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# SUMMARY REPORT THE JOINT WHO/IOMEH WORKSHOP ON HUMAN EXPOSURE ASSESSMENT IN ENVIRONMENTAL HEALTH DECISION-MAKING

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A Joint WHO/IOMEH Workshop on Human Exposure Assessment in Environmental Health Decision-Making was held at the Institute of Occupational Medicine and Environmental Health (IOMEH), Sosnowiec, Poland, 19–23 November 1996. 46 participants from 24 countries attended the meeting. The workshop was in conjunction with the 45th anniversary of the Institute of Occupational Medicine and Environmental Health (IOMEH), Sosnowiec, Poland.

The meeting was opened by Prof. J. Sokal, Director, IOMEH, and Dr. T. Kjellström, Director, WHO Office of Global and Integrated Environmental Health.

*The objectives of the workshop were:*

- to review and discuss local, national, and regional human exposure assessment activities including quality assurance and quality control (QA/QC);
- to review the first draft of the WHO/EHC teaching text on human exposure assessment;
- to identify and outline case studies on human exposure to heavy metals, carcinogens/mutagens, and air pollution for teaching purposes;
- to discuss the "state-of-the-art" in order to determine human exposure to pollutants and how different types of exposure information enter and influence the decision-making process.

## ISSUES DISCUSSED

### Human Exposure Assessment (HEA) as Part of the DPSEEA Framework

At the meeting the DPSEEA framework was introduced by Dr. T. Kjellström. This framework is another way to express the environmental health chain and allows it to put human exposure into a broader context. Within this framework, the driving forces component refers to factors which motivate and push the environmental processes involved. A wide range of driving forces exists, and includes population growth, technological and economic development. The driving forces generate pressures on the environment. These are generated by all sectors of economic activity and arise at all stages in the supply chain – from initial resource extraction, through processing and distribution, to final consumption and waste release. The state of the environment often changes in response to these pressures. The changes may be complex and far-reaching, affecting almost all aspects of the environment and all environmental media. Environmental hazard, however, pose risks to human well-being only when humans are exposed to them. Exposure thus refers to the intersection between people and hazards in the environment. Exposure is rarely an automatic consequence of the existence of a hazard since it requires that people are present both at the time and place where the hazard occurs. Exposure to environmental hazards in turn leads to a wide range of health effects. These may vary in type, intensity and magnitude depending upon the type of hazard to which people have been exposed, the level of exposure and the number of people involved. Faced with these effects, and concerned about other potential ecological or health impacts, society typically attempts to invoke a range of actions. These may take many forms and be targeted at different points along the environmental health chain. In the short term, actions may be protective (e.g. by trying to change individual behavior and lifestyle to prevent exposure). Actions may also be taken to reduce or control hazards (e.g. by limiting emissions of pollutants). The most effective long-term actions, however, are preventive in approach, aimed at eliminating or reducing the forces that drive the system.

### Presentations of Human Exposure Assessment Activities

Presentations on a number of local, national, and regional human exposure assessment and related activities were given.

### Textbook

The meeting reviewed the first draft. The textbook is aimed to strengthen education, training and research in the field of human exposure assessment. It provides an introduction into the topic and is intended to be used in postgraduate or related classes and courses.

In addition to the textbook, a collection of exercises are in preparation to give students the opportunity of applying various human exposure assessment methodologies. During the workshop human exposure studies were identified which after adaptation for teaching could serve as study exercises.

### HEA of Selected Pollutants – Monitoring

Before actually starting with a big or the main study, small scale studies or pilot studies should be conducted in order to get a better understanding of the exposure situation.

*Exposure assessment in a detailed environmental epidemiological investigation:* Exposure information in environmental epidemiology studies should, if possible, include biological or personal monitoring. Pb exposure can preferably be determined in human media such as blood, plasma, and bones, whereas urine is the human fluid of interest for arsenic measurements. Passive sampling devices are recommended to determine personal nitrogen dioxide exposure.

Questionnaires should be used to help identifying the main exposure sources. Existing data should be used to analyze exposure retrospectively.

*Methodologies to evaluate the efficiency of interventions limiting exposure:* Follow-up studies intended to evaluate the efficiency of interventions should mainly focus on environmental measurements. However, biological monitoring can also be performed to demonstrate the effectiveness of any intervention on the level of the human organism.

