

CONFERENCE ON “METALS IN EASTERN AND CENTRAL EUROPE: HEALTH EFFECTS, SOURCES OF CONTAMINATION AND METHODS OF REMEDIATION”, PRAGUE, CZECH REPUBLIC, 8–10 NOVEMBER 2000 KEYNOTE ADDRESS

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The countries of Eastern and Central Europe have emerged from a political system which, for decades, has disregarded any safeguards to human health from the deleterious effects of hazardous substances. Rapid industrialization without any bona fide environmental regulatory controls has placed enormous stress on these countries. The societal and economic costs associated with human health effects, environmental issues, and the cleaning up of contaminants while simultaneously trying to correct their economies have had severe impact on the countries in this region, forcing them to set and reset priorities with inadequate resources to meet the expectations of the population. Nonetheless, each country is doing a valiant job of trying to be self-sufficient, while preserving its own unique identity, so as to try to ensure future generations a higher standard of living and improved quality of life.

Metals are serious contaminants the world over, but this is particularly and acutely true in Eastern and Central Europe. Because metals are natural elements, once released they persist in the environment. Their persistence coupled with their ability to combine with organic chemicals and with each other, makes them particularly detrimental to human health. Metals are but one of the many challenges to the countries in the region. Although there is little doubt that metal contamination is a serious problem, there are barriers to determining the degree of the threat to humans. Furthermore, environmental contamination by metals is by no means the only or perhaps even the most serious threat to human health, but it certainly is a key contributing factor to ill health and diminution of the quality of life.

The problem of metals is endemic across the region, but the type and sources of the contamination vary from

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nation to nation. The countries of this region differ considerably in their efforts to deal specifically with metals. At the recent conference sponsored in part by the National Institute of Environmental Health Sciences, USA, the International Lead and Zinc Research Organization, USA, the National Institute of Public Health, Czech Republic, the University of Albany, USA, and the World Health Organization, Switzerland, representatives of thirteen countries in the region described the sources and fate of metal contamination, the resultant human health and ecological effects, and the means to remediate metals and mixtures of metals in Eastern and Central Europe. The conference on "Metals in Eastern and Central Europe: Health Effects, Sources of Contamination and Methods of Remediation" provided a forum for the presentation of the most recent research advances on this problem, and the considerations how to tackle it in this part of the world. The meeting attempted to discuss the problem surrounding metal contamination from the perspective that it is a legacy of the past that is being addressed at present while providing a framework for future research and collaborative efforts.

The papers published in this issue of *International Journal of Occupational Medicine and Environmental Health* are the proceedings of the conference held in Prague at the National Institute of Public Health on 8–10 November 2000. The conference is part of a series of meetings in the region, which began in 1994, sponsored by the National Institute of Environmental Health Sciences (NIEHS), the World Health Organization (WHO) and the University of Albany which has succeeded over the years to bring together scientists, public health practitioners, environmental engineers, and policy-makers from Eastern and Central Europe, together with a few experts from Western Europe and the United States, to discuss the challenges arising out of the exposure to environmental contaminants. The conference was organized in response to concerns voiced at previous conferences. Namely, that the exposure to metals of those living within the region pose serious and long-lasting health problems. This conference brought together health professionals, government and the private sector professionals to discuss recent developments

in the understanding of possible health effects to human populations and the ecosystem resulting from metal contamination, risk assessment, sources of contamination in the region, and the latest developments in methods of remediation.

The multidisciplinary philosophy behind these meetings, including this one, is based on the NIEHS Superfund Basic Research Program, a unique program of basic and translational research directed toward understanding, assessing, and attenuating the adverse effects of human health, resulting from exposure to hazardous substances [1,2]. It is a singular program linking biomedical research with related engineering, hydrogeologic and ecological components, providing a broader and more detailed body of scientific information in order to make sound decisions related to the management of hazardous substances. The Program fosters an interdisciplinary research approach to address the problems of exposure to hazardous substances in the environment. It is this philosophy that has been at work in these conferences in Eastern and Central Europe for the past seven years, increasing collaboration and communication among scientists from a variety of disciplines.

