substances. Admittedly the situation is not as brilliant as in the case of analytical methods.

Main advantages of HBM are that HBM
- accounts for all sources of uptake (air; food, cosmetics etc)
- accounts for all routes of uptake (by inhalation, oral, dermal)
- shows exposures which have so far been unknown
- reveals trends in exposure

In case of an undue exposure of a person or a group of persons, HBM
- replaces exposure calculations and worst case scenarios
- enables reasonable measures
- can be used to control interventions
- contributes to the evaluation of dose-response-relationship

A further possibility of HBM which up till now has not been recognized is that HBM can - because of the sensitivity of modern analytical methods - be used to study human metabolism directly. This is more reliable than animal experiments.

Conclusion: HBM should be conducted wherever possible.
**Not yet for Europe!**

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The potential of Human Biomonitoring (HBM) is obviously manifold and well known in the HBM community. However, still limitations arise when considering Human Biomonitoring on a European level. Recent activities showed that in the EU significant efforts are made to collect biomarker data in environmental health. However, the activities are fragmented and carried out for various purposes. Different population groups are recruited using different protocols and recruitment strategies. Consequently, results cannot be compared nor can health impact assessments be carried out.

The European Environment and Health Strategy as well as the Environment and Health Action Plan 2004 – 2010 of the European Commission recognised the value of HBM and the relevance and importance of coordination of HBM programmes in Europe.

Against this background, a team of experts from 35 institutes covering 27 European countries started recently to work towards a coherent approach to HBM in Europe as requested by Action 3 of the EU Environment and Health Action Plan through coordination of ongoing and planned HBM activities. The project will exploit existing and planned HBM projects and programmes of work and capabilities in Europe and will investigate what is needed to advance and improve comparability of HBM data across Europe. The developed approaches will be tested in a feasibility study funded by DG ENV.

As an overall objective a common understanding within all parties involved on the potential of HMB in supporting and evaluating current and future policy making (including e.g. REACH) and for environmental health awareness raising will be promoted. This project aim is to significantly advance the process towards a fully operational, continuous, sustainable and scientifically sound EU HBM programme.
Session 1: Lessons learned from existing programmes

**NHANES - National Health and Nutrition Examination Survey**

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Researchers are increasingly interested in using biomonitoring – the measurement of environmental chemicals, their metabolites or specific reaction products in biological specimens/body fluids – for investigating exposure to environmental chemicals. Although biomonitoring data per se do not provide information on health effects, general population biomonitoring programs are useful for investigating human exposure to environmental chemicals, and an important tool for integrating environment and health. One of these programs, the National Health and Nutrition Examination Survey (NHANES), conducted annually since 1999 in the United States by the Centers for Disease Control and Prevention is designed to collect data on the health and nutritional status of the noninstitutionalized, civilian U.S. population. NHANES includes a physical examination, collecting a detailed medical history, and collecting biological specimens (i.e., blood from participants one year of age or older and urine from participants ≥6 years old). Although biological specimens are used mostly for clinical and nutritional testing, some can be used to assess exposure to environmental chemicals. Data estimates from NHANES are probability-based, and are representative of the US population. More importantly, NHANES biomonitoring data can be used to establish reference ranges for selected chemicals, provide exposure data for risk assessment, and monitor exposure trends. We will present examples to illustrate the usefulness of NHANES data to assist epidemiologic investigations, to correlate the levels to other NHANES parameters/measurements (including potential health effects), and to identify a) populations with the highest exposures, b) potential sources/routes of exposure, and c) chemicals with highest prevalence/frequency.
Human Biomonitoring

Two cycles of the Flemish HBM programme (2002-2010): What are we learning?

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Since 2002 a human biomonitoring network has been established in Flanders as part of a program on environmental health surveillance. The biomonitoring network should support environmental health policy by identifying priorities for further action. The first cycle of this program (2002-2006) demonstrated that living in areas with different environmental pressure yields a different fingerprint of pollutants in the body hence indicating the importance of region based environmental policies and priorities. We also tested whether the exposure biomarkers were associated with biological effects in order to identify the health relevance of the exposure mixtures. Biomarkers of exposure, biological effect and health effect data were linked at the individual level and dose effect relationships were established. Asthma and allergy, growth and development and cancer were priority for the effect studies. In the first cycle of the program, about 4600 individuals of 8 different geographical areas were recruited including mother child pairs, 14-15 years old students and adults between 50 and 65 years of age. The possibility to obtain geographically differentiated information on environmental health was exploited further in the second cycle of the human biomonitoring program (2007-2011). A participatory process has been used to propose and finally select 2 hot spots of interest for human biomonitoring. The hypotheses will be tested whether in these hot spot areas specific biomonitoring data (exposure and effects) will be different from reference values that have been obtained over Flanders. As part of the second cycle of the biomonitoring program we have obtained reference data for biomarkers in the general population. 200 students, 200 adults and 250 mother child pairs were recruited over Flanders according to a stratified random sampling scheme. The exposure biomarkers included metals, classical persistent organic pollutants, but also perfluorinated compounds, brominated flame retardants, musks, bisphenol A, metabolites from phthalates, parabens and pesticides.

The studies of the Flemish Center of Expertise on Environment and Health are commissioned, financed and steered by the Ministry of the Flemish Community (Department of Economics, Science and Innovation; Flemish Agency for Care and Health; and Department of Environment, Nature and Energy)
**HBM in the Czech Republic – goals, tools, utilization and limitations**

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The Human Biomonitoring (HBM) Project was launched in the Czech Republic in 1994 as part of the nation-wide Environmental Health Monitoring System (EHMS). EHMS involves eight interconnected subprojects and thus makes it possible to integrate all collected data on health risks from environmental stressors in the air, water, food or soil to be available for the assessment of exposure, health risks and health status of the Czech general population. The main objectives of HBM are (a) to map the exposure of the Czech general population, by means of biomarkers, to a broad spectrum of environmental contaminants that enter the body mainly with the diet, (b) to monitor long-term trends, (c) to establish reference values for the general population or population groups, (d) to compare the obtained data with the existing health limits and (e) to generate information for the development of exposure prevention and restriction strategies.

Surprisingly, the questions resulting from the launch of the HBM Project more than 16 years ago were almost identical to those being discussed in the COPHES Project: sampling areas (urban vs. rural and polluted vs. non-polluted), age- and gender-matched population groups, recruitment strategies, questionnaire design, spectrum of biomarkers, matrices, sampling procedures, selection of laboratory methods and reliable laboratories, data storage, statistical analysis and data interpretation. The final scenario, a compromise between the ideal vision of the project and its feasibility, continues to be updated to keep up with the latest advances. The main limitation of the Czech HBM Project is its focus only on urban and suburban populations in four selected regions, but it has the advantages of providing interconnected environmental exposure and health data, of using accredited reference laboratories for analyses of biomarkers and of disseminating the obtained results e.g. in annual reports freely accessible on the web site of NIPH (www.szu.cz).
Environmental surveys, specimen bank and health related environmental monitoring in Germany

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Production of chemicals, use of products and consumer goods, contamination of food as well as today’s living conditions are related to a substantial exposure of humans to chemicals. Safety of human beings and the environment has to be safeguarded by producers and government. Human biomonitoring (HBM) has proven to be a useful and powerful tool to control human exposure and risk assessment.

The Umweltbundesamt (UBA) employs two major HBM tools - the German Environmental Survey (GerES), the German Environmental Specimen Bank (ESB). Both are essential elements of the Health Related Environmental Monitoring (HEM).

GerES is a nationwide population study which has repeatedly been carried out in Germany since the mid-1980s. The main instruments of investigation are HBM in combination with ambient monitoring, and collection of information on exposure pathways and living conditions via questionnaires.

The ESB is a permanent monitoring instrument investigating time trends of environmental pollution, and contamination and fate of chemicals in man and the environmental. It is run jointly by the German Federal Ministry for the Environment, the UBA and specialized research institutes (e.g., for sampling of human, biological, and abiotic material, trace analysis of pollutants, biobanking).

The HEM also focuses on exploring causal relations between environmental exposure and human health by cohort studies or by analyzing perinatal samples.

Additionally UBA is involved in different co-operation networks, the two most prominent of which are 1) the harmonization of HBM in Europe (COPHES) and 2) the co-operation between the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and German Chemical Industry Association (VCI). In this project emphasis will be placed on substances with a potential health relevance and on substances to which the general population might potentially be exposed to a considerable extent and for which HBM methods are not available up to now.
Session II: Future challenges and emerging programme

News and Perspectives of the French HBM programmes

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Since the 80ies in France, biomonitoring studies have been conducted to improve our understanding of human exposures to environmental chemicals and to orient and monitor reducing policies.

Until recently, however, only specific populations (children, young adults, people exposed to a specific source) or pollutants (lead, cadmium, arsenic, dioxins, PCBs) had been surveyed.

A recent national population-based biomonitoring survey, the ENNS Study conducted by the French Institute for Public Health Surveillance (InVS), provides a first estimate of the French population exposure to several pollutants (metals, pesticides, NDL-PCBs). Forty two biomarkers of exposure were measured in blood, urine and hair. Results show rather low levels for heavy metals and organochlorinated pesticides (similar to those observed in other countries). For PCBs and other pesticides (paradichlorobenzene and pyrethrinoids), French levels are notably higher than American and German ones.

This study can be considered as a bridge head of the national strategy of human biomonitoring (HBM), coordinated by InVS at the request of ministries of Health and Environment.

The main component of this strategy will be a cross sectional survey on a sample of 5000 children and adults designed to be representative of the French population (6-74 yrs). Biomonitoring will be coupled to health interview and examination and to nutrition questionnaires. The first survey is to be implemented in 2012 and should be repeated every 6 to 10 years.

This survey will be completed for the neonatal period and early childhood by a biomonitoring cross sectional study on mothers and children recruited for the Elfe Project. Elfe is a large (20 000) Birth Cohort study designed to be representative of births in France which is to start in 2011.

The overall aim of the national strategy of biomonitoring is to describe population exposure to environmental chemicals (around 100 biomarkers) and to establish reference values. It will be implemented in harmonization with HBM at European level (Cophes project).
Introduction of Korean HBM and some of findings

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In Korea, there have been steady efforts to measure levels of environmental pollutants in the human body across the population since the Ministry of Environment established the new department, the department of environmental health policy, in 2004. The objective of this presentation is to share our experience on the nationwide bio-monitoring survey and to get any insightful comment from the experts to improve our Korean version of HBM program.

This presentation will briefly describe the history and the current situation of this nationwide bio-monitoring in Korea. In 2005, the first survey on bio-monitoring for the general population was initiated jointly as a part program of the National Health and Nutrition Survey conducted by the Ministry of Health and Welfare. In 2009, the Environmental Health Law was in effect. The article 14 of the Law clearly states that the Minister should make a regular report on the bio-monitoring survey to the public in every three years. On the basis of the article, the survey was designed to provide valuable information on estimating the reference levels and geo-temporal distribution of exposure levels and consists of two main parts including the questionnaire survey and bio-monitoring of urine and blood samples from 6,000 participants whose age is 19 and older for three years. The target pollutants are heavy metals (lead, mercury, manganese, cadmium and arsenic), metabolites of ETS, PAHs, EDCs, VOCs and herbicides. This presentation will also cover some of findings that we have seen so far.

As we mentioned above, this nationwide program is at the very early stage. Although the program has value on its own, it should be a room to be expanded and extended in order to provide information on environmental exposure pathways and to watch for changes in the level of exposure to environmental pollutants among the general population.
Biomonitoring of environmental chemicals in Canada - first results of the Canadian Health Measures Survey

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Biomonitoring, which is used as an indicator and quantitative measure of human exposure to environmental chemicals, contributes to policy decisions mandated by Canadian regulatory, environmental and public health frameworks.

The Canadian Health Measures Survey (CHMS) is the most comprehensive direct health-measures survey conducted in Canada to date. This cross-sectional survey was designed to provide national-level data on indicators of environmental exposures, health and nutritional status, and related risk and protective characteristics. The first cycle of the CHMS (2007-2009) collected self-reported data, physical measures and biological specimens from a representative sample of 5,600 Canadians, aged 6 to 79 years. The objectives of the biomonitoring component are to:

- establish nationally-representative blood and urine concentrations for environmental chemicals;
- provide baseline data for tracking temporal trends and to allow for comparisons with sub-populations in Canada and internationally;
- provide data to explore relationships between chemical concentrations, other physical measures and questionnaire information collected from the participants.

The chemicals measured in the first cycle of the CHMS include metals and trace elements, organophosphate and pyrethroid insecticide metabolites, 2,4-dichlorophenoxyacetic acid, polychlorinated biphenyls, organochlorine pesticides, bisphenol A, brominated flame retardants, perfluorinated compounds and cotinine.

The CHMS reports, for 6 to 79 year old Canadians, a geometric mean (GM) blood lead concentration of 1.34 µg/dL. Ninety-eight percent of the population had concentrations under 5 µg/dL and less than 1% had concentrations above 10 µg/dL. Total mercury in blood was detected in 88% of the population with a GM and 95th percentile of 0.69 µg/L and 4.79 µg/L respectively. Bisphenol A was detected in the urine of 91% of the population with a GM concentration of 1.16 µg/L and a 95th percentile of 7.01 µg/L.

The CHMS is a continuous cyclical survey collecting data over two-year periods. The second cycle was launched in September 2009 and includes children 3 to 5 years of age. New chemicals measured in the second cycle include triazine herbicides, carbamate insecticides, halogenated phenolic compounds, triclosan, triclocarban, polyaromatic hydrocarbons, and benzene. The CHMS provides a rich resource for ongoing surveillance and research.
Biomonitoring in Israel: Past, Present, Future

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The first biomonitoring studies in Israel in the 1970s and 80s focused on measuring exposure to PCBs and organochlorine insecticides in the general population and organophosphate pesticides in agricultural workers. In the late 1990s, a regional biomonitoring study found differences in blood lead levels in children from Israel, Jordan, and the Palestinian Authority. Taken together with data on time trends in lead emissions in Israel, the study indicated the benefits from phasing out of leaded gasoline.

More recently, a pilot study in pregnant women in Jerusalem, conducted in collaboration with the US-CDC, found widespread exposure to phthalates; nine phthalate metabolites were detected in at least 95% of the samples. In the same sample of pregnant women, there was widespread exposure to organophosphate pesticides and the carbamate bendiocarb. Creatinine-adjusted total dimethyl (DM) metabolite concentrations were between 4 and 6 times higher than populations of pregnant women in the United States.

The Israel Ministry of Health is currently collaborating with the Hebrew University of Jerusalem and Al Quds University to study exposures to phthalates and organophosphates in pregnant women in Israel and the Palestinian Authority.

The Israel Ministry of Health has also begun the first National Biomonitoring Study to measure exposures to bisphenol A, phthalates, organophosphates, polyaromatic hydrocarbons, and the phytoestrogen genistein in the Israeli adult population. This study is being carried out in collaboration with the University of Erlangen-Nuremberg in Germany.

Until recently, human biomonitoring programs in Israel were limited to occupational settings (biomonitoring of metals, VOCs, and cholinesterase inhibitors) and biomonitoring of naval divers to measure transdermal absorption of environmental contaminants. The future of biomonitoring in Israel lies in extending such programs to measuring exposures in the general population, increasing international collaboration in this field, developing analytical capacity and expertise, and increasing use of human biomonitoring studies in forming and evaluating environmental health policy.
Heavy metals and persistent organic pollutants in placenta and birth defects


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Background: The role of environmental pollutants in the development of congenital malformations has been implied. However, human studies based on pollutant biomarkers have been limited. Objectives: To explore possible associations of selected heavy metals and persistent organic pollutants in placentas with the risk of neural tube defects (NTDs) in an area of Northern China, where NTD prevalence is high.

Methods: Placenta samples were collected from women having a neural tube defect-affected pregnancy (anencephaly, n=36; spina bifida, n=46) and women having a healthy full-term birth (n=50). Demographic and exposure information was collected by face-to-face-interview. Cadmium (Cd), arsenic (As), lead (Pb) and mercury (Hg) were assessed by ICP-MS; polycyclic aromatic hydrocarbons (PAHs), DDT and its metabolites (DDD and DDE), polychlorinated biphenyls (PCBs), and polybrominated diphenyl ethers (PBDEs) were analyzed by GC-MS with both EI and ECNI ion sources.

Results: Median concentrations of Hg, eight of the 10 PAH congeners and total PAHs, four of the six DDTs or its metabolites, and total DDTs were higher in the placentas of the NTD case group than those in the placentas of the control group. Higher concentrations of these pollutants were also observed for anencephaly and spina bifida, two subtypes of NTDs. In addition, a dose-response relationship was observed between total PAHs and the risk of NTDs. Those with the highest quartile of Hg, total PAHs, and total DDTs had an 8.71-fold risk (95%CI, 2.85 - 26.68), an 11.67-fold risk (95%CI, 2.99 - 52.30), and a 4.13-fold risk (95%CI, 1.27 - 13.37), respectively, for NTDs. No consistent associations between PCBs or PBDEs and the risk of NTDs were observed.

Conclusion: Possible associations of placental Hg, PAHs and DDT with the risk of NTDs exist. Further research is needed to confirm these findings. Placenta as a specimen for biomonitoring is also discussed.
Use of biomarkers to understand environmental exposure of women at high altitude in Peru

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Worldwide exposure to products of incomplete combustion from solid fuels is a concern to public health. In Peru, 30%+ households (90%+ in rural areas) rely on solid fuels for their energy source. Particulate matter (PM2.5), carbon monoxide (CO), and polycyclic aromatic hydrocarbons (PAHs) are commonly used to assess exposures to solid fuels combustion products, such as wood. The use of Improved Stoves equipped with chimney offers an alternative to reduce this exposure. We have evaluated the effectiveness of two different models of Improved Stoves for reducing exposures to woodsmoke products. This evaluation took place in rural communities in the Santiago de Chuco province in Peru at 3000+ metres above sea level on 64 households (32 households with each stove model) that use wood as their sole energy source for cooking and heating.

Methods: We evaluated air quality and human biomarkers in blood, breath and urine before and a few weeks after the use of Improved Stoves. Outdoors fixed site, kitchen area and personal exposures included the use of air samplers to measure PM2.5 and CO. Human biomarkers included 1) Carboxyhemoglobin (COHb), hemoglobin and lead in blood, 2) CO and Nitrogen Oxide (NOx) in breath and 3) hydroxylated PAH metabolites (OH-PAH) in urine.

Results: Personal and kitchen area exposures to PM2.5 and CO were significantly reduced (average reduction 33-71%); at the fixed sites there was not significant changes on the levels of PM2.5 and CO. Blood and breath biomarkers were reduced at different concentrations and urine OH-PAH had a reduction of (17 – 43)%.
Session III: HBM and health effects

The use of human biomonitoring and environmental samples in the US National Children’s Study

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The National Children’s Study (NCS) is an observational longitudinal Study that will follow a cohort of children from before birth to 21 years of age. The aim is to investigate the separate and combined effects of environments (chemical, biological, physical, and psychosocial) and genetics on pregnancy outcomes, child health and development, and precursors of adult disease. The NCS has a unique goal of collecting numerous environmental and biological samples, as well as a wide range of anthropometric, behavioral, dietary, and health data. To address this goal in making informed decisions about the Study, the NCS has adopted a data-driven and evidence-based decision-making approach, and a transparent governance mechanism. The Vanguard Study protocol was revised to focus on the feasibility, acceptability, and costs of recruitment, logistics, and study visit assessments. Early recruitment results from the first seven “Vanguard” locations indicated that the initial approach would require a prolonged recruitment phase with excessive costs. Three alternate recruitment strategies were designed and each is being deployed in 10 locations to examine their efficiencies, limitations, logistics, and costs. These changes were discussed and vetted through the Study’s governance structure which includes review and oversight by the Director of the National Institutes of Health (NIH), a federal Interagency Coordinating Committee (ICC), a chartered Federal Advisory Committee, and a Steering Committee of NCS Investigators. The Vanguard Study has collected and stored over 115,000 environmental and biological samples. Selected samples will be examined for stability, effects of collection methods, thawing conditions, and analyte profile to determine which methodologies provide optimal results. After recruitment for the Vanguard Study is completed and evaluated in 2011, the Main Study will be designed and implemented based on the Vanguard Study experience. The Vanguard Study and the Main Study will run in parallel for 21 years each.
Human Biomonitoring

Outline of Japan Environment and Children’s Study focusing on environmental chemicals and child health

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The Ministry of the Environment of Japan is launching a nationwide birth cohort study (Japan Environment & Children’s Study; JECS) in 2010. JECS will examine the effects of fetal exposures to environmental contaminants on the health and development of 100,000 children across the country. Other factors affecting children’s health and development such as home, social, environmental (other than chemical environment) and genetic factors will also be considered.