*Methodologies to monitor exposure trends:* As it is recommended for the evaluation of interventions, measurements to monitor exposure trends should first look at environmental concentrations. In the case of nitrogen dioxide, however, it is recommended to document air pollution *and* exposure trends together.

### Decision-Making

During the discussions it was felt that there is a great need for guidance of how scientists should present their data or exposure information to decision-makers. However, in order to facilitate the interpretation of exposure data by the decision-maker, information should be presented easily understandable and should include the following:

- a comparison of the actual exposure situation with relevant standards and guidelines;
- a comparison of the local or national exposure situation with neighboring locations or countries;
- an indication of the resulting health risk and associated costs due to medical care and due to peoples' absence from work;
- a cost/benefit analyses of intervention strategies.

## KEY CONCLUSIONS

*– Exposure assessment of environmental contaminants is important to health programs:*

Both the environment and human health can be damaged by pollution. Exposure to chemicals emitted into the air, water, or soil at high concentrations or over a long period of time can result in sickness, disease, or death. Exposure assessment is being used to determine if the level of contaminants that occur in the environment are unsafe to the general population or special susceptible groups such as children. Based on the Helsinki declaration, there is a trend to integrate health and environmental activities. Most of the countries at this meeting conduct some kind of environmental health monitoring activity. Representatives to this meeting presented information about the use of exposure assessment in the analysis of environmental health problems. There is considerable concern about the impact of environmental pollutant exposure on human health. As economic development increases and expands, questions arise about environmental health.

*– QA/QC technical support is essential to conduct exposure monitoring and assessment studies:*

In the HEAL program, interlaboratory comparison studies for quality control were used to help participating countries develop and maintain adequate exposure monitoring and data analysis capabilities. This need still exists. Quality control is needed for internal control, being in control across the analytical range, and external control, being in agreement with other laboratories. Exposure assessment training courses concerning quality control and quality assurance have been developed but there is a need to establish a mechanism for interlaboratory comparison studies for quality control to be conducted.

*– There is a need to exchange information about exposure assessment activities and programs that are occurring throughout the world:*

Generally, announcement and exchange of information about the many exposure assessment activities and programs occurs in the form of summary reports. However, there is considerable interest to obtain raw data and detailed reports. Announcing the availability of these reports using the Global Environmental Epidemiology Network (GEENET) or using an electronic mailing list or by posting data and reports on the Internet would improve the opportunities to obtain this much needed information.

*– There is a critical need for exposure assessment training materials, especially the exposure assessment textbook:*

It was recognized that exposure is a complex subject. A wide variety of scientific and engineering backgrounds exists that can be involved in assessing exposure to pollution. Yet, there are very few training materials currently available. A basic textbook is valuable to describe the field and introduce concepts. Confidentiality of data and ethical issues associated with exposure monitoring should be addressed in training materials. Case studies should be prepared as a training aid for use in training courses.

*– Data bases of exposure questionnaires and exposure data are needed:*

Questionnaires can be a useful tool in exposure investigations. However, they can be expensive to develop. It would be useful to establish a data base of survey questionnaires that institutions could use and modify to meet their needs for their exposure assessment investigations. There is considerable interest to make raw data collected in exposure studies available to the scientific community for subsequent analysis. In some exposure studies, such as Expolis and the national survey being conducted in Germany, provisions are being made to make raw data available for subsequent analysis.

*– WHO is a partner in stimulating international exposure assessment programs:*

WHO is viewed as a neutral, non-partisan organization in the advancement of exposure assessment methodology. WHO can stimulate efforts to establish training courses, information exchange networks, and provide technical advice. WHO can play a role in efforts to increase the awareness of exposure assessment to decision-makers in member states.

## SPECIFIC RECOMMENDATIONS

*– Better information of existing exposure assessment information:* data, guidelines, reports, is recommended. Publication of human exposure studies in the scientific literature whenever possible is encouraged.

Announcement of major human exposure assessment studies, such as the exposure survey in Germany, and the European Expolis study should be made directly to exposure assessment professionals. Establishment of an Internet home page concerning exposure is recommended.