The presentations highlighted the fact that there is human exposure to metals but that there is a limited relevant database in this region. Furthermore, there is a clear need for preventive measures. This point is definitely critical in that it stresses research issues that are crucial to exposure assessment and that, in turn, needs to be more clearly linked with individual susceptibility. Key to exposure assessment are the issues surrounding bioavailability of metals as well as mixtures of metals. It is important to assess source, fate, transport, persistence and bioaccumulation, as they are all interrelated. Therefore, by developing and using efficient and technologically relevant remediation measures, exposure and uncertainty of risk can be reduced. Therefore, remediation technologies needs to be viewed within the context of public health as primary prevention. Remediation fits into the public health paradigm. Interdisciplinary environmental health sciences research means that health investigators, public health officials, and biomedical researchers work closely with engineers,

ecologists, and hydrogeologists if the complexities of the metals are to be dealt with. This is especially important in Eastern and Central Europe. Furthermore, given the complexity and magnitude of environmental health problems associated with metals, research enterprises aimed at improving our knowledge of and ability to resolve these critical issues would profit from instituting collaborative relationships with the communities experiencing these problems.

RESEARCH FRAMEWORK

The efforts of many investigators have been driven in part by environmental health concerns in Eastern and Central Europe. Proceedings and policy commentaries of the meetings have been published in the peer-reviewed literature [3–7]. It is important to build upon the knowledge gained from these occurrences.

Populations in the region particularly desire to understand the consequences of exposure to environmental agents, such as metals, for human health and the relationship between exposure and disease outcome. From a scientific perspective, it is of crucial importance to determine whether individuals have been exposed to metals, the route of exposure, the levels and timing of exposure and whether the substance has reached the target organ or cell. Equally important is to determine if the exposure results in changes in normal physiologic processes that could lead to disease or dysfunction. These fundamental relationships are difficult to address. However, with the continued development of exposure models, development and validation of exposure biomarkers, effect and susceptibility based on mechanistic data, and the application of these to epidemiologic studies will be important for risk assessment and in the decision-making process for developing better and more effective prevention/intervention strategies.

There are many unanswered questions with regard to the consequences of environmental exposures for the populations in Eastern and Central Europe. The combined effects of urban and industrial growth in the region have generated a number of increasingly serious environmental

problems. Chief among these are the over-exploitation and contamination of ground and surface water resources; the lack of proper disposal or recycling of liquid, solid and hazardous waste; air pollution; and inadequate environmental infrastructure. International co-operation on trade and the environment has set the stage for new initiatives and collaborative efforts aimed at preventing pollution and promoting sustainable development. Currently, neither models of the data, nor co-ordinated regional studies of such issues exist.

The greatest impact on human health and sustainability in the broadest sense derives from atmospheric components and subsequent distribution within the environment system. Atmospheric contaminants are not restricted by area; cross border and, indeed, cross-continent transport readily occur. The impact is as great as are the consequences both direct (health) and indirect (agricultural, forestry, water degradation, and economic loss). There are specifically two major atmospheric concerns which are very specific to this region, gaseous and aerosol (particulate) emissions. Anthropogenic sulfur impacts on every spatial scale are respirable and exert damage to human respiratory systems and serve as potential carriers of toxic pollutants. Along with respiratory and cardiovascular damage, sulfur releases upon interaction with the ground toxic metals such as aluminum, iron, manganese, copper, zinc, mercury, lead, nickel, and cadmium. As such, airborne contaminants also induce local and regional hydrogeologic and health problems. What is needed is the link from the atmospheric measurement-modeling to health and to policy/decision makers.

To truly understand the health outcomes of environmental exposures to metals, there must be a reliable data source upon which analyses should be based. Thus, the collection of standardized baseline environmental data is essential, as is the identification of useful biomarkers and development of new genomic tools for assessing the health status. Research efforts are needed to identify the sources of hazardous environmental metal exposures among the populations of the regions because this knowledge is now incomplete or even non-existent. Little is known about the types of environmental agents to which these populations

are exposed at home or at school. Research activities need to include the development of methods for sampling and analyzing metal contaminants, their sources, transport, transformation, fate, uptake, and biotransformation.