Pregnant women will be recruited at antenatal clinics. Maternal blood samples will be collected as will umbilical cord blood at parturition. Maternal milk will be collected about one month after parturition. These biological samples will be analyzed for environmental contaminants, including mercury, arsenic, and selected POPs and pesticides. Congenital anomalies, if any, will be recorded. Questionnaires asking about the children’s health and development will be sent to all the participants every 6 months. Less frequently, once every few years, medical examinations of all the participants are planned. Several thousand randomly selected children will undergo precise checkups by pediatricians and developmental psychologists. The targeted outcomes are congenital anomalies, physical development, psycho-neurodevelopment impairments, immunologic impairments and metabolic/endocrinologic impairments.

The organization are composed of a national center, a medical support center and 15 regional centers. The national center is responsible for making protocols and manuals, collection and storage of data and biological samples and financing. The medical support center is responsible for medical affairs and training research staff working for regional centers to maintain the consistency and equivalence of the research. The regional centers are responsible for the practical research, including recruitment, sample collection and face-to-face interviews of the participants.

The recruitment will start in January 2011 and last for three years. The follow-up will continue until the age of 13 for the children. The provisional total budget for 16 years will be 90 billion yen (approximately one billion $US or 0.8 billion Euros).
9 months that last a lifetime. Experience from the Danish Pregnancy/Birth Cohort

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Animal studies have strongly supported the idea that the exposures during the time period of organogenesis and organ development may "program" disease susceptibility later in life. These exposures may be nutritional (or lack of), environmental exposures, stress, diseases or more. The results from animal studies have some support in epidemiologic findings. Support is sufficient to make this a priority area and to build a research infrastructure that allows long-term follow-up of many people starting as early as possible in life, at best before conception.

Pregnancy cohorts have a long history, but the first large-scale study with detailed data collection goes back to the Perinatal Collaborative Study from the 1950s. More recently Denmark and Norway started pregnancy cohort studies including about 100,000 pregnant women. Large-scale studies are also ongoing in the UK, China and the US (the National Children’s Study). Smaller studies have been done, or are planned, in many other countries.

In the presentation the history and the principles of the Danish National Birth Cohort (DNBC) will be presented. This cohort provides self-reported data, biological material and linked data from many other sources. It is an open database that is being used by a large number of external researchers. More information at www.dnbc.dk.
Biomonitoring, chemical exposures and human health

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In modern societies, humans may be exposed to a wide spectrum of environmental chemicals. Although for many chemicals the health significance of this exposure is unknown, studies to investigate the prevalence of exposure are warranted because of the chemicals’ potential harmful health effects, as often indicated in animal studies. Biomonitoring programs are useful for investigating human exposure to environmental chemicals. One of these programs, the National Health and Nutrition Examination Survey (NHANES), conducted annually in the United States by the Centers for Disease Control and Prevention is designed to collect data on the health and nutritional status of the noninstitutionalized, civilian U.S. population. NHANES data can be used to establish reference ranges for select chemicals, provide exposure information for risk assessment (e.g., set intervention and research priorities, evaluate effectiveness of public health measures), and monitor exposure trends. NHANES data have shown that in the general population, exposure to some environmental chemicals is prevalent. NHANES data also suggest variability in exposure by sex, age, and race/ethnicity, all of which probably reflect lifestyle differences. However, NHANES by design does not include population groups that might be highly exposed or the collection of urine from persons younger than 6 years. Therefore, biomonitoring efforts other than NHANES are needed. Such efforts should focus on a) identifying novel biomarkers; b) improving understanding of these biomarkers’ toxicokinetics in different populations, with emphasis on fetal and neonatal exposures - when susceptibility to potential adverse health effects of environmental chemicals may be highest; and c) studying targeted populations with known exposure source(s) to better relate internal exposure to potential health effects.
Session IV: Risk assessment of HBM data

**Effect biomarkers: too late for action?**

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Biomonitoring is the study of the presence and concentration of chemicals in humans usually by the measurement of blood, urine or other tissues. The measurement of chemicals and biomarkers has revolutionized the field of exposure assessment. Biomonitoring data can provide a picture of the amount of a chemical or agent actually absorbed into the body for a specific period of time (often referred to as the body burden). However, the use of human Biomonitoring data in risk assessment is less advanced. Environmental exposure assessment is often used in preference as it is deemed easier to correlate exposure to effect. However, exposure limits are ultimately derived from animal data or human data if available – so why is it that human Biomonitoring guidance values are not used in a regulatory framework?

This presentation will describe the limitations and potential benefits of effect markers. Examples of the proper and possibly improper use of biomonitoring and the impact made on our society are provided. What are the reasons for funding comprehensive national biomonitoring programs are there societal benefits and of course what are the risks, should effect markers be included?

The challenges will be discussed: careful interpretation, understanding that the data obtained are useful for establishing baseline information about exposure, rather than equating detection with risk. We must put biomonitoring data into context in order to provide the public with the tools to distinguish genuine health risks from trivial ones. This concept is difficult enough for ‘The Health professional’ let alone the Public.
Interpreting human biomonitoring data in a public health risk context using Biomonitoring Equivalents

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Currently, few screening tools are available for interpretation of human biomonitoring (HBM) data in a health risk assessment context.

In this presentation we describe the concept and implementation of Biomonitoring Equivalents (BEs), estimates of the concentration of a chemical or metabolite in a biological medium that is consistent with an existing reference value such as a tolerable daily intake (TDI) or reference dose (RfD).

To date, BEs have been developed for nearly 100 compounds.

Similar values are being derived by the German Human Biomonitoring Commission.

Use of BEs offers a practical approach to interpreting human biomonitoring data that leverages the existing risk assessment programs developed throughout the world and the vast resources that have been invested in setting safe exposure limits for a large number of chemicals.

Translating tolerable or safe (external) exposures (which are designed as risk management tools) into Biomonitoring Equivalents introduces concepts that must be considered when both interpreting HBM and communicating the results to the public and individuals.

Approaches for deriving BE values include use of PK or PBPK models, urinary mass balance assessments, and the direct use of measured biomarker concentrations that can then be used in an internal dose-based risk assessment framework.

In this presentation we summarize the advantages and disadvantages of the use of BEs for interpreting human biomonitoring data in a risk assessment context.

We demonstrate use of the BE values to evaluate current biomonitoring data for several chemicals to estimate margins between the BE values and measured biomarker concentrations in the general population.

The resulting screening level evaluation of biomonitoring data can be used as one tool to classify chemicals into relative categories of low, medium, and high priority for risk assessment follow-up.
Guidance value derivation in HBM - scope and limits

Michael Wilhelm
Ruhr-University Bochum, Institute for Hygiene, Social and Environmental Medicine, Bochum, Germany

In Germany, we can look back on more than 15 years of experience in deriving guidance values in HBM for public health use. These values as established by the German HBM Commission comprise of reference and human biomonitoring values. This approach has proven to be a valuable tool in assessing the internal exposure to environmental contaminants of individuals and groups. Reference values are statistically derived from reference populations, as studied in the German Environmental Surveys (GerES). Environmental conditions change with time and reference values need to be updated. Currently, the most serious limitation for derivation of reference values in Germany is the lack of an appropriate data base. The latest GerES with adults was performed 1997-1999. In risk communication - though clearly defined as statistically based-, we experienced that reference values are easily misinterpreted as health-based values. For derivation of health-based biomonitoring values we started from epidemiological studies showing a correlation between the concentration of a substance or its metabolite and adverse health effects. However, this approach was only suitable for a few very well studied contaminants such as cadmium or lead. Thus the commission decided to derive HBM values for substances for which a toxicokinetic extrapolation is possible to provide a concentration of a substance or its metabolites corresponding to tolerable intake doses.

Examples and limitations will be given.
Session V: Going global - do we need global HBM?

HBM as a tool in the assessment of climate change and health effects

Jon Oeyvind Odland
University of Tromsoe, Faculty of Health Sciences. Tromsoe, Norway

Globally, a number of persistent toxic substances (PTS), are recognised as being responsible for adverse health effects in children. The growing foetus and newborn child are especially sensitive to the toxic effects of persistent organic pollutants and heavy metals. The levels of these substances in maternal blood provide indications of the potential risks to the developing foetus. Cord blood studies and breast milk monitoring will add valuable information for the impact on child development. Considerable efforts have been made over the last thirty years to characterise PTS concentrations in the environment. The Arctic Monitoring and Assessment Programme (AMAP) has initiated collaborative research programmes in a range of developed and developing countries in the Southern and Northern Hemisphere.

The focus of the presentation will be a description of the strategy and the program, as well as the levels of metals and organic substances found in maternal blood in these regions and the implications of environmental exposures to the emerging chemicals of concern. The effects of climate change will add a new dimension to environmental surveillance and possible impacts on human life in all affected areas. A good monitoring system with possibility to register health effects in a compatible way is crucial for human adaptation to environmental changes. Good effect studies are now emerging from compatible child cohorts initiated in several countries. The most important reproductive health effects shown so far are impacts on sperm quality, time-to-pregnancy, birth weight, gestational age, and neurological effects in early childhood. The presentation will report from ongoing studies in all Arctic countries, as well as selected countries in the southern hemisphere. The precautionary principle must be introduced and adapted in all scientific and public health policies while the results are assessed. Most of all; the scientific world must agree on good and reliable methodology that is compatible in different geographical and cultural settings.
A plea for Human Biomonitoring in Africa

Jerome Nriagu
Department of Environmental Health Sciences, School of Public Health, University of Michigan, Ann Arbor, MI, USA

Environmental health impact assessment (EHIA) through the measurement of chemicals in human tissues and fluids (human monitoring) and environmental media (ambient monitoring) may be common in many parts of the world but not in Africa. In consequence, nobody knows or understands the impacts of unmitigated release of modern environmental health hazards (MEHHs), alone or in combination with traditional hazards of poor sanitation and malnutrition, on morbidity and mortality in Sub-Saharan African (SSA) countries, except that they are guessed to be serious. As example, African countries have used highly persistent pesticides such as DDT, dieldrin, endrin, heptachlor, lindane, and toxaphene, for more than 50 years for controlling disease vectors and combating agricultural pests. The way in which these pesticides are used in Africa leave room for concern about the environmental and health consequences compared to practices in other countries.

Human monitoring in sub-Saharan Africa is limited by poor infrastructures, lack of trained personnel, shortage of essential reagents and other supplies, and and slow manual technologies.

These limitations will be highlighted by considering the available blood lead data that have collected and reported in African countries.

Blood lead (Pb-B) is a biomarker of choice because of its well documented history in human biomonitoring programs.

Although large amounts of data on blood lead have been reported in many parts of the world, reliable measurements in Africa remain limited, and the extent of childhood lead poisoning in the continent is basically unknown. In this regard, one can call into question the recent (and not so recent) estimates of disease burdens using “guess-estimated” demographical and health surveys, statistical modeling and census information.

These estimates serve to remove the pressure on national governments in SSA from obtaining their own estimates and may even inhibit the capacity building required for monitoring and evaluation, with the result that there are few advocates for the type of study required to obtain reliable biomonitoring information.

I shall use a review of the meager published data to highlight the growing significance of chemical hazards associated with risk transitions in African countries in response to growing urbanization, industrialization/globalization, and development. I shall conclude with a plea for a shift in public health policy toward accommodating human monitoring as an essential effort in EHIA and other programs aimed at alleviating the burden of avoidable ill health and premature death for communities in SSA.
**HBM as a link between health and environment in Europe**


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(3) BiPRO GmbH, Munich, Germany
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(9) University of Copenhagen, Copenhagen, Denmark
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(11) Environmental Health Service International, Hulst, The Netherlands

HBM is seen as an essential element in a strategy aiming to integrate health and environment.

In support of the European Environment and Health Action Plan, COPHES, a consortium of 35 partners from 27 European countries, is developing a functional framework to define, organize and manage a coherent approach towards HBM in Europe.

The hypothesis that human biomonitoring in the field of environment and health can be performed in a coherent and harmonised approach throughout Europe by means of commonly developed protocols, strategies and scientific tools ensuring reliable and comparable data, whilst also leading to a more effective use of resources, will be tested in a feasibility study in 16 EU Member States (sharing expertise with 5 additional countries) coordinated by DEMOCOPHES.

Exposure to at least cadmium, mercury, phthalates, and cotinine will be assessed in children aged 6-11 years and their mothers, using human biomarker and questionnaire data. Where possible additional environmental exposure data and health data will be considered for the interpretation of the results. Special attention will be paid to strategies to communicate results and to policy consequences.

COPHES: COnsortium to Perform Human biomonitoring on a European Scale – FP7 grant agreement 244237

DEMOCOPHES: Demonstration of a study to coordinate and perform human biomonitoring on a European scale - LIFE09 ENV/BE/000410
Despite the ban of persistent organochlorines (OCs) in most of the developed nations, their usage has remained until very recently in many Asian developing countries for agricultural and public health purposes, including Vietnam. In this study, we collected human breast milk samples from the two biggest cities in Vietnam: Hanoi city (n = 42) and Hochiminh (n = 44) and determined the concentrations of persistent OCs such as PCBs, DDT and its metabolites (DDTs), hexachlorocyclohexane (HCHs), hexachlorobenzene (HCB), chlordane compounds (CHLs) and tris-4-chlorophenyl-methane (TCPMe). The contamination pattern of OCs was in the order of DDTs > PCBs > HCHs > TCPMe > CHLs >HCB. DDTs residue levels in human breast milk from Vietnam were among the highest values reported for Asian developing countries as well as for developed nations. This result suggests recent usage of DDTs in both north and south of Vietnam. In general, concentrations of OC compounds in primiparas were higher than those in multiparas, indicating that number of childbirth is an important factor influencing the OC burden in humans. Risk assessment studies indicated that current DDT levels approached the cautioning levels associated with adverse effects in children. Estimated infant daily intake of DDTs for some individuals exceeded the WHO guideline, which may raise concerns for children health.

Keywords: DDTs; PCBs; Human breast milk; Vietnam; infant health.
Panel discussion: The political dimension of HBM

Using human biomonitoring to help evaluate public policies

Ruth Etzel, M.-N. Bruné, M. Neira
World Health Organization, Department of Public Health and Environment, Geneva, Switzerland

The World Health Organization uses biomonitoring as an important tool to help evaluate the effects of public policies and/or the impact of public health interventions. For example, after countries phased out the use of leaded petrol, biomonitoring studies documented that the mean blood lead concentration among children was dramatically lower than during the period in which leaded petrol was being used. Biomonitoring data also can be used to calculate the social and economic benefit of phasing out the use of leaded petrol. In the US, for example, from biomonitoring data it was estimated that phasing-out of leaded petrol resulted in a gain of 5-6 points in mean population IQ score and this gain was calculated to yield an annual economic benefit of between 100 billion and 300 billion US dollars.

After reaching international agreement to phase out persistent organic pollutants, biomonitoring of persistent organic pollutants was undertaken in countries including Germany and Sweden to determine concentrations of dichlorodiphenyltrichloroethane (DDT) in breast milk. The results indicated that mean concentrations of persistent organic pollutants in breast milk began to decline. DDT was banned in Germany in 1972; the average concentration of DDT in breast milk decreased by 81% between 1969 and 1995.

Looking ahead, WHO envisions a potential role for biomonitoring to assess the impact of the proposed legally-binding treaty that is being negotiated to reduce mercury exposure to humans. WHO intends to work with countries to assess baseline mean concentrations of mercury in children's hair and to follow the levels over time to determine whether reductions in mercury occur after implementation of the proposed treaty. If the treaty successfully reduces mercury in the environment, mercury concentrations in children’s hair should decrease over time.

Biomonitoring can raise some risk communication issues; therefore, it is important to work with local communities, policy makers and local public health officials to facilitate communication and understanding of the importance and meaning of biomonitoring data.
Contribution of the Chemical Industry to Human Biomonitoring

Gerd Romanowski
Chemical Industry Association (VCI), Frankfurt am Main, Germany

The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the German Chemical Industry Association (VCI) have started their cooperation in human biomonitoring, in order to improve the knowledge of substances taken up by the human organism. The focus is on substances that might involve increasing exposure of the public at large or can have special relevance to human health without, however, being measurable in the human body with currently available methods. Against this backdrop, there are plans to develop over the next 10 years adequate analytical methods for up to 50 jointly selected substances or substance groups and to apply newly developed methods in relevant studies. Joint activities begin with a three-year trial and pilot phase.

The VCI is in charge of the development of detection methods, which the BMU will put to the test in suitable studies. In these efforts, the BMU will closely work with the German Federal Environment Agency (UBA).

Human biomonitoring is a central information and control instrument in health-related environmental protection: data from human biomonitoring can serve as early warning systems for formerly unnoticed environmental burdens. Risk assessments, which use e.g. medical and toxicological findings, are needed to examine whether or not the detection of substances comes with strains on human health. Furthermore, human biomonitoring provides sound scientific data on whether bans or restrictions of substances of concern have really reduced burdens on the population.

Human biomonitoring is a major instrument of prevention in occupational health and safety in the chemical industry. The VCI has been working in this field for many years and now contributes these experiences to joint activities with the BMU. With its commitment, the chemical industry underlines the great importance of product safety within the chemical industry's "Responsible Care" programme.
Human Biomonitoring (HBM) provides an integrated measure of exposure to specific chemicals from different sources, pathways and routes; it helps identify susceptible populations and provide information on early biological effects of exposure. HBM is useful as a scientific tool and also for environmental health assessments and for policy measures. European Environment Agency recognizes a value of HBM to underpin integrated environment and health assessments and strongly supports efforts towards a coherent approach to HBM in Europe, which build on the provisions of the EU E&H Action Plan. In a longer term perspective, a sustainable framework is needed in Europe to facilitate access and use of HBM data generated through research and survey projects. National experiences and current institutional settings in Europe, the US, Canada, Japan, etc., need to be explored in this context. Of importance is also reducing delay between data generation and their accessibility, and making HBM data available in formats suitable for different users; links with spatial data infrastructure development in Europe (INSPIRE) need further consideration. In a broader context of environmental policy needs for the protection of human health, better integration of the data and knowledge from HBM studies with those available from specimen banks and environmental biomonitoring is welcome. EEA is willing to share its expertise in reporting, assessments, and information systems, as well as extensive networks to facilitate activities towards a sustainable framework in Europe for human and environmental biomonitoring data.
**Statements of the European Commission**

**Peter Pärt**  
European Commission, Joint Research Centre, Ispra, Italy

Biomonitoring, and particularly environmental biomonitoring, has had large impacts on the development of policies for protecting human health and the environment. Just as an example - environmental biomonitoring originally identified properties like persistence, bioaccumulation potential and toxicity, which today are classifying criteria in chemical legislation. Therefore, biomonitoring, both human and environmental, is an invaluable tool support to policymaking, from policy anticipation to policy implementation. Biomonitoring can identify the problems when policy action is needed, but biomonitoring can also tell the success stories when policies have worked. Today a number of European policy actions in the chemicals and pesticide area are using results from biomonitoring programs as one source of input. With more fine tuned risk assessment procedures, adapted to individual vulnerability and vulnerable groups like children or the elderly, human biomonitoring programs may gain in importance for the future.

**Dr. Karl Freese**  
European Commission, Health and Consumers Directorate-General, Luxembourg, LU

*The abstract was not available by the editorial deadline.*
Health and Environment Alliance (HEAL) Statement

Lisette van Vliet
Health and Environment Alliance, Brussels, Belgium

- HBM is a very valuable tool to ascertain whether current regulation is working, or where stronger action is required to reduce exposure to man-made hazardous chemicals. A biomonitoring programme can provide a baseline measurement, and follow-up monitoring can show whether levels of exposure have fallen after a new control regime has been introduced. For example, biomonitoring children for traces of lead has shown that levels fall dramatically after a ban on leaded petrol is introduced.

- HBM is also a valuable tool to educate and involve stakeholders, from the general public, to specific vulnerable groups, about their exposure.

- HEAL agrees with the EU that HBM ‘the key to integrating human health considerations into the environment policy decision-making and evaluation’. To effectively do so, HBM needs to be specifically anchored in or enabled by legislation.

- Equally, important ethical and communication issues must be well managed. For example, announcements that breast milk contains certain synthetic chemicals may inadvertently discourage women from breastfeeding. Results for breastmilk should always be given in conjunction with the WHO recommendations that every baby should be exclusively breastfed for the first six months.

- HEAL advocates the swift elimination from the market of all hazardous chemicals in line with SAICM, which calls for chemicals to be produced and used in ways that minimize significant adverse impacts on the environment and human health by 2020.

- HEAL believes that the HBM can contribute to this goal, by deploying HBM results to inform policy-making, and monitor and enforce legislative compliance.