*– A QA/QC network consisting of information exchange, advice, training, protocols, and interlaboratory studies should be established:*

There is a need to expand training beyond the quality control courses offered by WHO Euro. There is a need for laboratory standards for environmental analysis and training materials for quality assurance and quality control for sampling and sample collection. Establishment of a network of centers to provide training and technical advice and support is very important. It is recognized that to succeed, this must be done in a sustainable

way to be able to recover costs. It may be necessary to convene a meeting devoted to this issue.

– *Regional cooperation of the exchange of raw exposure data bases are needed:*

The Global Environmental Epidemiology Network (GEENET) should be considered for this purpose, provided that scientists in the network are willing to perform the necessary functions to seek information requested in referrals. WHO will produce a document that describes existing institutional activities and summarizes the past history of HEAL.

– *Guidance for presentation of exposure assessment information to decision-makers is needed* – risk communication framework; transfer of data to information for risk assessment.

– *WHO should increase the awareness of exposure assessment and establish a link between exposure assessment experts and decision-makers:*

WHO will consider a new way to revitalize the HEAL program to perform a role in coordination of exposure information exchange and linkage of national exposure assessment activities to international programs.

– *An Internet site should be established* for human exposure assessment reports and information.

– *The case studies outlined at this workshop should be developed* for the use in teaching, distributed, and reviewed.

– When using geographic information systems (GIS) *health and environment information must be presented to decision-makers in such a way to prevent misinformation.*

*The Summary report has been shortened and edited by Vladimír Bencko, Institute of Hygiene and Epidemology, First Faculty of Medicine, Charles University, Prague, participant of the Joint WHO/IOMEH Workshop.*

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**Part 2 Population structure and Molecular Markers** is composed of chapters 4 through 9. In chapter 4 RAPD (randomly amplified polymorphic DNA) markers are used to characterize genetic relationships and population structures. Following chapters focus on macrospatial genetic structure and spetiation, application of molecular methods to the study of biological invasions, genetic mating systems, and genetic relatedness and pedigrees. Chapter 9 is devoted to PCR-based cloning across large taxonomic distances and polymorhism detection. Notably two general molecular problems are discussed here - first, how genes characterized in one or more species acquire species-specific genetic information in other species, second, how does one efficiently detect genetic variation so that populations can be screened effectively for either known or unknown variants. As an example studies on the major histocompatibility complex (MHC) in man and mouse are looked at.

**Part 3 Classic Problems in the Evolution of Growth and Development** contains chapters 10 through 16. These chapters deal with strategies for cloning developmental genes using closely related species, evolution of developmental systems in the nematode model organism, and mechanisms by which differential genomic expression is first established in the various spatial domains of the sea urchin embryo. Furthermore, looked at are evolutionary approaches to analyzing development, *in situ* hybridization studies of developmental genes and gene expression during ontogeny, and lineage analysis using retroviral vectors.

**Part 4 Evolution in Variable Environments and Physiological Adaptation** includes chapters 17 through 22. In this part examined are gene regulation of response to variable osmotic environments, a multidisciplinary approach for a better understanding of the evolutionary mechanisms that affect genetic variation of enzyme-encoding loci in natural populations, and molecular studies leading to better understanding of how animals cope with the challenge of oxygen transport during development. In concluding chapters sex determination of nonmammalian vertebrates, control of reproductive behaviour and sexual differentiation of brain in rodents, and models for basic reseach and biotechnological applications are outlined.

The second section **Protocols** focuses on descriptions of laboratory techniques and procedures. It presents a detailed compilation of over 60 protocols which have been developed, tested, and perfected by leading researchers. It provides step-by-step coverage of each protocol, featuring for each a summary of its underlying rationale, a list of necessary reagents and solutions, and a discussion of potential obstacles to a particular technique. Specific techniques covered include: cloning and cell preparation, DNA preparation and manipulation, gel electrophoresis, hybridization, molecular characterization of macromolecules, polymerase chain reaction, RNA expresion and transfection, and sequencing. In conclusion protocols by author and application codes are indexed.

Contemporaly tools of molecular biology continue to open new areas of biological research and provide important answers to classic problems. Mating strategies, physiological adaptation, genetic exchange between populations, cell lineages during development, and many others are now being powerfully adressed using tools from the molecular arsenal. This volume presents an authoritative resource designed to provide both basic and in-depth explanations of molecular investigation procedures for research scientists in all areas of organismal and integrative biology. Graduate students in diverse fields of biology will find this book to be an indispensable manual for laboratory work.

*Jindřich Jíra*