The timing and dose of metal exposures are critical in producing long-lasting effects on development and functionality later in life. Nutrition and nutritional deficiencies play major roles in prevention and development of environmentally related diseases. Research has shown an increased incidence of adult cardiovascular disease, resulting from poor maternal nutrition during pregnancy [8]. People undernourished during their first two months of development are three times as likely to be obese while those undernourished during the last trimester are more likely to have diabetes mellitus [8]. These studies, and others, highlight the importance of the critical role that timing of physiologic events such as hormone release, presence or absence of unnatural chemicals, nutritional status, and glucocorticoid levels play in a fetus ability to develop the phenotype encoded in its genotype. Stressors, besides undernourishment, would include the exposure to environmental agents, particularly metals. Research is needed to better understand the role of environmental pollutants such as lead, mercury, arsenic, etc. in the development of diseases. Understanding the effects of timing of exposure and the associated health effects either in childhood or latent effects in adulthood is critical.

The risk of metal exposure will differ for a number of reasons, such as physiology, metabolism, pharmacokinetics, physical environment, as well as a number of modifying effects, such as nutrition, prior exposures, gender, and poverty. One of the most important environmental health problems facing us today, is that associated with the health effects of metals, singly and in mixtures, producing subtle, but demonstrable changes at many levels. Long-term studies in populations in the region will provide the opportunity to better understand the differences in susceptibility to various and numerous environmental insults. Research is also needed in the development of biologically-based risk assessment models to better determine long-term low-level exposure in these populations.

Inter- and intra-individual variability with respect to chemical sensitivity and exposure exists. Biomarkers of genetic susceptibility can help identify sub-groups of the population with differing risk of disease and the use of these markers in epidemiologic research will facilitate our understanding of these differences. Biomarkers of exposure, especially those which can be measured non-invasively, would assist in the assessment of toxic metal exposures in these populations. The use of physiologically based biomarkers in human studies have the potential to derive better risk models, which are needed to predict risk and to develop better prevention modalities. The validation of such biomarkers is critical to our ability to better extrapolate exposure to individual risk.

Community-based prevention/intervention research is needed not only to foster refinement of scientifically valid primary, secondary, or tertiary prevention methods but also to strengthen the participation of affected communities within the region in this effort. Community-based prevention/intervention research thus seeks to expand our knowledge and understanding of the potential causes and remedies of environment-related disorders, while at the same time enhances the capacity of communities to participate in the processes that shape research approaches and intervention strategies. Such community-research partnerships is beneficial to both the researchers and the community members.

An important tool to improve public health is an effective method of prevention/intervention to reduce the risk of uncertainty to metal exposure. There is a need to explore new technologies for preventing/reducing exposure to metals, new methods of prevention research, and new means for ensuring participation of affected communities in these efforts. For example, research is needed on new and innovative primary prevention strategies, including remediation strategies and technologies that reduce bioavailability and/or toxicity of metals. This would include areas of research development of remediation methods to clean up contaminated aquifers, development of new, non invasive methods to characterize hazardous sites and for the long term assessment of the effectiveness of remedial actions,

studies to develop and demonstrate methods and strategies to remediate metals (e.g., arsenic, mercury, cadmium, manganese) found in high concentrations or widely dispersed in soils and sediments.

CONCLUSION

There is no doubt that metals are a major problem in Central and Eastern Europe. Previous conferences have focused on similar issues but this one specifically focused on metals because of the ubiquitous nature of these agents and the severe health and environmental consequences of contamination. Nonetheless, the health and environmental issues surrounding metals can be broadened to include all environmental agents in the most liberal sense; therefore, the interdisciplinary approach of this meeting on metals could be used as a model, including the proposed actions needed to deal effectively with this issue. The meeting was organized with the hope that discussions among the policy-makers in the various countries would facilitate the regional co-operation in dealing with the issues relating to metals in the context of the economic and social realities that exist in the region.

The Eastern and Central European region presents unique preventive research opportunities. Based upon current health concerns and meeting recommendations, it would be important to develop and implement a multidisciplinary research program that will bridge research gaps and meet the needs of investigators and affected communities to improve the overall public health of Eastern and Central European residents. Recommendations from participants at the various meetings over the years clearly demonstrate that there is a need for scientifically sound, high technology-based research that could enhance ongoing

health and environmental initiatives. A program, designed to investigate chemical, physical and social exposures in the Eastern and Central European region and their resultant health effects, needs to be established and effectively managed. In addition to basic research, prevention/intervention research needs to be a facet of the program, which may include community-based research and/or technology development and implementation by industry.

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