- HEAL favors the tracking of one or more synthetic hormone-mimicking chemicals at EU level.
**UNEP’s needs for and implementation of HBM - the POPs example**

Heidelore Fiedler  
United Nations Environment Programme (UNEP), Division of Technology, Industry and Economics, Chemicals Branch, Châtelaine (Geneva), Switzerland

The Stockholm Convention on persistent organic pollutants has the objective to protect the environment and humans from adverse effects from POPs. At its second meeting in 2006, the Conference of the Parties adopted the Global Monitoring Plan (GMP) for its effectiveness evaluation according to article 16 of the Convention. The GMP attempts to establish baseline time and spatial trends, i.e., demonstrate a 50% decrease of POPs concentrations in ten years. In order to achieve this goal, the same protocols and strict quality controls have to be applied.

UNEP Chemicals assists developing country laboratories through capacity building projects. The first global report with an emphasis on the initial twelve POPs and the core matrices - ambient air and mothers’ milk or human blood - was delivered in 2009. Since the 4th Round of the WHO Human Milk Study (2005), UNEP and WHO work together to analyse pools of mothers’ milk samples from countries around the globe.

Analytical difficulties arise through the fact that concentrations of organochlorine pesticides in humans vary by a factor of 20,000. Results show that some of the POPs are metabolized and so far could not been detected (aldrin, chlordane, heptachlor); some show only regional presence (mirex). The data allow priority setting within regions and between countries: higher concentrations of dioxin-like compounds (as TEQ) are found in Europe and in one African country; elevated PCB are found in Europe, whereas subtropical countries have a tendency towards elevated DDT concentrations. Especially for dioxins/furans, TEQ levels have decreased over the past 20 years.

The Secretariat of the Stockholm Convention is coordinating the regional networks as well as the updating of the guidelines to include nine new POPs. Since some of them are more water-soluble, it is expected that human blood will gain more importance in UNEP’s human biomonitoring projects.
Human Biomonitoring

Nutzen für die Politik – Herausforderung für die Wissenschaft

Political benefits – scientific challenges


Curricula vitae
### Curricula Vitae of Chairs and Speakers (in alphabetical order)

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization and Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aguilar-Villalobos, Manuel</td>
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</tr>
<tr>
<td>Prof. Dr. Angerer, Jürgen</td>
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</tr>
<tr>
<td>Prof. Dr. Barr, Dana Boyd</td>
<td>Emory University, Rollins School of Public Health, Atlanta, US</td>
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<tr>
<td>Dr. Berman, Tamara</td>
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<tr>
<td>Bloemen, Louis</td>
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Undergraduate Research Grant for the USA National Science Foundation  
Part of the Research team to study the effects of air pollution exposure of the fetus in Peru.  
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Reviewer for the International Society of Exposure Sciences since 2007.

PUBLICATIONS

A.- Published:

3.- Perfluorinated chemicals in selected residents of the American continent, Journal of Chemosphere 2006  
4.- A pilot study to assess residential endotoxin and blood IgE in a group of pregnant women from Trujillo, Peru. Journal of Environmental International  
5.- Characterizing the spatiotemporal variability of PM-2.5 in Cusco, Peru using kriging with external drift. Journal of Atmospheric Environment, 2009  
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Qualification & Career:
1971 Promotion, Dr.rer.nat. (Chemistry)
1971 Head of department analytical chemistry at the Institute of Occupational Medicine; Hamburg
1982 Habilitation at medical faculty of the University of Hamburg (venia legendi)
1989 Appointment Prof.
1989 - 2007 Head of the analytical laboratories of the Institute of Occupational & Environmental Medicine of the University of Erlangen-Nuernberg
2008 Scientific advisor at the Institute for Prevention and Occupational Medicine of the German Social Accident Insurance - Institute of the Ruhr-Universität Bochum (IPA)

Scientific workscope:
biological monitoring of toxic substances in occupational and environmental medicine comprising organic solvents, pesticides, PAHs, organochlorine compounds, phthalates, acrylamide, Hb-, DNA-adducts, metals etc.
about 500 scientific publications; about 600 oral presentations
1982 - 2007 coorganizer of the German External Quality Assessment Scheme (G-Equas). more than 100 parameters for boimonitoring; 2 campaigns per year; 150-180 participants;

Membership in scientific committees:
1976 - 2010 Commission for the Investigation of Health Hazards of Chemical Substances at the Workplace of the Deutsche Forschungsgemeinschaft (DFG) "MAK-Commission"
1976 - 2009 Chair of working group „Analytical Chemistry“ of the MAK-Commission
1982 - 2010 Working group Evaluation of Biological Limit Values of the MAK-Commission
1992 Commission Human Biomonitoring of the German Federal Agency of the Environment
2005 HESI, Washington DC; Technical Committee: Biomonitoring
2008 Appointment as a member of the Scientific Committee on Consumer Safety by the European Commission

Membership in scientific societies:
- ISEA International Society of Exposure Analysis
- GHUP International Society of Hygiene & Environmental Health Sciences (vice chair)
- DGAUM German Society of Occupational & Environmental Medicine
- GdCh German Chemical Society

Editorial activities:
- Till 2009 Biomonitoring-Methods, Wiley-VCH, New York (editor)
- International Journal of Hygiene & Environmental Health, Urban & Fischer (coeditor)
- Umweltmedizin in Forschung & Praxis; ecomed Verlagsgesellschaft, Weilheim (coeditor)
- Journal of Chromatography B, Elsevier New York, (editorial board)
**Prof. Dr. Dana Boyd Barr**

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Dr. Dana Barr has been employed as a Professor at Emory University for about 9 months; before that she spent 23 years at the Centers for Disease Control and Prevention serving as Chief of the Pesticide Laboratory. During her tenure at CDC, she devoted much of her time to the development of methods for assessing human exposure to a variety of environmental toxicants.

She is developing similar laboratory and research capacity at Emory University.

Dr. Barr has authored or coauthored about 300 peer reviewed publications.

She has served as the treasurer and president elect (term begins 2011) of the International Society of Exposure Science (ISES) and currently serves as Editor-in-Chief of its official journal, Journal of Exposure Science and Environmental Epidemiology.

Dr. Barr received her BS in Biology from Brenau University in 1987 and her Ph.D. in Analytical Chemistry from Georgia State University in 1994.

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Tamar Berman is an Environmental Health Toxicologist at the Israel Ministry of Health and a doctoral canditate at the School of Pharmacy at the Hebrew University of Jerusalem. Her doctoral research is on urinary concentrations of phthalate and organophosphate metabolites and plasma concentrations of pesticides in pregnant women in Jerusalem. She was involved in the Middle East Regional Cooperation project on childhood lead exposures and is an investigator in the Ministry of Health National Biomonitoring Study.

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**Louis Bloemen**

Environmental Health Sciences International (EHSI),  
HV Hulst, NL  
E-Mail: lb@ehsi.eu

Louis J. Bloemen has over 20 years experience in addressing health related issues related to chemicals, mainly in the European arena. As a biochemist and epidemiologist, his interests include biological monitoring, chronic disease and reproductive epidemiology, occupational asthma, and observational and experimental human mechanistic studies.

He is experienced in managing multi-disciplinary teams to address scientific issues around chemicals. He has conducted studies in several European countries, the U.S, and China. His background includes the integration of study results in EU and EPA risk assessments.

Mr. Bloemen has served on numerous industry working groups, either as a chairman or as a member. He has represented the European chemical industry at IARC meetings and European Union committees. He is an advisor to the European commission on biological monitoring and has been a member of the Dutch occupational limit setting committee DECOS.
**Dr. Antonia M. Calafat**
Centers of Disease Control and Prevention, Atlanta GA, US
E-Mail: Acalafat@cdc.gov

Antonia Calafat, Ph.D. serves as Chief of the Personal Care Products Laboratory at the Division of Laboratory Sciences, National Center for Environmental Health (NCEH) of the Centers for Disease Control and Prevention (CDC) in Atlanta, GA. She earned her Bachelor, Masters and Doctoral degrees in Chemistry from the University of the Balearic Islands in Spain. Prior to her career at CDC, she was a Fulbright Scholar and a Research Associate at Emory University. Since starting her tenure at CDC in 1996, Dr. Calafat has been involved in developing, validating, and applying analytical methods for measuring, in biological matrices, environmental chemicals including volatile organic compounds, disinfection-byproducts, chemical warfare agents, and phytoestrogens.

She currently leads several active research programs for assessing human exposure to chemicals added to consumer and personal-care products such as phthalates, environmental phenols (e.g., bisphenol A, triclosan, parabens), and polyfluoroalkyl compounds.

Dr. Calafat has developed and maintained extensive collaborative research with leading scientists in the fields of exposure science, epidemiology, toxicology and health assessment, and has authored or co-authored over 150 peer-reviewed publications. Her research has made relevant contributions to CDC’s biomonitoring program including the CDC’s National Reports on Human Exposure to Environmental Chemicals.

**Dr. Ludwine Casteleyn**
Katholieke Universiteit Leuven, Center for human genetics, Leuven, BE
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Occupational health physician, master after master social law, radioprotection.

Researcher Center for Human Genetics, KULeuven: interaction between genetic factors and occupational/environmental exposure factors; ethics and data protection.

Chair EU Technical Working Group human biomonitoring (HBM) for Children and EU Implementation Group HBM.

Till 2006 government advisor Flemish HBM Program and chair of the working group on translation of HBM results into policy measures. WP leader ethics and communication in NewGeneris.

Dr. Milena Cerna
National Institute of Public Health, Prague, CZ
E-Mail: mcerna@szu.cz

Education
1963 - 1969 Faculty of Medicine, Charles University, Prague
1972 Postgraduate Diploma (Board Certification I), Hygiene and Epidemiology
1979 Postgraduate Diploma (Board Certification II), Hygiene of Nutrition

Academic
1977 Ph.D.
1989 D.Sc.
1991 Assoc. Prof.
2002 Prof.

Editor-in-Chief of the Central Eur. J. Public Health

Research activities
Genetic toxicology, environmental toxicology, nutrition toxicology, human biomonitoring. Principal investigator of the project „Health consequences of human exposure to toxic pollutants from the environment, biological monitoring and genotoxicity testing“ in the framework of the Environmental Health Monitoring System in the Czech Republic.

Prof. Dr. Ruth A. Etzel
World Health Organisation, Geneva, CH
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Ruth Etzel, MD, PhD is Senior Officer for Environmental Health Research at the World Health Organization.

She was a Commissioned Officer in the US Public Health Service for 20 years and served in numerous public-sector positions including: Centers for Disease Control and Prevention (Founding Chief of the Air Pollution and Respiratory Health Branch), Department of Agriculture (Director of the Division of Epidemiology and Risk Assessment) and the Indian Health Service (Research Director at the Alaska Native Medical Center).

She is the Founding Editor of Pediatric Environmental Health, 2nd edition.

She has used biomarkers in numerous studies of the health effects of exposure to environmental contamination.
**Dr. Heidelore Fiedler**  
United Nations Environment Programme, Châtelaine, CH  
E-mail: heidelore.fiedler@unep.org

Heidi Fiedler is a Senior Scientific Affairs Officer with the United Nations Programme (UNEP).

She obtained a Masters degree and Ph.D. from the University des Saarlandes in Saarbrücken, Germany.

For more than ten years she worked as a Senior Scientist at the University of Bayreuth with Professor Otto Hutzinger; then she moved to the Bavarian Institute for Waste Research (BfA GmbH) before she joined UNEP in 1998.

Her expertise is with persistent organic pollutants from source identification to characterization of exposures.

At Chemicals Branch, she is responsible for the scientific backstopping in UNEP and capacity building with emphasis on POPs monitoring and development of methodologies for quantification and reduction of dioxin emissions.

She is editor for the journal Chemosphere, co-chair of the International Dioxin Symposia; and obtained an honorary doctorate from Örebro University, Sweden, in 2009.
**Jochen Flasbarth**  
President of the Federal Environment Agency, Dessau-Rosslau, DE  
E-mail: info@umweltbundesamt.de

**Professional career**
- **1983 - 1989**  Study of economics, political science and philosophy in Münster and Bonn, degree in economics (Diplom-Volkswirt)
- **1989 - 1992**  Head of the editorial office at Economica-Verlag in Bonn
- **1994 - 2003**  Full-time president of Naturschutzbund Deutschland (NABU) e.V. (Nature and Biodiversity Conservation Union)
- **2003 - 2009**  Head of Directorate-General “Nature Conservation and Sustainable Use of Natural Resources” at the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
- **Since 2009**  President of the Federal Environment Agency

**Voluntary involvement in nature conservation**
- **Since 1979**  Member of the former Deutscher Bund für Vogelschutz (DBV, German Society for the Protection of Birds), from which Naturschutzbund Deutschland e.V. (NABU, Nature and Biodiversity Conservation Union) emerged
- **1980 - 1992**  Various functions at NABU, including federal chairman of Naturschutzjugend (German Youth Association for the Protection of Nature); later, member and then vice-president in the NABU presidium
- **1985 - 2003**  Member of the board of Deutscher Naturschutzring (DNR, German League for Nature and Environment)
- **1986**  Founding board member of Verkehrsclub Deutschland (VCD, German Transport Association)
- **1988 - 2003**  Member of the DNR executive board
- **1992 - 1994**  President of Naturschutzbund Deutschland (NABU) e.V.
- **Since 1993**  Member of the board of trustees of the Michael Otto Stiftung für Umweltschutz (Michael Otto foundation for environmental protection)
- **1993 - 2003**  Member of the ZDF television board
- **1994 - 2003**  Member of the supervisory board of the Wuppertal Institut für Klima, Umwelt, Energie (Wuppertal Institute for Climate, Environment, Energy) GmbH
  - Member of the advisory council of B.A.U.M.-Environment-Protection-AG
  - Member of the jury for the Commerzbank/Impulse environment award
- **1995 - 2003**  Member of the main committee/board of the Arbeitsgemeinschaft für Umweltfragen e.V. (AGU)
- **1996 - 1998**  Member of the “Nationales Komitee für Nachhaltige Entwicklung” (National Committee for Sustainable Development)
  - Member of the advisory council to the project “Sustainable Germany” (Study Commission on Protection of Humans and the Environment)
- **1997 - 2003**  Chairman of the board of trustees of Stiftung Naturschutzgeschichte (Foundation on the history of nature conservation)
- **2000 - 2003**  Member of the board of Allianz pro Schiene (pro rail alliance)
- **2001 - 2003**  Member of the Federal Government’s Council for Sustainable Development
- **2002 - 2004**  Member of the Zukunftsrat (Council for the future) at the State Government of North Rhine-Westphalia
**Dr. Karl Freese**  
European Commission, Health and Consumers Directorate-General, Luxembourg, LU  
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*The curriculum vitae was not available by the editorial deadline.*

**Dr. Nadine Fréry**  
French Institute for Public Health Surveillance (InVS), Saint Maurice, FR  
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Nadine Fréry is a senior scientific epidemiologist, with 20 years experience in biomarkers and human biomonitoring (HBM). She works at the French Institute for Public Health Surveillance (InVS), in the Environmental Health Department as coordinator of HBM projects. She was in charge of developing national HBM programmes to assess the exposure of the French population to chemicals.

Nadine Fréry participates in several expert committees and working groups on environmental health and HBM (European working groups in HBM: SCALE, ESBIO, Implementation Group). She is currently a member of the European COnsortium to Perform Human biomonitoring on a European Scale (COPHES).

**Dr. Andreas Gies**  
Federal Environment Agency, Department of Environmental Hygiene, Berlin, DE  
E-mail: andreas.gies@uba.de

Since 1988 Dr. Andreas Gies has been working at the Federal Environment Agency in Berlin. Currently Dr. Gies is head of the Department of Environmental Hygiene and also head of the WHO Collaborating Centre for Air Quality Management and Air Pollution Control at the Federal Environment Agency.

Dr. Gies studied biology and chemistry at Free University of Berlin. He received a Master's degree on “Changes in lipid composition in brain cell membranes of aging rats” and a doctorate on “Molecular mechanisms inducing relaxation in molluscan catch muscles in *Mytilus edulis*”.

His research areas are human biomonitoring, assessment of health effects of environmental pollutants and exposure analysis. He published more than 40 scientific papers, including UBA reports and book chapters.

**Scientific Assignments**

- Member of the OECD Hazard Assessment Advisory Body (1988-1992)
- Member of the IPCS Steering Group on Endocrine Disrupters (1999-2003)
- Scientific advisor in numerous European, national and international research projects including EDEN, Comprendo, CONTAMED, DEER and REEF (EUR) Fishnet (SWI) Nanocare (GER)
- Head of WHO Collaborating Centre for Air Quality Management and Air Pollution Control at the Federal Environment Agency
- Editor of Chemosphere Environmental Toxicology and Risk Assessment
**Prof. Dr. Philippe Grandjean**
Harvard University, Department of Environmental Health, Boston MA, US  
E-mail: pgrand@hsph.harvard.edu  
Philipppe Grandjean, MD, DMSc is Professor and Chair of Environmental Medicine at the University of Southern Denmark (since 1982). He is also Adjunct Professor of Environmental Health at Harvard School of Public Health, and he serves as Consultant in Toxicology to the National Board of Health, Denmark.

**Douglas Haines**  
Health Canada, Healthy Environments and Consumer Safety Branch, Environmental and Radiation Health Sciences Directorate, Chemicals Surveillance Bureau, Ottawa, CA  
E-mail: doug_haines@hc-sc.gc.ca  
Douglas Haines, B. Sc., M.Sc., is the Director of the Chemicals Surveillance Bureau in Health Canada’s Healthy Environments and Consumer Safety Branch. His Bureau is responsible for implementing national human biomonitoring and environmental monitoring initiatives to track Canadians’ exposures to environmental chemicals.

Mr. Haines previously managed Health Canada’s Great Lakes Health Effects Program and the health component of the St. Lawrence Vision 2000 Program which focussed on assessing and managing health risks posed by environmental pollution in these two ecosystems.

Mr. Haines obtained a Bachelor of Science in Biology from Lakehead University and a Master in Science in Kinesiology from the University of Ottawa.

**Sean M. Hays**  
Summit Toxicology, Lyons CO, US  
E-mail: shays@summittoxicology.com  
Sean Hays is the President and founder of Summit Toxicology, a toxicology and risk assessment consulting firm headquartered in Colorado.

Sean received a B.S. in biomedical engineering from Texas A&M University, an M.S. in Physiology from the University of Vermont, an M.S. in chemical engineering from Colorado State University, and a Ph.D. in Toxicology from the University of Utrecht.

Sean has been a consultant since 1995, where he specializes in conducting exposure assessments, deriving acceptable exposure limits (i.e., reference doses and reference concentrations, cancer slope factors, permissible exposure limits, and minimal risk levels), and developing pharmacokinetic (PK), physiologically based pharmacokinetic (PBPK), and pharmacodynamic (PD) models for drugs and chemicals.

Sean has been an invited speaker at numerous venues on the topic of interpreting human biomonitoring data and is the originator of the concept of the Biomonitoring Equivalent (BE), a screening tool that allows for interpretation of biomonitoring data in a public health risk context.
Dr. Dorota Jarosinska
European Environment Agency, Copenhagen, DK
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Dorota Jarosinska - MD, PhD, currently working at the European Environment Agency in Copenhagen, Denmark as a project manager in Environment and Health. A specialist in public health, focused on environmental medicine/health.

Postgraduate education in environmental health included a year-long training on 'Advanced Environmental Sanitation', a two-year long specialised training for physicians, and a Fulbright scholarship at the National Institute of Environmental Health Sciences, USA.

Past experiences include the clinical practice of environmental medicine, prevention programmes, and research. Cooperated with the WHO Europe on projects on environment and health information system; authored several scientific papers and contributed to the reports by EEA, WHO, and UNEP.

Dr. Reinhard Joas
BiPRO GmbH, Munich, DE
E-Mail: reinhard.joas@bipro.de

Dr. Reinhard Joas is the coordinator of the COPHES project (FP7) which aims to coordinate Human Biomonitoring activities in Europe.

He is educated as chemical engineer and economist and is founder and Managing Director of BiPRO.

Since over 20 years he is working as a consultant for national European governments, the European Commission and the European Parliament on environmental and health issues.

He is actively involved in the European activities related to Human Biomonitoring since almost 10 year.

Prof. Dr. Lisbeth E. Knudsen
University of Copenhagen, Department of Public Health, Copenhagen, DK
E-mail: liek@sund.ku.dk

Professor in Toxicology at the Health Faculty of University of Copenhagen with focus on Human biomonitoring of exposures to environmental pollutants, in vitro toxicology as alternative to animal experiments. Teaching is within public health, toxicology, environmental and occupational health.

At the national level Lisbeth coordinated major human biomonitoring studies within occupational health: stainless steel welders 1987, busdrivers and mail carriers 1995 and participated in several EU programs including REPROTEXCT, NEWGENERIS, COPHES and DEMOCOPHES.

Member of Danish Consensus Platform for 3R Alternatives to Animal Experimentation (DACOPA) and the board of ECOPA.
**Dr. Marike Kolossa-Gehring**  
Federal Environment Agency, Department of Environmental Hygiene, Section Toxicology, Health related Environmental Monitoring, Berlin, DE  
E-mail: marike.kolossa@uba.de

Dr. Marike Kolossa-Gehring received her state exam in Biology in 1986 and Ph.D. based on a toxicological thesis in 1991 from the University of Kiel. During all her working life she was engaged in the field of toxicology and protection of health and the environment.

She joined the German Environment Agency in 1992 where she worked as a scientist in the sections environmental impacts on human health, general and international affairs of environmental chemicals and toxicology. She has worked on the development of methods for testing and assessment of chemicals, endocrine disruptors and fertility impairment, ambient and indoor air quality, and health related environmental monitoring.

In 2002 she became head of the section responsible for environmental risk assessment and regulation of pharmaceuticals, washing- and cleansing agents. Since 2004 she is heading the section toxicology, health related environmental monitoring where she leads the German Environmental Survey, the German Specimen Bank which are the basis for the German concept of a health-related environmental monitoring.

She is a member of the EU Expert team to Support BIOmonitoring (ESBIO), a consortium preparing a concept for biomonitoring in Europe and the German member of the Implementation Group established by the EU-Commission. She is chair of the OECD Endocrine Disruptor Testing and Assessment Task Force, member of the Human Biomonitoring Commission and the ad hoc group Toxicology of the Indoor Air Hygiene Commission of the Federal Environmental Agency.
Prof. Jong - Tae Lee
Korea University, College of Health Science, Seoul, KR
E-Mail: jtleekorea.ac.kr

Education:
1995 Ph.D. Epidemiology, University of North Carolina at Chapel Hill, North Carolina, U.S.A.
1991 M.Sc. Epidemiology, University of Toronto, Ontario, Canada
1986 B.Sc. Biology, Seogang University, Seoul, Korea

Employment:
2009 - present Associate Professor
Department of Environmental Health, College of Health Science, Korea University, Seoul, Korea
2004 - 2009 Associate Professor
Department of Public Health, Graduate School of Hanyang University, Seoul, Korea
2002 - 2004 Assistant Professor
Department of Preventive Medicine, College of Medicine, Ewha Womans University, Seoul, Korea
1996 - 2001 Assistant Professor
Department of Preventive Medicine and Public Health, College of Medicine, Yonsei University, Seoul, Korea

Research Interests:
- Effect of air pollution on health
- Monitoring and modeling of air pollution exposure
- Research on environmental risk factors to reproductive outcomes
- Methodological research on the analysis of longitudinal data and case only data
- Epidemiologic method

Prof. Dr. med. Gabriele Leng
Currenta GmbH & Co. OHG, Leverkusen, DE
E-mail: gabriele.leng@currenta.de

1983 - 1991 Study of chemistry and medicine at The University of Western Ontario in London, Canada and the universities of Bielefeld, Frankfurt and Düsseldorf (1992: graduation; 1993: licence to practise medicine)
1998 - 2002: Medical specialist in hygiene and environmental medicine as well as in occupational medicine
1999 Postdoctoral lecture qualification in hygiene and environmental medicine: „Biomonitoring of pyrethroids in the environmental and occupational medicine”
Since 2002 Head of Institute of Biomonitoring, Currenta GmbH&CoOHG, D-Leverkusen
2005 Associate Professor, University of Düsseldorf
**Dr. Larry L. Needham**  
Centers of Disease Control and Prevention, Atlanta GA, US  
E-mail: Lneedham@cdc.gov

Dr. Larry Needham is Chief of the Organic Analytical Toxicology Branch in the National Center for Environmental Health of the Centers for Disease Control and Prevention (CDC).

His work has involved developing and applying analytical methods for assessing human exposures, via biomonitoring, to environmental chemicals, including persistent organic pollutants (POPs), perfluorinated chemicals, non-persistent organic chemicals (e.g., pesticides, phthalates, alkylphenols, polycyclic aromatic hydrocarbons, phytoestrogens, volatile organic chemicals, chemicals of mass destruction), and heavy metals.

His group is responsible for almost all of the analytical data in CDC’s biannual National Report on Human Exposure to Environmental Chemicals (www.cdc.gov/exposurereport). In addition they collaborate with investigators both domestically and internationally on epidemiological studies involving the relations between human exposures to environmental chemicals and potential adverse health outcomes.

Dr. Needham has authored or co-authored more than 400 scientific publications.

Dr. Needham is an active member of ISEA, former President (2003-2004), and the 2006 recipient of ISEA’s Wesolowski Award. He is also the recipient of the ISES 2010 Constance L. Mehlman Award.

In addition to ISEA, he is a permanent member of the annual Dioxin meeting’s international advisory Board and editor of Chemosphere: Persistent Organic Pollutants and Dioxins. He also regularly consults with many groups, including the National Academy of Sciences, U.S. EPA, Health Effects Research Institute.

Dr. Needham received his BS from Middle Tennessee State University in 1968 and his Ph.D. from the University of Georgia in 1972.

In his first year as an ISEA Distinguished Lecturer he spoke on applications of biomonitoring data to several academic groups and professional societies in the U.S. and in Peru.

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**Alexander Nies**  
E-mail: alexander.nies@bmub.de

Alexander Nies is Deputy Director-General for chemical safety, environment and health in the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. His responsibilities include the legal and factual implementation of REACH in Germany, international (e.g. Stockholm and Rotterdam Conventions, UNEP Governing Council) and national chemicals management, environmental effects of biocides, pesticides and drugs, and environmental contaminants in food. He holds this position since 1 August 2006.

Before his current position, he was the Head of several divisions in the Ministry, including the division on radioactive waste management policy and on radioactive waste disposal where he was, inter alia, responsible for the development of a site selection procedure in cooperation with all involved stakeholders.

He is a mathematician by education and joined the Ministry in 1991. Before that he worked for two years at the Technical University in Berlin and for seven years in a national research centre for environmental health where he was involved in risk assessments for the nuclear fuel cycle.
Prof. Jerome Nriagu
University of Michigan, School of Public Health, Ann Arbor MI, US
E-mail: jnriagu@umich.edu

Jerome Nriagu, PhD, DSc, is Professor in the School of Public Health and Research Professor in the Center for Human Growth & Development, University of Michigan.

His research interests include sources, fate and effects of heavy metals in the environment; exposure and risk assessment with a focus on trace metals; and environmental health in developing countries.

He is the Editor-in-Chief of Science of the Total Environment (Elsevier) and Encyclopedia of Environmental Health (soon to be published by Elsevier).

Prof. Jon Oeyvind Odland
University of Tromsoe, Faculty of Health Sciences, Tromsoe, NO
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Jon Oeyvind Odland, MD, PhD, Specialist in Gynecology and Obstetrics. Professor of International Health, Faculty of Health Sciences, University of Tromsoe. President of The Norwegian Forum for Global Health Research. Scientific editor, International Journal of Circumpolar Health. Chair of AMAP Human Health Assessment Group. Key National Expert, Sustainable Development Working Group. Contributor to books and reports on environmental, epidemiological and reproductive issues. Editor of the AMAP human health reports. Presentations in different international conferences, mainly on environmental and reproductive issues. Totally 80 peer reviewed publications. From 2010 leader of The Climate, Environment and Health Research Center, University of Tromso. Ongoing projects in reproductive and occupational health, environment, and climate change in 20 countries globally.
Dr. Joern Olsen
Aarhus University, School of Public Health, Aarhus, DK
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EDUCATION
1973/74   MD, Aarhus University
1980 PhD in Epidemiology, Aarhus University

EMPLOYMENT
Clinical worker in surgery, internal medicine, general practice, and psychiatry.
1975 - 76   Assistant professor in Human Genetics, Aarhus University
1976 - 77   Research fellow, Aarhus University
1977 - 84  Assistant and associate professor, Department of Social Medicine, Aarhus University
1984-    Professor of epidemiology and social medicine, Aarhus University
1994-    Head, the Danish Epidemiology Science Centre, Aarhus University
2005 - 10 Professor, chair, Department of Epidemiology, UCLA School of Public Health, Los Angeles, USA

PUBLICATIONS
About 500 peer-reviewed research publications in English since 1975, most in reproductive health.

Dr. Peter Pärt
European Commission, Joint Research Centre, Ispra, IT
E-mail: Peter.part@jrc.ec.europa.eu

Peter Pärt is advisor in Environment and Human Health Interactions in Institute of Environment and Sustainability in the European Commission Joint Research Centre and is currently leading the JRC project ENVIHEALTH (Health Impact Assessment of Environmental Risk Factors).


In 2005 he co-authored together with Ingvar Andersson at the European Environment Agency (EEA), the joint JRC/EEA report on Environment and Health (EEA report 10/2005) and is currently together with Dorota Jarosinska at EEA editing a joint JRC/EEA Reference Report on Environment and Health to be published early 2011.

Before joining the European Commission in 1997, Dr Pärt was associate professor (lecturer) in ecotoxicology at the Uppsala University, Uppsala, Sweden.

He has published 72 articles in peer-reviewed journals and 5 book chapters in the area of aquatic toxicology and physiology.
**Prof. Dr. Pham Hung Viet**
Hanoi National University, Research Centre for Environmental Technology and Sustainable Development (CETASD), Hanoi, VN
E-Mail: cetasd@hn.vnn.vn

Prof. Dr. Pham Hung Viet is currently Director of Research Centre for Environmental Technology and Sustainable Development (CETASD), Vietnam National University, Hanoi (VNU-Hanoi).

He received PhD in Chemistry in Switzerland in 1987. From 1987, Prof. Viet has working as a senior lecturer and reputative scientist at Hanoi University of Science (HUS) belonging to VNU-Hanoi. From 1998 up to now, Prof. Viet has played a key role as Task Manager or National Project Coordinator in managing relevant environmental pilot-projects supported by Swiss Agency for Development and Cooperation (SDC, Switzerland), Japanese Society for Promotion of Scientists (JSPS, Japan), the United Nations University (UNU, Japan). In the time from 2004-2007 he has been invited by IERC as a member of the International Advisory Board of IERC.

In the research field, Prof. Viet is focusing on the application of instrumental analytical methods in organic analysis for persistent organic pollutants (POPs) and endocrine disrupting chemicals (EDCs), the assessment of contamination of ground and drinking water by heavy metals. He has conducted research on flow injection analysis (FIA) using electrochemical sensors and biosensors as detector for determination of environmentally relevant ions as well.

Regarding the teaching field, Prof. Viet has been the main supervisor and/or co-supervisor of more than 100 graduate students, 45 master students and 14 PhD students. The list of publications includes approximately 100 publications covering: 68 publications in internationally refereed journals; 70 international conference contributions; 4 text books and monographies.

**James Quackenboss**
U.S. Environmental Protection Agency, Las Vegas NV, US
E-Mail: Quackenboss.James@epamail.epa.gov

James Quackenboss is a Research Scientist for the National Exposure Research Laboratory (NERL) at the U.S. Environmental Protection Agency (EPA).

He has served on the Interagency Coordinating Committee (ICC) for the U.S. National Children’s Study (NCS) since 2002, and has worked with the NCS Program Office on exposure assessment and study designs.

At U.S. EPA, he contributed to the development of the National Human Exposure Assessment Survey (NHEXAS), and coordinated the design of the Minnesota Children’s Pesticide Exposure Study. He received an MS in Preventive Medicine-Epidemiology from the University of Wisconsin-Madison.
**Prof. Dr. Aiguo Ren**  
Peking University, Institute of Reproductive and Child Health, Beijing, CN  
E-mail: renag@bjmu.edu.cn

Aiguo Ren is Professor and Director of the Institute of Reproductive and Child Health, Peking University, China.

He completed his medical education in China and earned his Doctoral degree at the University of Occupational and Environmental Health, Japan.

His research focuses on birth defects control and prevention.

His is maintaining a birth defects biobank and a maternal-child cohort starting from pre-pregnancy.

He is the editor of Chinese Journal of Reproductive Health, associate editor of Public Health Nutrition, and reviews for a number of international scientific journals.

He is the board member of the Chinese Association of Maternal and Child Health.
Dr. Norbert Röttgen
Federal Minister for the Environment, Nature Conservation and Nuclear Safety, Bonn, DE

Education
1984 Abitur (higher education entrance qualification)
1984 - 1989 Law studies at the University of Bonn
1989 First state examination in law
1993 Second state examination in law
2001 Awarded doctorate in law (Dr. iur), Bonn

Professional background
1993 Admission to practice as a lawyer, regional court, Cologne
1999 Admission to practice as a lawyer, higher regional court, Cologne

Political career
1982 Joined CDU
1992 - 1996 Chair of the CDU youth organisation Junge Union, North Rhine-Westphalia
Since 1994 Member of the German Bundestag
2002 - 2005 Legal policy spokesman of the CDU/CSU parliamentary group
2005 - 2009 Chief parliamentary secretary of the CDU/CSU parliamentary group in the Bundestag
Since 28 October 2009 Federal Minister for the Environment, Nature Conservation and Nuclear Safety
Dr. Gerd Romanowski
Chemical Industry Association (VCI), Frankfurt am Main, DE
E-mail: romanowski@vci.de

1977 to 1983: Studied chemistry at the University of Bremen
August 1983: Diploma examination in chemistry
January 1986: Received doctorate in the natural sciences (Dr. rer. nat.) from the University of Bremen
1986 to 1991: Scientist at Philips GmbH, Aachen, Research Laboratory
1991 to 1993: Research and science policy manager in the Science and Research Department of the Chemical Industry Association (VCI)
1993 to 1997: Head of the VCI Director General’s office
1998 to 2001: Director of the Science and Research Department at VCI, managing director at the Chemical Industry Fund, managing director of the German Association of Biotechnology Industries (DIB)
Since April 2001: Executive Director of VCI,
Director of the VCI-Department Science, Technical and Environmental Affairs, Director of Chemical Industry Fund

Dr. Elizabeth Salter Green
Chemicals Health and Environment Monitoring Trust (CHEM Trust), London, UK
E-mail: elizabeth.saltergreen@chemtrust.org.uk

Elizabeth is founding director of CHEM Trust - Chemicals, Health and Environment Monitoring Trust, set up in 2007.

CHEM Trust’s priority work areas are; endocrine disrupting chemicals, particularly those implicated in the disruption of male reproductive health, breast cancer, neurological impairment and diabetes; and European Union chemicals policy and legislation.

Prior to CHEM Trust, Elizabeth was Director of the WWF Toxics Programme for over 10 years (1995-2007), working in the UK, Brussels and Switzerland. Elizabeth directed the WWF biomonitoring programme and WWF lobbying activities during the REACH negotiations from 1999 to 2006. During this time Elizabeth was also seconded to the United Nations Balkans Task Force to investigate the pollution generated via the NATO bombing during the Balkans War (1999).

Her first degree is in clinical physiology, specialising in the endocrinology of metabolism and reproduction. This was followed by six years of marine research. Her second degree is in international environmental law specialising in regional EU and global environmental legislative instruments.

Elizabeth is author of The Toxic Consumer – an accessible guide to the most common toxic chemicals, the consumer products in which they are found, and ways in which consumers can reduce their exposure to them.

Elizabeth is married with 2 young children. Prior to starting her family she had her own toxic body burden tested as part of the WWF biomonitoring programme and, despite a healthy lifestyle, was concerned to find a cocktail of hazardous chemicals in her body.
Prof. Hiroshi Satoh
Tohoku University Graduate School of Medicine, Sendai, JP
E-mail: h.satoh@ehs.med.tohoku.ac.jp

Professor, Environmental Health Sciences, Tohoku University Graduate School of Medicine

Education
1979  Ph.D., Tohoku University Graduate School of Medicine, Japan,
1974  M.D., Tohoku University School of Medicine, Japan,

Professional Experience
1989-present Tohoku University Graduate School of Medicine, Environmental Health Sciences, Professor,
1985-1989 Hokkaido University School of Medicine, Department of Hygiene, Associate Professor,
1981-1985 Fukushima Medical University, Department of Hygiene, Assistant Professor,
1979-1981 The University of Rochester, NY, USA, Toxicology and Environmental Health, Research Fellow,
1979  Tohoku University School of Medicine, Department of Public Health, Research Associate

Dr. Martin Schlaud
Robert Koch Institute, Berlin, DE
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Martin Schlaud is the head of the unit "Health of Children and Adolescents, Prevention Concepts" in the department "Epidemiology and Health Reporting" of the Robert Koch Institute in Berlin, Germany. He is the medical PI of the nationwide German Health Interview and Examination Survey for Children and Adolescents ("KiGGS").

After he had studied human medicine at the universities of Giessen and Hannover, he received a doctorate for his thesis on epidemiological associations between ambient air pollution and risk of croup disease in children. He received his further education in epidemiology in Hannover, Berlin and Boston.

During his career as the head of the section "Clinical and Non-Clinical Epidemiology" in the Department of Epidemiology, Social Medicine and Health System Research at Hannover Medical School, he planned, carried out, analyzed and published numerous epidemiological studies, mainly focused on the health of children. At Hannover Medical School, he qualified as a professor of epidemiology and social medicine and is with the Robert Koch Institute since 2003.
**Prof. Dr. Greet Schoeters**

Flemish Institute for Technological Research (VITO), Mol, BE  
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Dr. Greet Schoeters is program manager Environmental Risk and Health at VITO – Belgium and associated professor at the University of Antwerp. She coordinates Flanders human biomonitoring program (2002-2011) which has been established as part of the Flemish Environmental Health surveillance program.

Research projects focus on understanding the relationship between environmental chemical exposures and health. Major interest is on development of biomarkers and their application in human biomonitoring and in alternative toxicity testing.

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**Dr. Ovnair Sepai**

Health Protection Agency, Chemical Hazards and Poisons Division, Chilton, UK  
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Lead a team of 12 toxicologists.

The group provides expert advice to Government Departments and Agencies as well as HPA and other health professionals on the health effects of exposure to environmental chemicals. This includes review of available data and assessment evidence gaps.

Provide the secretariat to the Chief Medical Officers Expert committees – Carcinogenicity, Mutagenicity and Toxicity. These responsibilities make this group a strategy link with government policy makers.

Expertise in the development, validation and application of human Biomonitoring methods for the assessment of human exposure and uptake of anthropogenic and naturally occurring environmental chemicals.

Represent the HPA on a Pan-European initiative (COPHES) to develop a standardised approach to human Biomonitoring across the EU.

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**Dr. Shibata, Yasuyuki**

National Institute for Environmental Studies, Environmental Chemistry Division, Tsukuba-City, JP  
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Graduated Dept. Biochemistry, Univ. Tokyo in 1977, and started working at the National Institute for Environmental Studies from 1982 until now, including one year research fellow experience at Harvard Medical School.

The major research topics include pollutant analysis in biological and environmental samples, speciation of arsenic in human and environmental samples, and environmental researches by the analysis of carbon 14 and other cosmic-ray produced long-lived radio-nuclei by accelerator mass spectrometry.
Prof. Skakkebaek, Niels E.
Copenhagen University Hospital (Rigshospitalet), Department of Growth and Reproduction, Copenhagen, DK
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Education
1965 Graduated Medical School, University of Copenhagen.
1965 - 1967 Basic medical training at Sct. Joseph’s Hospital, Copenhagen.
1972 - 1980 Training in medicine and pediatrics at various hospitals in the Copenhagen area.

Doctoral dissertation
1974 Doctor of Medical Sciences, University of Copenhagen. Studies on meiotic chromosomes in infertile males.

Professional career
1967 - 1972 Chromosome Laboratory, Rigshospitalet, Copenhagen (Research assistant).
1974 - 1975 Medical Research Council Reproductive Center, Edinburgh, Scotland.
1975 - 1980 Clinical training and laboratory research at Rigshospitalet (combined).
1980 - 1982 Laboratory of Reproductive Biology, Rigshospitalet (Consultant).
1982 - 1990 Professor of Pediatrics, University of Copenhagen, Fuglebakken Hospital and Hvidovre Hospital.
Since 1990 University of Copenhagen, Rigshospitalet, Professor
1990 – 2006 Chairman of University Department of Growth and Reproduction, Rigshospitalet, Copenhagen.
Since 2006 Senior Researcher, University Department of Growth & Reproduction and adjunct professor, University of Copenhagen.

Research
Since 1972 - Carcinoma in situ testis (CIS): biological, genetic, clinical and epidemiological aspects.
Prevalence of CIS in infertile men, patients with undescended testis and with intersex.
Prevalence of CIS in risk groups and normal population. CIS in the contralateral testis of men with unilateral testicular cancer. Eradication of CIS by local irradiation of the testis.
Early detection of CIS by biopsy of the testis. Detection of CIS cells in seminal fluid.
Stem cell properties of the CIS cell.
Since 1985 - Endocrinological aspects of growth and reproduction with emphasis on IGF-I and Inhibin-B, and their relation to puberty and testicular function, including spermatogenesis.
Since 1992 - Environmental aspects of male reproduction and its disorders, including testicular cancer. Testing of the so-called endocrine disrupter hypothesis (which links poor semen quality, testicular cancer, undescended testis and hypospadias as various symptoms of a testicular dysgenesis syndrome, due to impaired differentiation of fetal primordial germ cells). Systematic molecular studies of gene expression in the testis and testicular neoplasia.

Major accomplishments:
Demonstration of CIS as the precursor of testicular germ cell tumours. Linking CIS with maldeveloped gonads and the intersex syndrome. Establishment and optimisation of testicular biopsy as a tool in early detection of CIS. Characterisation of the phenotype of the CIS cell and discovery of several markers for CIS. Eradication of CIS by low dose irradiation (preventing orchiectomy of second testis in men with testicular cancer). Providing evidence for developmental origin of CIS and germ cell cancer. Scientific evidence for adverse trends in male reproductive health and for an aetiological link between male reproductive disorders.

Publications
Published approximately 500 papers, more than 400 of these are in international peer reviewed journals.

Citations per July 2010: 23,937 (extracted from ISI Web of Knowledge).

H-index: 73 (calculated according to Hirsch JE. An index to quantify an individual's scientific research output). www.arxiv.org/abs/physics/0508025

Research awards, prizes and donations
**Hubert Steinkemper**  
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**Studies in Law**  
University of Freiburg 1968 -1973  
2nd state examination in law 1975  
University of Illinois Master of Comparative Law (M.C.L.)

Subsequently, academic assistant at the “Institut für Ausländisches und Internationales Privatrecht”/University of Freiburg

**Federal Ministry of the Interior**  
Desk officer 1980 -1987

**Federal Ministry for the Environment, Nature Conservation and Nuclear Safety**  
Head of Division 1987 -1994  
Deputy Director-General 1999 - 2009; Directorate IG I (Immission Control, Safety of Installations and Transport)  
Director General since 2009; Directorate-General IG (Environmental Health, Immission Control, Safety of Installations and Transport, Chemical Safety)

**Eisaku Toda**  
Ministry of the Environment, Environmental Risk Assessment Office, Tokyo, JP  
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Director of the Chemicals Evaluation Office of the Ministry of the Environment from 2007 to 2009. During this period also served as Chairman of the OECD Test Guidelines Working Group, and Vice-President of the International Conference for Chemicals Management.  
Since August 2010, Director of the Risk Assessment Office, responsible for environmental and health risk of chemicals including the Japan Eco & Child Study.
**Dr. Lisette van Vliet**  
Health and Environment Alliance, Brussels, BE  
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Lisette van Vliet is Toxics Policy Advisor for Health and Environment Alliance, and works in Brussels, the seat of the European Union.

She holds a Ph.D. in international relations and environmental studies from the Australian National University in Canberra. Prior to working on Toxics, she worked in international forest politics, mainly on forestry and timber certification and wood purchasing policy. She conducted research for NGOs such as Greenpeace, Co-op America, Save the Rainforest and Robin Wood (Germany), and for environmental management consultants.

Lisette now works on REACH, the new EU chemicals legislation, and on other EU legislation and policy governing hazardous chemicals such as phthalates, mercury and endocrine disruptors.

**Prof. Dr. Wilhelm, Michael**  
Ruhr-University Bochum, Institute for Hygiene, Social and Environmental Medicine, Bochum, DE  
E-mail: wilhelm@hygiene.rub.de

**Education**

Biology, biochemistry (Diplom-Biologe) and medicine (Medical Doctor, Promotion), University of Hamburg; Habilitation in Toxicology, Heinrich-Heine-University Düsseldorf; Medical specialist in Pharmacology and Toxicology, Environmental Medicine, Hygiene and Environmental Health.

**Professional experience**

Assistant at the University Hospital Hamburg-Eppendorf, the Institute of Toxicology and Pharmacology, assistant director, Institute of Hygiene, all Heinrich-Heine-University Düsseldorf. Since 1997 C4 Professor and Head of Department of Hygiene, Social and Environmental Medicine, Ruhr-University Bochum. Since 2010 chairman of the German Human Biomonitoring Commission.
Human Biomonitoring

Nutzen für die Politik – Herausforderung für die Wissenschaft
Political benefits – scientific challenges


Poster abstracts
List of Authors (in alphabetical order with poster number)

<table>
<thead>
<tr>
<th>Author</th>
<th>Institution</th>
<th>Poster Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahn, Ryoung-Me</td>
<td>Dongduk Women's University, School of Natural Science, KR</td>
<td>1.1</td>
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<tr>
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<td>6.1</td>
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<td>1.7</td>
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<td>1.5</td>
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<td>Université Libre de Bruxelles, BE</td>
<td>2.5</td>
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</table>
1.1 **Biomonitoring of Exposure to Hazardous Materials from Foods Consumption in Korea - Study design and baseline characteristics**

**Kyoung-Ho Lee** (1), **Ryoung-Me Ahn** (2), **Ki-Jae Lee** (3), **Jin-Heon Lee** (4)

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This study is mainly about analyzing hazardous materials from foods consumption in nationwide populations for evaluating individual contaminant exposures and health risk factors. A study was conducted in nationwide survey to assess the feasibility of implementing a system of exposure among the general population to hazardous materials from foods.

Participants in the study numbered 872 (42.3%) men, 1,191 women (57.7%) and total 2,063 adult participants at 100 randomly selected areas in Korea. Blood, urine and questionnaires were collected from each participant. These bio-specimens were collected and delivered in low temperature under internal SOP’s control. The following hazardous materials in specimens are now being measured; Phtalates and Acrylamide from urine (LC-MS/MS), Heterocyclicamines from serum (LC-MS), POPs from serum(GC-MS), Perfluorocarbons from serum (LC-MS/MS), Phenols from urine (GC-MS). Information on exposure conditions of all human subjects were collected by questionnaire-based interviews, including socio-demographic information, socioeconomic status, family history, indoor and outdoor environments, life-style, occupational history and dietary information.

In this paper, we describe the study design, methodology as well as baseline characteristics of the study. The same study is now on with 1,000 child (under19) funded by KFDA. These resources from the nationwide health survey will be valuable in future studies of biomarkers from foods consumption in Korea.
1.2 Mercury, Lead and Cadmium levels in urine of 170 Adults living in Madrid (Spain): A pilot Human Biomonitoring Study

Argelia Castaño (1), A. Cañas(1), J. Sánchez(1), M. Esteban(1), C. Navarro(1), M. Arribas(2), C. Rodríguez(1) G.Díaz (1) J.Jimenez (1)

(1) Environmental Toxicology. C.N.S.A. Instituto de Salud Carlos III. Majadahonda, Madrid, Spain
(2) Servicio de Prevención. Instituto de Salud Carlos III. Majadahonda, Madrid, Spain

Concerns about adverse health effects of environmental pollutants have led to an increase in measures to control and protect the general population. Human Biomonitoring (HBM) is a well recognized tool to estimate the exposure of the human population to environmental pollutants. Following recommendations of the European Environment and Health Action Plan (COM(2004) 416 final) developed within the SCALE strategy, a coordination action has been funded by European Commission 7th Framework Program in order to establish a common strategy on HBM across Europe. Some EU countries have applied HBM in the general population over the last 20 years, among others Germany, Belgium, Sweden and Czech Republic, while others are on the way to set up their national HBM activities. Spain is one of these.

Spanish Environment Ministry has recently funded a HBM study on the Spanish general population. This study aims to determine reference levels for several biomarkers i.e. heavy metals, POPs and cotinine, measured in urine, whole blood, serum and hair, within the general adult Spanish population. The study will involve more than 2000 volunteers throughout Spain. Samples have been taken during 2009-2010 and the analyses are currently underway. The results presented here are those obtained in a pilot study carried out just in the Madrid area to establish the methodology.

The study group is formed by 170 volunteers of which 79 % were female and 21% male. Participants were asked to complete a questionnaire with diet and living habits and provide a morning urine sample. The age of participants ranged from 23 to 76 years old. The results of the urinary concentrations for total mercury, cadmium and lead are reported. The geometric mean for total Mercury, Cadmium and Lead were 1.20, 0.25 and 1.11 µg/L (1.22; 1.12 and 0.25 ug/g creatinine) respectively.
1.3 Biomonitoring Study of Children Exposed to Different Levels of Pollution in the Hainaut Province

Marie-Christine Dewolf (1), Dr. E. Noël (1), Ph. Fierro (1), W. Fris (1), P. Bouviez (1), M. Hakimi (1), A. Marijns (2), C. Passelecq (2), W.H. Zhang (3)

(1) Hainaut Vigilance Sanitaire- Hygiene Publique in Hainaut, Mons, Belgium (HVS-HPH)
(2) University of Mons Hainaut, Mons, Belgium (UMons
(3) School of Public Health, University of Brussels (ESP, ULB)

Children are not exposed equally to the multiple sources of exposure. The objective of this study was to estimate the exposure 6 to 12 years’ old children living in different environments.

An environmental characterization (including surface soils testing and air quality monitoring) and a biomonitoring of children living in 4 targeted municipalities have been carried out. Children’s exposure has been estimated through the analysis of urines and hair samples. To better understand the exposure and refine the results’ interpretation, the zones of emissions’ impact have been estimated by means of a dispersion model and a geostatistic analysis has been undertaken on the surface soil results.

A total of 476 sample were analysed, the geometric mean of heavy metals levels in children’s hair for Cd, Hg, Ni and Pd were respectively, 0.09 µg/g; 0,24 µg/g; 0,43 µg/g and 2,59µg/g. The analysis of risk factors showed the positive significant relationships between Hg level and fish consumption and Cd levels and garden fruits consumption. Significant differences have been found between the communities.

Because no reference value was found addressing children specifically, the heavy metals levels in urines were compared with different reference values of the general population. The variability between reference values has brought some difficulties to interpret the results. The values of: P98 for Cd (0.72 µg/g creatinine), P50 for Cr (0.31 µg/g creat.), P95 for Co (1.42 µg/g creat.), P95 for Hg (1.94 µg/g creat.), P50 for Ni (1.47 µg/g creat.), P50 for Pb (0.77 µg/g creat.) are < all reference values. The muconic acid in urines shows 30 % above the strictest reference value. The value of P50 for 1-hydroxypyrène (0.32 µg/g creatinine) is > strictest reference value. 41.5 % of the children had 1 heavy metal (on the 6 analysed) in their urines above one of the Belgian reference values; 7.7 % had 2 heavy metals and 0.2 % had 4 heavy metals.

The assessment of environmental risk factors from their emissions to potential health effects constitute a necessary step for the development of adequate policies, the implementation of effective actions and the change of the behaviours will lead to the integration of the child within his environment. Therefore, global approaches, including different techniques are necessary to better understand the multiple and complex exposure pathways.
1.4 Human Biomonitoring – Pollution gets Personal! Studies of the Environment Agency Austria

Philipp Hohenblum (1), S. Scharf (1), G. Lorbeer (1), M. Uhl (1), A. Riss (1), H.-P. Hutter (2)

(1) Environment Agency Austria, Vienna, Austria
(2) Institute of Environmental Health, Medical University of Vienna, Austria

Humans are exposed to a broad variety of man-made chemicals. Major exposure routes are environmental pollution, food and consumer products. As fundamental competence of the Environment Agency Austria, the environmental burden is well described in studies about (emerging) pollutants in relevant media (eg. household dust, indoor air, products,…). These data present a good knowledge of pollutants’ environmental distribution and can be used to identify/detect substances relevant for human exposure.

Human biomonitoring data reveal the individual body burden irrespective of sources and routes of uptake. It outlines that humans are in the centre of the environment being exposed via oral, pulmonary or dermal pathways. This work presents data of polycyclic musk compounds (galaxolide), industrial chemicals (Bisphenol A [BPA]) and polybrominated diphenylethers (PBDEs).

Galaxolide was detected in groundwater samples, sewage treatment plants, riverine sediments as well as in indoor particulate matter and household dust in the lower range of mg/kg or µg/L. Personal care products and laundry products contained galaxolide up to several percents. Furthermore, we determined polycyclic musk compounds in blood plasma of young adults (n=100). Galaxolide was detected in 91% of the samples (max. 4.1 µg/L).

PBDEs are also encountered in high alpine areas. They accumulate e.g. in humus and spruce needles and can be detected in sewage sludge or sediments. Humans are exposed to PBDE by a variety of household and construction products. Representative data of human blood samples are currently elaborated. A study with occupationally exposed persons showed only minor concentrations.

Bisphenol A was detected in household dust, waste water, sewage sludge, riverine sediment and soil samples in the range of µg/L or mg/kg. Major source for exposure to humans is canned food. An Austrian human biomonitoring data base is currently elaborated.

It can be concluded that the selected substances can be detected in all environmental compartments. Some media contain concentrations comparable to sewage sludge. Products play an important role as sources relevant for human exposure.


12 data not published. Case study on exposure of 25 theatre employees in Vienna in collaboration with the Austrian Social Insurance for Occupational Risks (AUVA).
1.5 First Nations Biomonitoring Initiative

Stuart Wuttke, E. La Corte
Assembly of First Nations, Ottawa, Canada

Background

First Nations, the first peoples of this land, are bound to the environment through their traditional foods and lands, thus increasing their exposure to environmental contaminants and health risks these may impose in an individual.

Until now very little or no information exists on First Nations exposure to environmental contaminants, making this initiative the first study of its kind in Canada and with First Nations ownership and control, demonstrating the level of commitment and responsibility that the FN leadership can undertake toward the progress and wellbeing of their peoples.

Purpose

The Assembly of First Nations is implementing a biomonitoring study to determine the level of several environmental contaminants in First Nations Communities across Canada. This study will be undertaken in the fall of 2010 and will provide information on the body’s burden of pesticides, trace metals, PFCs, PCBs, among others, in the individuals of the studied communities.

The results will be comparable to those obtained through the Canadian Health Measures Survey for the Canadian population, allowing the identification of possible similarities or differences and the identification of potential areas of concern either by human activities or cultural and behavioral differences.

Methods and results

The components of this initiative are comprised of a physical examination with anthropometric and clinical information collection; a household questionnaire to assess risk, exposure and utilization of the contaminants in study; and biological specimen collection (blood and urine) for laboratory analysis.

The results will be collected, aggregated and analyzed in spring 2011 for the development of a final report. Based on the conclusions and recommendations of the final report, phase 2 of the study will be planned for the following years.

This biomonitoring study will provide baseline data for future studies and help First Nations focus on specific health related issues.
1.6 Human biomonitoring national programme development in Slovenia

Lucija Perharic, P. Vracko
National Institute of Public Health, Ljubljana, Slovenia

In Slovenia patchy human biomonitoring (HBM) data, mainly in areas polluted with lead, mercury or polychlorinated biphenyls (PCBs), has been collected over the past three decades. In 2007 we prepared a HBM national programme based on the initiatives and recommendations of the World Health Organisation, the International Programme on Chemical Safety and the European Environment and Health Action plan 2004 – 2010.

In the absence of national reference values we proposed an initial two year cross sectional environmental epidemiological study aiming to establish national reference values for selected chemicals by examining blood of 40 males in addition to blood and milk of 40 breastfeeding first time mothers, aged 20 – 35 years living in four unpolluted areas, and fulfilling other specific inclusion and exclusion criteria. Thereafter inhabitants of other regions including the polluted hot spots would be involved. The following chemicals were selected: benzene, cadmium, fluoride, lead, mercury, organochlorine pesticides, and a range of polybrominated diphenyl ether, polychlorinated dibenzodioxin, polychlorinated dibenzofuran and PCB congeners. The selection criteria were based on national air and soil monitoring data, toxicological hazard of chemicals, their persistence and bioaccumulation potential, estimated size of exposed populations, analytical capacity, known public concerns, as well as trends in other countries. In order to identify exposure sources we also designed a detailed questionnaire which would be completed by the study participants. Secondary to financial limitations, organisational difficulties and certain other reasons our programme was modified, and study onset delayed. The first results are expected by the end of 2010.

We expect that the National Institute of Public Health will play an active role in interpretation of the results, their linking with the existing health monitoring data, risk assessment, risk communication, recommendation of risk reduction measures, and further development of the national HBM.
1.7 Harmonised Human Biomonitoring in Europe – activities towards an EU HBM framework


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(2) Katholieke Universiteit Leuven, Leuven, Belgium
(3) Umweltbundesamt, Berlin, Germany
(4) Institute for Prevention and Occupational Medicine of the German Social Accident Insurance (IPA), Bochum, Germany
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(6) Flemish Institute for Technological Research, Mol, Belgium
(7) Health Protection Agency, London, UK
(8) University of Copenhagen, Copenhagen, Denmark
(9) Josef Stefan Institute, Ljubljana, Slovenia
(10) Environmental Health Service International, Hulst, The Netherlands
(11) Federal Public Service Health, Food Chain Safety and Environment, Brussels, BE

HBM is an effective tool to assess human exposure to environmental pollutants and potential health effects of such pollutants. It is seen as an essential element in a strategy aiming to integrate health and environment. In support of the European Environment and Health Action Plan European Member States scientists are developing a functional framework to define, organize and manage a coherent approach towards HBM in Europe. The framework aggregates experiences from existing and planned HBM activities in European countries and worldwide to investigate what is needed to support better comparability of HBM data. Such is needed to establish human biomonitoring as a tool for the control of chemical regulations (REACH) and to improve quantification of exposure of the general European population to existing and emerging pollutants. Additionally HBM can be used to determine reference values for exposure, to support policy making by e.g. evaluation of policy actions aimed at reducing exposure to potentially hazardous environmental stressors at a European level and to promote more comprehensive health impact assessments of policy options. Furthermore communication and a link to European biobanking activities will be enhanced. From an inventory and analysis of existing and planned HBM studies in different EU MS similarities and discrepancies (related to environmental exposures, national environmental health concerns, analytical capacities, and political and health priorities) are identified and harmonized study protocols are prepared. The concept will be tested from 2011 on in a feasibility study. All this is done by a consortium consisting of 35 partners from 27 European countries (COPHES).
1.8 The German Environmental Specimen Bank – Human specimens

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The German Environmental Specimen Bank (ESB) is the national instrument for retrospective monitoring in human and environmental matrices. Routine operation of the German ESB started in 1985. After two decades the German ESB provides a continuous record of the chemical exposure of the environment and human populations providing data on temporal trends and spatial differences.

Every year real-time monitoring (RTM) of body burden is performed in blood, urine, and hair from German university students. At sampling data are collected via standardized self-reported questionnaires on medical parameters (e.g., health status, body weight), personal meta-data (e.g., sex, age, place of birth), exposure relevant behaviour (e.g., nutrition, contacts to chemicals), and other exposure factors (e.g., social environment, milieu).

Routine analysis currently covers 69 inorganic substances, e.g. heavy metals, essential elements, and five organochlorine compounds. RTM demonstrates that concentrations of several substances remain unchanged over time e.g., arsenic, cadmium, mercury. Concentrations of other substances significantly have decreased, e.g. lead and pentachlorophenol (PCP).

Stored samples in the German ESB allow a rapid retrospective monitoring of emerging contaminants whenever needed. Recent examples from the German ESB work are phthalates, brominated and perfluorinated compounds. ESB data confirms the success of EU and global regulatory efforts to reduce human and environmental exposure, e.g., dioxins, PCBs, PFOS. In contrast, German ESB data indicate time dependent increase of e.g., PBDE and DINP concentrations in human tissues and the potential need for harmonized risk reduction strategies. Current research investigates the feasibility of sampling human tissues from highly vulnerable groups, i.e. children. A future key issue is the integrated risk assessment of ESB human and environmental data. Information about specimen sampling and extensive results are available at www.umweltprobenbank.de.
2.1 The perinatal archive of the German Environmental Specimen Bank: Internal exposure of the newborn with phthalate metabolites

Lorenz Dobler (1), Antje Müller (1), Andreas K. Günsel (1), Rolf Eckard (1), Walter Klockenbusch (2), Sebastian D. Schäfer (2), Marike Kolossa-Gehring (3), Jürgen Angerer (4), Matthias Wittassek (5), Gerhard A. Wiesmüller (1)

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(4) BGFA - Research Institute of Occupational Medicine German Social Accident Insurance, Ruhr University Bochum, Germany
(5) Institute and Outpatient Clinic of Occupational, Social and Environmental Medicine, University of Erlangen-Nuremberg, Germany

Currently, information on human exposure to phthalates in sensitive populations, e.g., the newborn, is very limited. Therefore, 11 amniotic fluid samples collected during Caesarean section and 11 corresponding maternal urine samples taken immediately before delivery have been analysed for metabolites of DEHP, DiNP, DnBP, DiBP, and BBzP using a LC/LC-MS/MS method developed for simultaneous determination of several phthalate metabolites in human urine. As shown in Table 1, nearly all phthalate metabolites analysed could be detected in all amniotic fluid samples, but mainly in a very low and narrow concentration range: Mean levels measured in amniotic fluid are clearly lower than in maternal urine. For the majority of the phthalate metabolites analysed, no significant correlations (Spearman’s rank correlation) between both biological matrices could be observed.

In conclusion, several phthalates or their metabolites, resp., can cross the placenta barrier and may also reach the human fetus. The in utero phthalate exposure, fetal metabolism of phthalates, and potential effects on fetal (reproductive) development should be investigated in further studies. Because of the continuous turn over of amniotic fluid, maternal urinary levels seem to be most appropriate for assessing both maternal and fetal phthalate exposure.

Table 1: Phthalate metabolites in amniotic fluid and maternal urine.

<table>
<thead>
<tr>
<th>Phthalates Phthalate Metabolites</th>
<th>&gt; LOD n</th>
<th>Mean* Median Std.-Dev.* Maximum</th>
<th>&gt; LOD n</th>
<th>Mean* Median Std.-Dev. Maximum</th>
<th>Spearman-r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amniotic fluid</td>
<td></td>
<td></td>
<td>Urine (maternal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEHP 2cx-MMHP [µg/L]</td>
<td>11</td>
<td>.60 .84 .22 .92</td>
<td>11</td>
<td>6.36 4.22 4.41 12.97</td>
<td>p &gt; 0.05</td>
</tr>
<tr>
<td>5cx-MEPP [µg/L]</td>
<td>11</td>
<td>.90 .53 .72 2.68</td>
<td>11</td>
<td>32.99 26.96 25.16 84.64</td>
<td>p &gt; 0.05</td>
</tr>
<tr>
<td>5OH-MEHP [µg/L]</td>
<td>8</td>
<td>.19 .23 .08 .31</td>
<td>11</td>
<td>18.83 10.49 14.71 38.14</td>
<td>0.65 (p = 0.03)</td>
</tr>
<tr>
<td>5oxo-MEHP [µg/L]</td>
<td>2</td>
<td>.10 n.c. n.c. 23</td>
<td>11</td>
<td>18.25 11.95 13.52 35.25</td>
<td>n.c.</td>
</tr>
<tr>
<td>MEHP [µg/L]</td>
<td>11</td>
<td>2.35 1.62 2.28 8.41</td>
<td>11</td>
<td>(74.00)b (55.62)b (67.50)b (242.18)b</td>
<td>n.c.</td>
</tr>
<tr>
<td>DiNP cxx-MiNP [µg/L]</td>
<td>1</td>
<td>n.c. n.c. n.c. 4.85</td>
<td>10</td>
<td>5.84 5.60 4.53 17.28</td>
<td>n.c.</td>
</tr>
<tr>
<td>OH-MiNP [µg/L]</td>
<td>1</td>
<td>n.c. n.c. n.c. 23</td>
<td>11</td>
<td>5.93 2.50 7.66 23.30</td>
<td>n.c.</td>
</tr>
<tr>
<td>oxo-MiNP [µg/L]</td>
<td>0</td>
<td>n.c. n.c. n.c. n.c.</td>
<td>9</td>
<td>2.33 1.28 3.07 10.96</td>
<td>n.c.</td>
</tr>
<tr>
<td>BBzP MBzP [µg/L]</td>
<td>11</td>
<td>2.08 1.91 .34 2.83</td>
<td>11</td>
<td>6.26 4.97 3.57 12.06</td>
<td>p &gt; 0.05</td>
</tr>
<tr>
<td>DiBP MBP [µg/L]</td>
<td>11</td>
<td>10.01 4.15 10.39 35.69</td>
<td>11</td>
<td>50.63 33.81 48.66 160.48</td>
<td>0.74 (p = 0.01)</td>
</tr>
<tr>
<td>DnBP MnBP [µg/L]</td>
<td>11</td>
<td>9.07 7.77 5.15 18.88</td>
<td>11</td>
<td>35.15 23.87 31.88 96.98</td>
<td>p &gt; 0.05</td>
</tr>
</tbody>
</table>

*a For calculation of the mean values we set values <LOD to LOD/2 and those >LOD but <LOD+LOD/2 to standard deviation
*b The MEHP levels in the MU samples are assumed to be invalid because of highly probable DEHP/MEHP contamination from the urine bags
*n.c. = not calculated
2.2  *In utero exposure to pesticides as measured in meconium – a preliminary study*

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Meconium (the baby’s first faecal material) is known to accumulate over the last two trimesters of pregnancy and may provide a cumulative measure of prenatal exposure to xenobiotics. Some studies showed that it allows a good detection of many chemicals, in particular when combining with some measures of maternal exposure. It seems to be an interesting, but insufficiently used, matrix for biomonitoring studies.

The main objective was to develop an analytical method to assess some pesticide levels in meconium of newborns, in order to further estimate prenatal pesticide exposure in Picardy, a northern part of France (using those levels combined with other measures and exposure data). A wide range of pesticides and metabolites, including carbamates, phenylureas, pyrethroids and organophosphates, have been firstly targeted. The selection has been done by considering their toxicity (developmental effects, endocrine disruption …); the quantities used in Picardy (census from the regional organisation for plant protection); the theoretical potential of ending up in air and water; the importance of household; and on the bases of other French biomonitoring data (concerning other biological matrices). The protocol of preparation, extraction and analyses of targeted pesticides and their metabolites in meconium has been developed. LC-MS/MS analyses have been done, in order to determine the pesticides as well as their metabolites simultaneously. The developed method and the preliminary results of exposure to pesticides are presented in the current poster.
2.3 The perinatal archive of the German Environmental Specimen Bank: Body burden of the newborn

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Since the 1980s the German Environmental Specimen Bank (ESB) has been sampling human specimen (e.g., blood and urine) from healthy young adults. Because of increasing demands for the investigation of vulnerable stages in human development a pilot study was performed to verify operational and scientific feasibility of perinatal matrices, e.g., amniotic fluid, cord blood, placenta, in human biomonitoring within the ESB routine program.

Until March 2009 perinatal samples have been collected from 102 mother-newborn-pairs. Concentrations of 5 persistent organic pollutants have been analyzed using GC-MS. Multi-element analyses are performed with high resolution ICP-MS.

The concentrations (mean and standard deviation) of PCP, HCB, PCB-153, PCB-138 and PCB-180 that have been measured in 3 perinatal media are shown in Table 1. The mean concentrations of these substances in cord and maternal blood show significant differences (Wilcoxon signed-rank test, p < 0.01).

Table 1: Organochlorine compounds in different perinatal media.

<table>
<thead>
<tr>
<th>Media</th>
<th>N</th>
<th>MEAN</th>
<th>Std.-Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCB [ng/g]</td>
<td>22</td>
<td>0.14</td>
<td>0.10</td>
</tr>
<tr>
<td>PCB138 [ng/g]</td>
<td>22</td>
<td>0.34</td>
<td>0.25</td>
</tr>
<tr>
<td>PCB153 [ng/g]</td>
<td>22</td>
<td>0.19</td>
<td>0.14</td>
</tr>
<tr>
<td>PCB180 [ng/g]</td>
<td>22</td>
<td>0.12</td>
<td>0.10</td>
</tr>
<tr>
<td>PCP [ng/g]</td>
<td>22</td>
<td>0.10</td>
<td>0.04</td>
</tr>
</tbody>
</table>

The concentrations of Cd, Hg, Mn, and Pb have been measured in 7 perinatal media (s. Table 2). All elements show significant mean differences (Student’s t-test for dependent samples, p < 0.001) for the mean levels in cord and maternal blood, in placenta and amnion, and, except for Mn, in maternal urine and amniotic fluid.

Table 2: Heavy metals in different perinatal media.

<table>
<thead>
<tr>
<th>Media</th>
<th>N</th>
<th>MEAN</th>
<th>Std.-Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cd [ng/g]</td>
<td>73</td>
<td>1.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Hg [ng/g]</td>
<td>73</td>
<td>2.6</td>
<td>2.3</td>
</tr>
<tr>
<td>Mn [ng/g]</td>
<td>73</td>
<td>923</td>
<td>39</td>
</tr>
<tr>
<td>Pb [ng/g]</td>
<td>73</td>
<td>14.8</td>
<td>18.6</td>
</tr>
<tr>
<td>Cd [ng/L]</td>
<td>72</td>
<td>614</td>
<td>412</td>
</tr>
<tr>
<td>Hg [ng/L]</td>
<td>72</td>
<td>919</td>
<td>875</td>
</tr>
<tr>
<td>Mn [ng/L]</td>
<td>72</td>
<td>19106</td>
<td>20580</td>
</tr>
<tr>
<td>Pb [ng/L]</td>
<td>72</td>
<td>13348</td>
<td>15441</td>
</tr>
<tr>
<td>Cd [ng/L]</td>
<td>5</td>
<td>1038</td>
<td>520</td>
</tr>
<tr>
<td>Hg [ng/L]</td>
<td>5</td>
<td>89</td>
<td>39</td>
</tr>
<tr>
<td>Mn [ng/L]</td>
<td>5</td>
<td>1484</td>
<td>1672</td>
</tr>
<tr>
<td>Pb [ng/L]</td>
<td>5</td>
<td>599</td>
<td>514</td>
</tr>
</tbody>
</table>

Pollutant concentrations in cord blood and newborn urine are supposed to reflect the fetal exposures most adequately. However, the results provide further insight into interrelations within the perinatal exposure to environmental pollutants.
2.4 Biomonitoring methods to assess exposure of infants to the mycotoxin ochratoxin A through human milk in mother-child pairs

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Ochratoxin A (OTA) is a well known nephrotoxic mycotoxin classified by IARC as possible human carcinogen and a frequent contaminant in food. Human OTA exposure has been documented by biological monitoring using blood or urine, and also breast milk samples [1]. Since breast milk is the best form of nutrition for the first months of life, it is important to monitor contaminant levels in this matrix. Yet, the database on OTA levels in human milk is rather small. The aim of this study was to assess the OTA exposure of neonates/infants with human milk by sensitive biomonitoring methods with non invasive sampling.

In a hospital cohort in Chile, mothers were asked to provide milk on different occasions up to six months after delivery, and urine from their children (exclusively breastfed). Samples were analyzed using HPLC with fluorescence and/or mass spectrometry detection [2, 3]. OTA was present in 91% of the breast milk samples, with higher average OTA levels in colostrum (85 ng/mL) than in mature milk (33 ng/mL), obtained at later stages of breastfeeding. OTA was detected in most of the urine samples which documents absorption of mycotoxin by infants. Calculating daily OTA intake in Chilean infants showed that at the given levels of OTA in human milk, the tolerable daily intake proposed for adults (5 ng/kg-bw/day) can be exceeded. A similar magnitude of exposure is evident from OTA levels in breast milk of several European countries (Tab.1 in [2]). As infants may be more susceptible to nephrotoxic effects of OTA, further biomonitoring studies, including suitable effect parameters, are indicated.


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2.5  Lead levels in umbilical cord blood in selected maternity units of Belgium in 2004 and 2007

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Introduction:  The average of blood lead levels has significantly decreased over the last two decades among general population; however in Belgium, there are still high-risk populations such as group of pregnancy women to be diagnosed with elevated lead levels. The objectives of this study were to evaluate the situation of the cord blood levels and seek for sources of intoxication by a questionnaire in two time periods.

Method:  The studies have been contacted the first time in 2004 and thereafter in 2007. The methods used in two time period were similar. In each of selected maternity units in Belgium, umbilical cord blood sample were collected on consecutive births. At the same time a questionnaire on possible sources of exposure to lead was administered to the mother.

Result:  A total of 381 cord blood sample were collected from 4 hospitals in 2004 and 225 cord blood sample were collected from 5 hospitals in 2007. The prevalence of elevated lead (≥50 µg/L) was 4.5% in 2004 and 2.3% in 2007 respectively. In addition, if a cut-off of 20 µg/L is chosen as a marker of “no lead exposure”, only 52% and 84% of newborns were in that category in 2004 and in 2007 respectively. The factors associated with elevated lead levels (≥20 µg/L) were mothers’ country of origin from south Mediterranean (odds ratio, 2.8; 95 %CI, 1.7 to 4.4) and using khol for make-up (odds ratio, 3.0; 95 %CI, 1.1 to 8.0).

Conclusion:  The results of two time periods study were similar, although lead levels have globally decreased, the lead concentration was not absent in the newborns. Sources of exposure are difficult to distinguish by questionnaire for those populations. Confirmation of these risk factors in future studies could lead to new strategies to prevent sensitization in this population who are at risk for subsequent lead intoxication.
3.1 Human biomonitoring to assess exposure of Norwegian infants to perfluorinated compounds

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Perfluoroalkyl compounds (PFCs) comprise a large group of man-made fluorinated organic compounds used in numerous consumer products and industrial applications. Several PFCs have been shown to be persistent and bioaccumulative and have been found widespread in the environment and in humans. Animal studies have demonstrated hepatotoxicity, developmental toxicity, immunotoxicity as well as hormonal effects. In order to explore the prenatal exposure to PFCs and the infants’ exposure from breast milk, the Norwegian Institute of Public Health has initiated several studies.

Up to seven PFCs were detected in the 123 paired samples of maternal and umbilical cord blood plasma. The maternal and fetal levels were significantly correlated for perfluorohexane sulfonate (PFHxS), perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA) and perfluoroundecanoic acid (PFUnDA). The relative proportion of PFHxS was higher than that of PFOS in cord blood compared to maternal blood, and it was higher for PFOA than for PFNA and PFUnDA. This indicates that the chain length of the fluorinated compound is an important determinant for placental passage. Mean PFC concentrations in cord blood were 34 to 84% of the maternal concentrations.

Concentrations of PFOS and PFOA were determined in paired samples of serum and breast milk from 19 Norwegian mothers. Breast milk concentrations were only 1.4 and 3.8% of the serum concentrations, respectively, and the relationships were linear. Assuming a consumption of 700 ml breast milk/day the intakes from breast milk are 61 for PFOS and 29 ng/day for PFOA. In comparison, a dietary intake of 113 and 44 ng/day has been estimated for the adult Norwegian population.

Finally, to study rates of elimination through breastfeeding, nine primiparae mothers (and one mother breast feeding her second child) collected breast milk samples monthly from about two weeks after birth and up to twelve months. Using linear mixed effect models, the depuration rates for PFOS and PFOA were calculated to be 3.1 and 7.7% per month, respectively.
3.2 Urinary isoflavone phytoestrogens in German children and adolescents - a longitudinal examination in the DONALD cohort

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(2) Research Institute of Child Nutrition (FKE), Dortmund, Germany

There is concern about human exposure to hormonally active agents, mostly in children as a susceptible subgroup. Important estrogenic compounds in the human diet are the isoflavones daidzein (DAI) and genistein (GEN). We aimed to examine age-dependent and secular trends in phytoestrogen exposures and to investigate equol excretion of German children using biomarker analysis in 24-h urine samples from a longitudinally designed study. Concentrations of DAI, its metabolite equol (EQ), and GEN were determined by GC-MS analysis (Moors S., et al. 2007, Mol Nutr Food Res. 51(7): 787-798) in 510 urines collected between 1985 and 2000 from 90 German children (6-18 years), who are participants in the Dortmund Nutritional and Anthropometric Longitudinally Designed (DONALD) study. The results from the biomarker analysis indicate isoflavone exposures at quite variable levels: Analyte concentrations in the children’s urines cover the range found previously in adults on typical German diet and with soy intake. EQ, the DAI metabolite produced by the gastrointestinal microflora, was detected in a high fraction of all samples, with 28/90 children (31%) excreting EQ in all their urines, and 62/90 children (68%) in at least one sample. Interestingly, in multiple urines obtained from individuals at different ages (between 6-18 years), equol formation did not appear to be a constant trait over time. When stratified by sex, DAI, EQ and GEN concentrations (ng/mL) and excretion rates (µg/day) were similar in boys and girls. Total isoflavone excretion rates (µg/day) increased during childhood (6-12 yr) (p=0.02) and were constant during adolescence (13-18 yr) (p=0.6). No clear trend for changes in dietary isoflavone exposure over the total study period was seen (p=0.7). In conclusion, biomarkers in urine of German children and adolescents indicate a frequent, but widely variable dietary isoflavone intake and suggest no secular increase (1985-2000) in isoflavone phytoestrogen exposure. Overall, the magnitude of isoflavone exposure in German children is similar to that in a large cross-sectional study in the United States, and considerably higher than that to bisphenol A.
3.3 Biomonitoring of Perfluorinated Compounds (PFC) in Adults and Children Exposed to Contaminated Drinking Water in Germany – Results of the Recent Follow-up Studies


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(2) Institute and Outpatient Clinic of Occupational, Social and Environmental Medicine, University Erlangen-Nuremberg, Germany
(4) Public Health Department of the Hochsauerlandkreis, Meschede, Germany

In Arnsberg, Germany, about 40,000 residents have been exposed to PFOA (500-640 ng/l)-contaminated drinking water. In 2006, waterworks installed activated charcoal filtering; PFC-concentrations in drinking water decreased significantly. Human biomonitoring studies were performed in 2006, 2007 and 2008. Here we report on the results of the follow up studies between 2007 and today.

90 children (5-6 years old), 164 mothers (23-49 years) and 101 men (18-69 years) took part in the first cross-sectional study 2006. Participation rate in the two year follow up study was 77 percent. 105 anglers have been included in another investigation to assess the impact of fish consumption from the PFC-contaminated water bodies on the internal exposure to PFC.

Lifestyle factors and drinking water consumption habits were assessed by questionnaire and interview. Perfluorooctanoate (PFOA), perfluorooctanesulfonate (PFOS), perfluorohexanoate (PFHxA), perfluorohexanesulfonate (PFHxS), perfluoropentanoate (PFPA) and perfluorobutanesulfonate (PFBS) in blood plasma and PFOA/PFOS in drinking water samples were measured by solid phase extraction, HPLC and MS/MS detection.

In 2006, PFOA-concentrations in blood plasma of residents living in Arnsberg were 4.4-8.3 times higher compared to the reference population (ratios based on geometric means: children 22.1/4.8 µg/L, mothers 23.4/2.8 µg/L, men 25.3/5.8 µg/L). Two years later, geometric mean concentrations decreased (data for Arnsberg only; geometric means: children 13.7 µg/L, mothers 13.8 µg/L, men 20.2 µg/L). These numbers correspond to a decrease of 36 percent (children), 37 percent (mothers) and 18 percent (men), respectively. Based on a first order kinetics/one compartment model PFOA half-lives were estimated from these data (3 years for children and mothers). In fish consuming anglers distinctly elevated PFOS-concentrations were observed (1-649 µg/l, median: 31 µg/l; median of controls: 10 µg/l).

This most recent investigation of the German cohort confirms the slow elimination of PFOA in humans. Fish consumption from contaminated water bodies contributes substantially to the PFOS body burden.

The studies were financed by the North Rhine Westphalia State Ministry for Environment and Nature Conservation, Agriculture and Consumer Protection.
3.4 Human biomonitoring of endocrine disrupters and reproductive health: the Italian PREVIENI project

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(2) S. Andrea Hospital, Dept of Gynaecological Sciences, Perinatology and Neonatology. II Faculty of Medicine and Surgery University of Rome La Sapienza, Italy
(3) Dept of Environmental Sciences, University of Siena, Italy
(4) World Wildlife Fund Italy

Linking environment and health through the investigation of selected endocrine disrupters (ED) human exposure and associated biomarkers is the main goal of the Italian project PREVIENI (http://www.iss.it/prvn), funded by the Italian Environment Ministry and supported by World Wildlife Fund Italy. PREVIENI targets human fertility as a highly sensitive ED target by integrating clinical findings, biomarkers of internal exposure and biomarkers of effective dose related to infertility conditions; moreover, PREVIENI aims at providing information on the exposure to ED in the Italian general population as well as on the relevance of certain biomarkers to conditions related infertility.

According to established inclusion criteria, fifty couples affected by an infertility status were enrolled in four Italian areas representative of different environmental exposure scenario i.e., metropolitan area, industrial site with high exposure risk, agricultural center and country town, as lower contamination area possibly usable as reference control data. Ten fertile couples as control also were enrolled in the metropolitan area and the country town. The investigation is accompanied by a validated questionnaire on lifestyle and food habits. Informed consensus was obtained from each participant. The clinical investigation included potential ED-relevant parameters such as hormone balance, seminal fluid, thyroid structure and immune function. The collected blood samples were divided in two aliquots in order to analyze biomarkers of exposure and molecular alterations as potential biomarkers of effective dose.

In the early PREVIENI phase, priority has been given to perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) on the basis of widespread exposure, paucity of Italian data and some epidemiological evidence linking PFOS/PFOA exposure and reduced fertility in women. Toxicological data show that PFOA, in particular, may alter the expression of several nuclear receptors (NRs) involved in xenobiotic and steroid metabolism such as peroxisome proliferator-activated receptors, constitutive activated receptor and pregnane X receptor. Therefore, toxicological evidence suggests to investigate cross-talking NRs in leukocytes as potential suitable biomarkers linking internal levels of ED and reproductive disturbances.

Preliminary results on internal exposure to PFOS/PFOA and the modulation of NRs are presented.
3.5 Human biomonitoring in a case of PFC contamination of private drinking water wells

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In 2009, the local drinking water distribution company detected PFC contamination in groundwater of a waterworks of Cologne, caused by fire-fighting foams that have been used on a refinery site. PFC levels in public drinking water supply were below the health-based guide value of 0.3 μg/l recommended by the German Drinking Water Commission (TWK) of the Federal Ministry of Health (BMG). Within the contaminated groundwater ply two private drinking water wells were detected. In one well-funded water, increased PFC levels were measured (maximum 13 μg/l). Main components were PFOS (ca. 70%) and PFHxS (ca. 13%). The aim of the investigation was the disclosure of potential internal exposure of the occupants of the wells to PFC.

To determine whether the well water yielded in body burden in the 10 subjects using the well water, HBM was performed by the determination of 6 PFC in the serum samples of the occupants. The period of the contamination cannot be estimated precisely, but was assumed to be more than 8 years.

The results of the biomonitoring showed increased levels of 3 PFC (μg/l; Min / median / max) compared to reference values of individuals without known PFC exposure: PFOA (4 / 7 / 18), PFOS (5 / 16 / 295) and PFHxS (12 / 32 / 205). Reference values of the German Federal Environment Agency (UBA) are for PFOA 10 μg/l and for PFOS 20 μg/l (women) and 25 μg/l (men). For PFHxS, actually no reference value exists. However in reference populations the PFHxS serum levels are generally below 10 μg/l.

In conclusion human biomonitoring mirrored very well the PFC contamination of drinking water. It has to emphasise that to our knowledge this was the highest PFOS exposure by drinking water ever detected. The results point out the significance of HBM for individual risk assessment and of health-based guidance values for drinking water.
3.6 **Retrospective analysis of body burden of perfluorinated compounds in German young adults: Time trends between 1982 and 2007**

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Perfluorinated compounds (PFC) are widely used in consumer and industrial products for water, grease and dirt repellence. Hitherto, only little is known about the time trend of PFC blood levels in human beings. This study investigates systematically the time trend between 1982 and 2007 of human blood levels of 11 perfluorinated acids (PFBA, PFPA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnA, PFDoA, PFTriA, PFTeA) and 5 perfluorosulfonated acids (PFBS, PFHxS, PFHpS, PFOS, PFDS). Blood samples analyzed are from the German Environmental Specimen Bank for Human Tissues where they are stored under stable deep freezing conditions (-80°C). From this continuous sample stock, stored samples of 10 males and 10 females aged 20-29 years are randomly selected per year investigated. Analyses are performed with LC-MS-MS. Only for PFOS, PFOA and PFHxS, considerably more than 50% of the sample concentrations measured are above the limit of quantification (0.5µg/L). In 1982, mean blood levels (± standard deviation) of PFOS, PFOA and PFHxS are 15±9µg/L, 4±2µg/L and 1.0±0.5µg/L, respectively. PFOS blood concentrations are highest in 1989 (29±22µg/L) and decrease to 8±4µg/L in 2007. PFOA blood concentrations are highest in 1986 (7±4µg/L) and fluctuate more or less around 5µg/L over time. PFHxS blood concentrations increase from 1±1µg/L in 1982 to 2±1µg/L in 2001 with a slight decrease to 2±1µg/L in 2007. The observed time trend of PFOS blood levels is consequence of PFOS phasing-out by industry and in concordance with the short time trends of the American Red Cross Studies (2000/2001, 2006) and the American National Health and Nutrition Examination Survey (1999/2000, 2003-2004) as well as the American Hagerstown Study (1974, 1989, 2001, 2006). While the observed PFHxS time trend is also comparable with these studies, PFOA decrease over time found therein could not be confirmed by this study.
4.1 *Environmental chemical hazards and their impact on senior citizens*

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The quick rise in the number of elderly people in Germany demands for a better understanding of risks posed to them by environmental hazards. With more adverse health effects and loss of physiological function, kinetics and effects of chemical hazards may differ in the elderly. Our study aimed at detecting associations between exposure, human body burden and biological effects regarding adverse health effects in senior citizens aged 55 to 65 years. The investigation comprised comparative analyses in students aged 20 to 29 years. The study was conducted in autumn 2005 and spring 2006, considering a total number of 242 senior citizens and 234 students. Blood and urine samples were analyzed for concentrations of 69 inorganic substances using HR-ICP-MS or AAS and five organic compounds using GC-MS. Personal meta-data, medical history and information about potential sources of exposure and nutrition were collected using a self-reported questionnaire. The results show significantly higher blood levels of cadmium, lead, mercury, uranium, HCB, PCB-138, PCB-153 and PCB-180 for senior citizens than for students. In both groups women had significantly higher HCB levels. Female students exhibited significantly lower blood lead levels than male students. No gender difference in lead levels was found for senior citizens. Furthermore, relevant variables were selected using stepwise multiple linear regression from a set of potential predictors. All linear models for the aforementioned substances in blood and urine were based on main predictors (gender, sex, smoking, nutrition, dental fillings, etc.). Some of the predictors of exposure identified are well-known, possible others like e.g., illness/disease, medication and other environmental stressors need to be examined in future studies.
4.2 Decrease of internal exposure to organochlorine compounds and heavy metals in children in Baden-Württemberg between 1996/97 and 2008/09


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Introduction
The benefit of measures to reduce organochlorines and heavy metals initiated by environmental protection policies is best reflected in the internal concentration of these substances in humans. Therefore, between 1996 and 2009 concentrations of these compounds in blood and urine were monitored in ten-year-old children in Baden-Württemberg.

Methods
In winter 1996/97, 1998/99, 2000/01, 2002/03; 2004/05 and 2008/09 blood and urine was sampled from 4th grade primary school children. In blood samples the organochlorines DDE, HCB, PCB-138, PCB-153 and PCB-180 were analysed by gas chromatography and ECD detection. PCDD/PCDF were measured in pooled blood samples using GC/MS. Lead concentrations in blood were quantified by graphite furnace atomic absorption spectrometry (AAS), mercury in urine by using cold vapour AAS.

Results
For all organochlorines and heavy metals a clear decrease of the internal concentration could be shown within the 12 years investigation period. For DDE the median decreased from 0.32 µg/l to 0.11 µg/l. The median of HCB decreased from 0.19 µg/l to 0.07 µg/l. The sum of the three PCB-congeners PCB-138, PCB-153 and PCB-180 decreased from 0.47 µg/l to 0.18 µg/l. The burden of PCDD/PCDF in pooled blood samples resulted in approximately half the concentration after the 12-year period. Breast-feeding had a clear influence on the internal concentrations of the chlororganics.

The concentrations of lead in blood decreased from 23.6 µg/l to 13.8 µg/l in areas without geogenic lead exposure. The median of mercury concentrations in urine decreased from 0.25 µg/l to a value below the detection limit of 0.2 µg/l; the 95th percentile was reduced from 3.1 µg/l to less than 0.2 µg/l. The decline of amalgam fillings in children during the investigation period had a strong influence on internal concentrations.

Conclusions
The internal concentration of the persistent xenobiotics investigated here decreased to a low level that is not likely to be of concern for human health. Concentrations measured were even below those assessed in the KUS study of the Federal Environment Agency (Kinder-Umwelt-Survey UBA).
4.3 Concentrations and determinants of organochlorine levels among pregnant woman in Eastern Spain

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Persistent organic pollutants (POPs) comprise a large variety of toxic substances with ample distribution. While exposure to these toxins occurs mainly through diet, maternal POP levels may be influenced by certain sociodemographic, environmental, or lifestyle factors. This is important given that these substances may have adverse effects on fetal development. The aim of this study is to examine the sociodemographic, environmental, lifestyle, and dietary determinants of the levels of hexachlorobenzene (HCB), b-hexachlorocyclohexane (b-HCH), 1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane (4,4'-DDT), 1,1-dichloro-2,2-bis(4-chlorophenyl)ethylene (4,4'-DDE), and polychlorinated biphenyls (PCB congeners 118, 138, 153, 180) measured in the blood of pregnant women participating in a mother-child cohort study conducted in Valencia (Spain).

The study population consisted of 541 pregnant women who formed part of the INMA (Childhood and the Environment) cohort (2004-2006). POP levels were determined in blood taken during the 12th week of pregnancy with the aid of gas chromatography with electron capture detection. Sociodemographic, environmental, and dietary information was obtained from a questionnaire. Multivariate Tobit regression models were constructed in order to assess the association between POP levels and selected covariates.

The results showed that all the women had detectable levels of at least one of these compounds while in 43% of the subjects, all eight compounds were detected. The compounds found in the greatest number of women were 4,4'-DDE (100%) and PCBs 153 and 180 (95%). The most important determinants of high POP levels were the mother's age, country of origin, increased body mass index, and number of weeks of breastfeeding after previous pregnancies. With regard to diet, 4,4'-DDT and 4,4'-DDE levels increased with the intake of meat, fruit, and cereal. PCB 153 levels increased with the intake of seafood.
4.4 Human versus environmental biomonitoring of PCB and HCB based on Saxony, Germany data

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In this study principle relationships of pollutant levels in human and environmental matrices were investigated by employing data of the German Environmental Specimen Bank (ESB). The investigated human data encompassed hexachlorobenzene (HCB) and polychlorinated biphenyls (PCB) in blood plasma between 1995 and 2008 from students from University of Halle. Furthermore, HCB and PCB data from different environmental samples were studied such as (1) pine shoots from the nature park Dübener Heide sampled during 1991-2004; (2) and (3) egg matter of city pigeons from nature park Dübener Heide and entire territory of Leipzig sampled during 1997-2008 and 2000-2008, respectively; (4) and (5) earthworm from nature park Dübener Heide and entire territory of Leipzig sampled during 2000-2008 and 1999-2008, respectively.

A similar pattern was found for both type samples during investigated years whereas the human data followed the corresponding environmental levels with some delay. In order to visualize here mentioned the human data curve was back-shifted by two years. Consequently, fairly good visual relationship was found for both blood plasma and pine shoots samples in regard to PCB 138 and PCB 180 during 1995-2002. However, PCB 153 that was the prevailing congener does not manifest such a good association.

In addition, associations between human/environment-ratios of pollutant levels and physicochemical properties were analyzed for HCB, PCB138, PCB 153, and PCB 180. In case of blood plasma/city pigeons egg matter pairs negative slopes were found for the correlations with Kow of the compound for two locations. This can be explained by the fact that the accumulation of the pigeon eggs is more pronounced for the lipophilic compounds than human blood. However, blood plasma/earthworm pairs exhibit the opposite behavior.

Although the data set is limited with respect to the number of chemicals the study shows first very interesting relationships between eco-surveillance and human biomonitoring data.
5.1 Use of personal care products and exposure to musks, parabens and triclosan

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Background: Personal care products may contain multiple chemicals with adverse health effects. The Flemish Centre for Expertise on Environment and Health conducted a biomonitoring campaign and measured biomarkers of exposure to synthetic musks (fragrance ingredients), parabens and triclosan (all antibacterial preservatives) in 14-15-year old students. The internal concentrations in the human body were studied in relation with use of personal care products.

Methods: In 210 participants (121 boys and 89 girls) galaxolide and tonalide – two polycyclic musks – were measured in whole blood by GC-MS; urinary para-hydroxybenzoic acid (HBA) – a metabolite of parabens – was measured by LC-MS/MS and urinary triclosan (TCS) was measured by GC-MS. From self-assessment questionnaires, a score (low-moderate-high) for the use of personal care products was calculated, based on the number of products used, and the frequency of use.

Results: After adjustment for sex and age, the geometric mean in the total study group was 163 (95% CI: 155-172) ng/g fat for galaxolide, 26.8 (24.7-29.2) ng/g fat for tonalide, 779 (735-825) µg/g creatinine for HBA and 1.63 (1.23-2.16) µg/g creatinine for TCS. The use of personal care products was scored as low in 48.6% of the participants, moderate in 25.0% and high in 26.4%. Blood levels of galaxolide significantly increased with higher use of personal care products (ANOVA: p=0.002). A similar non-significant (p=0.32) trend was seen for tonalide. Urinary levels of TCS increased threefold from the low to the high consumer group (p=0.003), while no significant differences were found in the levels of HBA.

Conclusions: Higher use of personal care products is associated with increasing levels of musks and triclosan in the human body. These compounds have endocrine activity and accumulate in people. However, possible health effects at the levels that are currently measured in the Flemish population still have to be studied.
5.2 External quality assessment of human biomonitoring in environmental exposure levels

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The number of applications of human biomonitoring (HBM) for the identification and assessment of the chemical exposure of the general population from the environment increased in the last decade distinctly. To assure the comparability and the accuracy of HBM results an appropriate external quality assessment of the applied methods is essential. The international programme of the German External Quality Assessment Scheme (G-EQUAS) provides proficiency testing for most of the HBM parameters. The poster gives an overview on the parameter spectrum as well as of the results of the G-EQUAS programme in the environmental exposure range.

Since 1992 G-EQUAS provides intercomparison runs for biological monitoring parameters in the environmental exposure range twice the year with a successive increase of numbers of parameters. In the last run 18 inorganic (3 in blood, 6 in urine, 9 in plasma) und 36 organic parameter (21 in urine, 15 in plasma) were provided in the environmental exposure range. Additionally the analyses of 4 haemoglobin adducts were offered. For each parameter two samples with different exposure levels were sent to the participants. The target values as well as the tolerance ranges were estimated on the basis of the results of a group of reference laboratories. The successful participation was certified if the participant results scored within the tolerance ranges for both samples.

The number of participants ranged from 3 to 37 laboratories for the different parameters. The highest interest was found for the detection of metals in blood, serum and urine, whereas only a few of participants took place in the analyses of organophosphate metabolites and haemoglobin adducts. The rate of success ranged from 38 to 100 %. Poor success rates were found for organophosphate metabolites, 1-naphthol and cotinine in urine. An effect of training was observed for a group of laboratories which participate regularly for the analysis of organochlorinated compounds in serum.
5.3 Allocation of reliable analytical procedures for human biomonitoring by the Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area of the DFG

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In 1955 the Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area was founded by the Deutsche Forschungsgemeinschaft (DFG). The Commission advises the German government and its agencies concerning the estimation of health risks by chemical exposure and their prevention. Within the commission the working group “Analyses of Hazardous Substances in Biological Materials” (AibM) deals with the development of procedures to analyse chemical substances in biological materials. Most of these detailed, ready-to-use protocols for human biomonitoring methods do not only enable the monitoring of occupational exposures but also the determination of the chemical exposure in the general population. The poster will give an overview of the AibM working group and of the manifold applications of the methods in population studies.

Generally, a member of the working group or an external expert submits a human biomonitoring method to the group. After a first discussion the AibM group selects an examiner, who tries to reproduce the method in her/his laboratory and to verify the reliability criteria. The examination report is discussed within the group. The method may be adopted for publication or may be given back to the author with the demand for revision. In case of fundamental drawbacks the method will be rejected. The adopted methods are published at regular intervals in German and in English.

Since 1985 the working group published 129 analytical methods (plus 11 methods for markers of susceptibility) in 12 issues of the English edition. 80 methods contain detection limits which allow the analyses of environmental exposure for one or more parameters. However, only 44 were originally designed for the application in population studies. Relevant examples are the detection of the metabolites of organophosphate pesticides, pyrethroides and phthalates in urine as well as the detection of perfluorinated compounds and polychlorinated biphenyls in serum.
5.4 Cadmium, Mercury and Phthalates environmental exposure in Lithuania

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**Background:** In the implementation of the EU programme Environment and Health one of the key stones is usage of environmental pollution markers. Cadmium, mercury, phthalates and metabolites may serve as indicators of human exposure (biomarkers) to environmental chemicals.

**Objective:** The objective of this report is to provide data for the main toxic substances used in Lithuania’s industry, recorded in EU regulatory framework for Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) amounts for 2007-2008 and its environmental levels and to determine the priority substances in a national biomonitoring program to assess exposure of the general population.

**Methods:** We used Lithuanian Environmental Protection Agency data base on main toxic substances and publicized data about the pollutants levels in atmosphere, soil and surface waters.

**Results:** In the recent years there was an increase in imported phthalates amounts (79,568 t/year), a decrease in mercury and it compounds (from 4,400 kg/year to 6.6 kg/year) and a stable amount of imported cadmium compounds (11 kg/year). The concentration of cadmium in atmosphere, soil and in surface waters haven’t exceeded allowed limits; however, Di-2-ethylhexylphthalate, Di-iso-nonylphthalate and Di-butylphthalate amounts in wastewaters and sediments exceeded allowed limits.

**Conclusions:** In Lithuania some phthalates emissions in wastewater exceed allowed limits. Therefore phthalates should be included into water pollution regulation, and industrial enterprises, who use phthalates, should establish monitoring the pollutants in their wastewaters. It is recommended to include phthalates, respectively their metabolites in urine as priority substances in a national biomonitoring program to assess exposure of the general population.

**Keywords:** Cadmium, Phthalates, REACH, Environmental pollution.
5.5 O-Nitrophenol in Human Urine Samples - Human Biomonitoring Following a Major O-Nitroanisole Accident in Germany


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Background: Due to a major chemical accident in the Frankfurt/Main region in 1993, a nearby residential area became contaminated by a mixture of o-nitroanisole (ONA) and its derivatives. Very early, o-nitrophenol (ONP), a metabolite of the main contaminant, ONA, was assessed to be the appropriate human biomonitoring (HBM) urine biomarker. Analysis of real-time accident-related urine samples from exposed residents (children/adults) revealed elevated ONP levels. However, the examinations also resulted in inexplicable ONP urine levels being detected in the non-exposed control groups. In 1998, the expertise of a federal scientific working group resulted in a joint study to obtain comprehensive data on ONP excretion of the population in Germany.

Method: The existing accident-related ONP HBM data were matched against the samples of a follow-up examination (Study 1) and the samples of environmental health data (Study 2). Study 1: In a follow-up examination of 30 exposed children in the metropolitan area of Frankfurt/Main four years after the accident, their urine samples were collected and matched with those of a control group of 30 children in the countryside of Osnabrück. Study 2: Urine specimens from 125 adults and 124 children had been randomly collected and analysed in the context of the German Environmental Survey 1990/92 (GerES II). The specimens of the different studies were analysed using similar ONP assays (24-h urine samples/GCMS).

Results: HBM real-time to the ONA accident: Test series 1: 294 residents exposed (247 children/47 adults), 3-4 days after the accident: ONP 68.7 ± 195.4 mg/L (mean ± SD) Controls: 116 controls, non-exposed children: ONP 44.4 ± 157.5 mg/L. Test series 2: 94 workers exposed during decontamination procedures for up to 4 weeks: ONP 35.8 ± 132.3 mg/L. Test series 3: 22 children in follow-up (subgroup Test series 1) 5/6 months after exposure: ONP 61.9 ±109.2 mg/L. Test series 4) 17 children in follow-up (subgroup Test series 1) 10 months after exposure: ONP 55.9 ± 103.5 mg/L. HBM follow-up studies: Study 1: 2 x 30 children (30 out of 247 exposed children (subgroup Test series 1) 4 years after exposure: ONP 2.06 ± 1,39 mg/L and 30 control children: ONP 2.02 ± 1,10 mg/L. Study 2: 249 controls, non-exposed (125 adults/124 children), urine specimens collected in the context of GerES II: ONP 2,85 ±5,81 mg/L.

Discussion: Analysis of real-time accident-related urine samples from exposed residents (children/adults) revealed about three times higher ONP levels than in controls. Surprisingly, levels detected in exposed workers were in the same range as those detected in non-exposed children. Follow-up test series of exposed children after 5-6 months, 10 months and 4 years resulted in decreasing levels. Area-wide controls from the GerES 1990/92 showed again inexplicable human urine levels in a wide range (0,5-80 mg/L). No similar findings had been described in literature to date. The HBM of ONP shows the importance of further research, in particular for a clear interpretation of new biomarkers, their sources and defining background levels.
5.6 **PBDE in Blood of Children in Baden-Württemberg between 2002/03 and 2008/09**

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**Introduction**

PBDE are used in high amounts as flame retardants in plastic materials and textiles. Due to their persistence, their accumulation in the food chain and their toxic properties they have been integrated in the human bio-monitoring program of the Baden-Württemberg State Health Office since 2002.

**Methods**

In winter 2002/03 (n = 162), 2004/05 (n = 194), 2005/06 (n = 411) and 2008/09 (n = 770) pooled blood samples of 10-year-old pupils were analysed for PBDE in repeated cross sectional studies after extraction and purification by silica gel using HRGC/HRMS. Samples were pooled according to region, gender, and breast feeding.

**Results**

Weighted mean values of PBDE were calculated for the four investigation periods (Tab. 1). By reason of analytical difficulties and due to strong variations of PBDE in different pooled samples the interpretation of a time trend must be done with caution. While the concentration of the deca-brominated diphenylether (BDE #209) increased, that of other congeners (BDE #47, BDE #99) decreased slightly or remained the same level. Consistent differences with respect to gender and breast-feeding were not recognizable.

**Table 1:** Weighted mean values of selected PBDE in blood of 4th grade pupils (ng/g blood fat)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002/03</th>
<th>2004/05</th>
<th>2005/06</th>
<th>2008/09</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDE #47</td>
<td>1.89</td>
<td>n.n.(1.1)</td>
<td>1.27</td>
<td>1.01</td>
</tr>
<tr>
<td>BDE #99</td>
<td>0.81</td>
<td>0.38</td>
<td>0.59</td>
<td>0.36</td>
</tr>
<tr>
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<td>0.31</td>
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</tr>
<tr>
<td>BDE #153</td>
<td>1.20</td>
<td>1.14</td>
<td>1.14</td>
<td>0.95</td>
</tr>
<tr>
<td>BDE #154</td>
<td>0.05</td>
<td>0.08</td>
<td>0.08</td>
<td>0.04</td>
</tr>
<tr>
<td>BDE #183</td>
<td>n.n.(0.4)</td>
<td>0.16</td>
<td>0.19</td>
<td>0.14</td>
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<tr>
<td>BDE #209</td>
<td>1.62</td>
<td>2.60</td>
<td>4.20</td>
<td>n.n.(7.6)</td>
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n.n.: below limit of detection (detection limit given in brackets)

**Discussion**

Concentrations of PBDE in children range on the same level as in adults (Gabrio et al. 2008, Fromme et al. 2009) and are not critical from the toxicological point of view (EPA 2008). Because of the tentative increase of BDE 209 the internal concentrations of BDE should be monitored in future. The strong variations of PBDE concentration in different samples (Gabrio et al. 2008) indicate, that apart from ingestion other routes of exposure (dermal, inhalation) and additional sources (textiles, building materials) must be taken into consideration.
5.7 **Determination of 2,5-toluylenediamine (2,5-TDA) and aromatic amines in urine after personal application of hair dyes – kinetics and doses**

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The personal use of hair dye products is currently under discussion due to the potentially increased risk of bladder cancer among long-time users described in epidemiological literature. In order to investigate the dermal absorption of aromatic diamines as well as aromatic amines possibly present as contaminants in hair dye formulations, we conducted a biomonitoring study under real-life conditions and calculated kinetics and doses for the urinary excretion. Urine samples of two female subjects were collected for a time period of 48 h after personal application of a hair dye cream and analysed for aromatic diamines as well as o-toluidine and 4-aminobiphenyl using highly specific GC/MS-methods.

2,5-toluylenediamine (2,5-TDA) as active ingredient of hair dyes is rapidly absorbed dermally. After a distribution phase of 12 h, 2,5-TDA is excreted with a half-time of 8 h. Maximum values of urinary 2,5-TDA reached 1540 and 1900 ug/g creatinine, respectively at 5 and 7.5 h after application. Excretion was 90 % complete within 24 h after application. The doses of 2,5-TDA excreted within 48 h were 700 ug for application of a brown-reddish hair dye cream and 1.5 mg for the application of a brown-black hair dye cream. Urinary 4-aminobiphenyl as well as contaminations with other aromatic diamines were not detectable in our study. Due to the artifactual formation of o-toluidine in the presence of high concentrations of urinary 2,5-TDA, our results could not prove an increased internal exposure of humans to carcinogenic amines after personal application of hair dyes.
5.8 Use of on-line SPE-UPLC-MS-MS technique to strengthen and economize human biomonitoring studies

Koen De Cremer, I. Van Overmeire, J. Van Loco
Scientific Institute of Public Health, Direction of Food, Medicines and consumer safety, Brussels, Belgium

As human biomonitoring is being more and more accepted as a crucial tool for assessing and evaluating the past, current and future influence of the environment on human beings, it is essential that these biomonitoring studies can be performed in a fast, reliable and cost-effective manner.

One way to fulfil these requirements is the use of an on-line SPE-UPLC-MS-MS method combined with isotope dilution.

On-line Solid Phase Extraction (SPE) warrants a fast and automated decomplexation technique of the complex sample matrix by sending unwanted sample components to the waste and retaining (and concentrating) the analytes on the SPE column. By doing this on-line, no evaporation steps are needed, avoiding possible loss of the analytes. Also no manual intervention is needed, increasing the reproducibility and avoiding possible human errors. Moreover, hands-on FTE time is decreased significantly resulting in a much lower cost per sample. Ultra Performance Liquid Chromatography (UPLC) will reduce the chromatographic time significantly resulting in a high throughput of the samples.

Triple Quadrupole Mass Spectrometry (MS-MS) is a very sensitive and specific detection technique. A high number of compounds (having similar chemical properties) can be measured simultaneously further reducing significantly the cost per sample. Isotopic dilution will provide accurate quantification of the compounds of interest in the sample.

We have developed an on-line SPE-UPLC-MS-MS method combined with isotope dilution for the quantification of nicotine and some of its metabolites in urine. The online SPE takes 3 minutes and the chromatography (UPLC) less than 5 minutes resulting in a total time for extraction, purification and analysis of a sample in 10 minutes. Validation of the method is ongoing. On the hand of this example we will show the benefits of this methodology compared to others.

This sensitive and automated method will allow a high throughput of a large number of samples, while analytical costs are significantly reduced.
6.1 Italian biomonitoring survey for metals in adults and children

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A surveillance programme (PROgramme for Biomonitoring of the Exposure, PROBE) was launched by the Italian Ministry for Health in 2008 for acquiring knowledge of the internal dose of metals in the general healthy population. Five Italian regions for a total of ca. 1,800 urban subjects (adults and children) were involved and 20 metals (As, Be, Cd, Co, Cr, Hg, Ir, Mn, Mo, Ni, Pb, Pd, Pt, Rh, Sb, Sn, Tl, U, W and V) were measured in blood.

The PROBE data and activities have improved:

i) the quality and standardization of procedures for metals quantification;

ii) the evaluation of the metals internal dose with regard to specific geographical areas;

iii) the identification of susceptible sub-populations and possible risk factors (lifestyle and diet);

iv) the assessment of reference values (RVs) suitable as reference terms for public health prevention and protection.

The following data are presented:

i) the procedure for the selection of individuals, sample collection and treatment;

ii) the validated measurements methodology - including the estimation of uncertainty;

iii) the RVs for metals in blood of adults and children.
6.2 Human Biomonitoring (HBM) as a pragmatic tool to support risk management of chemicals under REACH

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REACH requires health risk management for workers and the general population and introduced the concept of Derived No-Effect Level (DNEL). DNELs must be derived for all substances that are classified as health hazards. In analogy to other health-risk based guidance values, such as reference doses (RfDs) and tolerable daily intakes (TDIs), risk to health is considered negligible if the actual exposure is less than the DNEL.

Exposure assessment is relatively simple for occupational situations but more complex for the general public, in which exposure may occur via multiple pathways, routes, and media. For such complex or partially defined exposure scenarios, human biomonitoring (HBM) gives a snapshot of internal or absorbed dose of a chemical and is often the most reliable exposure assessment methodology.

For human risk management HBM data can be interpreted using the recently developed concept of Biomonitoring Equivalents (BE). Basically, a BE translates an established reference value into a biomarker concentration using toxicokinetic data. If the results of an exposure assessment using HBM indicate that the levels measured are below the DNEL-based BE (BEDNEL), it would indicate that the combined exposure via all potential exposure routes is unlikely to pose a risk to human health and that health risk management measures might not be needed. Hence, BEs do not challenge existing risk assessments but rather build upon them to help risk management, the ultimate goal of any risk assessment.

A challenge in implementing this approach forms the limited availability of toxicokinetic information for many substances. However, methodologies such as generic physiologically-based toxicokinetic models, which allow estimation of biomarker concentrations based on physicochemical properties, are being developed for less data-rich chemicals.

Acceptance of the use of BE by regulatory authorities will allow initial screening of population exposure to chemicals to identify those chemicals requiring more detailed risk and exposure assessment, assisting in priority setting and ultimately leading to improved product stewardship and risk management.
6.3 Expert Judgement of Poisonings and Human Biomonitoring - The BFR 3-Level and Matrix Model

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Background: German physicians are obliged to submit essential and relevant data on poisonings to the BfR (ChemG §16e). Compared to the assessment of acute poisonings, the expert judgement procedure of poisonings due to low-dose and chronic exposure, e.g. from the environmental sector, needs additional scientific tools and data, preferably based on definite internal human data from human biomonitoring (HBM) findings.

Method: Since 1990 more than 60,000 reports on cases of poisoning have been assessed, validated and documented. The main procedure of the BfR assessment process is a 3-level model (3LM), for low-dose exposure assessment accompanied by two different matrix procedures (MP1 and MP2) for an improved assessment of 1) exposures and 2) causalities.

Results: In a general step, all cases have to be assigned to three clear-cut categories regarding the type of relationship by means of assessment from the top to the bottom level: This means the distance of exposure from the emission point and the related time interval (1st level), the substance-specific symptoms/signs observed (2nd level) and the time dependence (dechallenge/rechallenge) of the exposure-related symptoms/signs (3rd level). Often, the category of relationship between health impairment and exposure (‘No relationship’, ‘Relationship exists or ‘Relationship cannot be evaluated’) can be directly derived on this basis.

In particular cases, especially in those involving chronic low-dose level exposure additional procedures such as the exposure matrix MP1, and the causality matrix, exposure vs. probability, MP2, are essential. Especially the MP1 with data of the source of the exposure, the distance from the noxious agent and its monitoring data (ambient monitoring / HBM data) can serve to precisely to clarify the degree of exposure probability. So in case of existing HBM data, cases can be assessed with a clear evaluation of the ‘relationship between exposure and health impairment’ by the MP2 matrix. In difficult cases, the cases underwent an additional scoring course, also based on HBM data.

Conclusion: Especially in terms of quality control, the assessment process of poisonings based on the 3 LM had to be accompanied by additional assessment matrices for exposures and causalities, in which HBM data are extremely valuable.
6.4 *Simulation of blood and urine levels of multiple chemicals with a generic PBTK-model in MS-Excel following inhalation and/or oral intake and/or dermal exposure*

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IndusTox Consult, 6525 EC Nijmegen, Netherlands

A Physiologically Based ToxicoKinetic (PBTK)-model can estimate the level of a chemical in body tissues and body fluids following exposure, but it has the drawback that a large number of substance-specific partition parameters need to be defined. A generic PBPK-model contains algorithms as QSPRs (= Quantitative Structure-Property Relationships) for blood:air and tissue:blood partitioning based on basic physical-chemical properties. Thus, a generic PBPK model can be applied even when experimental partition characteristics of a compound are lacking. The *IndusChemFate model* is a newly developed, generic PBTK model with QSPR-based partitioning, based on: octanol/water partition, molecular weight, density, vapour pressure and water solubility. The model is programmed as a macro in Visual Basic and it runs in MS Excel. The *IndusChemFate model* assumes a 70 kg reference human and considers three routes of exposure (inhalation, dermal and/or oral). All physiological parameters are adopted from reference documents. The model has two built-in exercise levels. Uptake by inhalation is modelled in the regular way.

Dermal uptake is simulated for vapour and liquid skin contact. Dermal uptake by direct skin contact with liquids assumes deposition over an assigned exposure period, for instance an 8-h working day. Key feature of this module is that evaporation from the skin is fully accounted for. Oral intake is modelled as a bolus dose that is directly applied to the stomach and then transferred to the intestinal tissue at a first order rate. Michaelis-Menten saturable metabolism is incorporated in the liver. Metabolism can also be modelled in 10 other organs/tissues. Enterohepatic circulation of phase II metabolites is optional at a user-defined rate.

Published studies with inhalatory and/or dermal exposure were used to test the accuracy of the prediction of concentrations in blood and urine with the *IndusChemFate model*. Comparisons of model-simulations with data of published studies of exposed volunteers and/or workers will be shown for PAH-exposure and urinary 1-hydroxypyrene-glucuronide excretion and for MTBE-exposed volunteers and urinary MTBE-metabolites. Additionally, real-time simulations will be demonstrated to get an impression of the transparency of the results of predictive simulations. The model should be regarded as a first tier assessment tool or screening tool for prediction of body fluid concentrations.

The software and user manual is available free from charge at http://www.cefic-lri.org/lri-toolbox/induschemfate

The work has been funded by CEFIC-LRI.
6.5 Reference values for lead, cadmium and mercury in blood of adults from the metropolitan area of Sao Paulo (Brazil)

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The aim of this study was to derive reference values (RV), that is the 95th percentile of the background exposure, for lead, cadmium and mercury in blood of adults from the Metropolitan Area of Sao Paulo (Brazil), and to investigate the association between blood metals and socio-demographic and lifestyle factors.

Blood samples of 653 blood donors, non-smokers and without any occupational exposure to the studied metals were collected in 2006. In our evaluations we distinguished between the younger group (18–39 years) and the older group (40–65 years). RV derived for the younger group were for men 59.73 µg/L for Pb, 0.41 µg/L for Cd and 4.30 µg/L for Hg; for women 47.09 µg/L for Pb, 0.48 µg/L for Cd and 3.71 µg/L for Hg. For the older group were for men 79.84 µg/L for Pb, 0.35 µg/L for Cd and 5.10 µg/L for Hg; for women 63.10 µg/L for Pb, 0.44 µg/L for Cd and 6.10 µg/L for Hg.

The RV for lead were similar to the Czech Republic and Germany, but higher than those observed in a study of the U.S. population (NHANES). RV for Cd were well below of those from these countries. The RV for Hg were similar to the U.S. and higher than the value in Germany and in the Czech Republic. Pb and Cd in blood showed a significant association with sex and age. Men had 50% more lead in blood, and the older group showed 23% more lead than those in 18–39 years old. The variables most related to the levels of Hg were fish consumption and amalgam fillings. Also, the older group had 19% more Hg than the younger group. Individuals with basic education showed significantly lower mercury levels than those with higher education.

Due to the high susceptibility of children and women of childbearing age to the effects of heavy metals it is recommended to conduct other studies in Brazil aiming to propose RV for these population subgroups. Biomonitoring studies should be performed continuously to assess trends and to update RV.
6.6 **Combination of linear regression and decision trees for estimating variance components of internal human exposure**

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In a comparative study, performance of linear regression and decision trees based on Exhaustive CHAID are tested for modelling measured concentrations of selected substances in human body fluids (whole blood, blood plasma, urine). Cadmium, mercury, lead, uranium and hexachlorobenzene are used as target variables because they come from different sources, have different biological kinetics and thus are supposed to have a pattern of predictors. The test sample set is a subset of routine samples of the German Environmental Specimen Bank for Human Tissues (ESB-Hum), sampled between 2000 and 2006, consisting of young healthy adults without occupational exposure (age: 19-29 years, \( n \sum = 3,368 \), males/females: 1,348/2,020). For all elements/substances investigated patterns and rankings of predictors are similar for decision trees and regression models. As expected, the numbers of significant predictors is higher with decision trees than with linear regression because weak and non-linear predictors as well as predictors that are valid only in specific subgroups are excluded by stepwise linear regression. Percentages of explained variances differ significantly by substance and by scale and strength of association to predominant predictors. If the best predictor is in metric scale and associations are strong, linear regression usually outperforms decision tree models. Otherwise, explained variance of decision trees is higher if predominant predictors are in categorical scale. In conclusion, the results show that linear regression and decision trees used in combination may improve general performance when modelling human exposure. For example within ESB data-exploration, regression is used to eliminate the influence of well-known strong confounders like time, lipids (blood plasma), and creatinine (urine). With data adjusted in this way it is easier to assess consistency of weak predictors in decision trees.

Information about importance of main and also less significant explanatory variables as well as relations between explanatory variables is crucial for policy makers to decide on efficient regulations and/or further investigations.
6.7 The German Human Biomonitoring Commission – Reference and Human Biomonitoring Values

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(3) Ruhr-University Bochum, Germany

In Germany, the Human Biomonitoring Commission of the Federal Environment Agency (UBA) was established to develop scientifically based criteria for the application of Human Biomonitoring (HBM), in 1992. The Commission’s mandate is to support the UBA in its work by providing experts advice. The goal is to clarify fundamental and practical issues related to HBM.

To achieve a harmonised assessment of internal exposure to substances in environmental medicine, the Commission has developed criteria for the derivation of different guidance values: reference values and HBM values.

Reference values are defined as the 95th percentiles of the concentrations of a substance in human biological material; they are statistically derived from representative groups of the general population. The reference value permit to assess the exposure of individuals or population groups as elevated or not elevated compared to the current background exposure.

Up to now, the Commission has derived reference values for antimony, arsenic, cadmium, lead, nickel, mercury, platinum, pentachlorophenol (PCP), thallium, uranium in urine or/and blood, for metabolites of Di(2-ethylhexyl)phthalate (DEHP), organophosphorous, polycyclic aromatic hydrocarbons, and of pyrethroids in urine, for polychlorinated biphenyls (PCB), for ß-hexachlorocyclohexane, hexachlorobenzene and for dichlorodiphenyltrichloroethane in blood as well as for some PCB and organochlorine pesticides in human milk.

HBM values are health-based exposure limits and derived on the basis of toxicological, epidemiological studies or toxicokinetic extrapolation which provides a concentration of a substance or its metabolites corresponding to tolerable intake doses. Two levels are defined: HBM I and II. Up to now, the Commission has derived HBM values for lead, cadmium, mercury, PCP and DEHP. As a consequence of the reassessment of critical lead effects the Commission suspended the HBM values for lead in blood of children and adults in 2009.
6.8 The Austrian Platform for Human Biomonitoring


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When Austria decided to take part in the European process of harmonizing human biomonitoring it was realized that this task, being a cross sectional project, needs to be implemented by a broad interdisciplinary community. On this occasion the Environment Agency Austria founded in September 2007 the “Austrian Platform for Human Biomonitoring”. The platform brings together experts from science and administration in order to guarantee a coordinated, evidence based approach towards policy consulting in the field of environmental health.

The platform aims at establishing human biomonitoring in Austria as a tool for health and environmental protection, supporting national prevention targets and extending national competence in the field of human biomonitoring. The platform should contribute to implementing national and international conventions (Stockholm convention, environment and health action plan, European chemical policy REACH,…). It should enable the implementation of studies and identification of environmental health factors by means of human biomonitoring. Coordinated planning of research activities has already led to a co-operation project with the study concerning the nutritional status of the Austrian population, which will be published in the Austrian Nutrition Report. Within this collaboration it is intended to monitor contaminants (phthalates, bisphenol A, polybrominated diphenyl ethers, perfluorinated compounds) for which food intake is a relevant pathway of exposure.

Further objectives are the advancement of communication between relevant federal authorities, federal provinces, local authorities and scientific institutions which should enable quick and efficient dealing with “hot spots” and its risk management. Current results are disseminated in order to support reliable reporting of environmental health issues. A symposium was held in January 2010.

The Austrian platform for human biomonitoring is a collaborative initiative between universities, the Austrian Social Insurance for Occupational Risks, the Chief medical Offices of the Austrian Federal States as well as ministries, the Austrian Agency for Health and Food Safety, the Austrian Health Institute, the Austrian Medical Association and the Environment Agency Austria.
Human Biomonitoring

Nutzen für die Politik – Herausforderung für die Wissenschaft

Political benefits – scientific challenges


List of participants
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