WHO Workshop on Human Biomonitoring (HBM) to Support Chemical Risk Assessment, Bangkok, Thailand, 17-19 November 2016

Meeting Record

Opening, Welcome Address and Meeting Arrangements

1. The World Health Organization's (WHO) Workshop on Human Biomonitoring (HBM) to Support Chemical Risk Assessment was held in Bangkok, Thailand from 17 to 19 November 2016 and hosted by the WHO Collaborating Centre for Capacity-Building and Research in Environmental Health Science and Toxicology, Chulabhorn Research Institute as a contribution to the WHO Chemical Risk Assessment Network (www.who.int/ipcs/network). The meeting was attended by 27 participants including from 11 Institutions participating in the WHO Chemical Risk Assessment Network. A full list of participants is contained in Annex 1.

2. The meeting was formally opened by Dr Daam Settachan on behalf of Dr Mathuros Ruchirawat, Vice-President for Research and Academic Affairs, Chulabhorn Research Institute. In his opening remarks Dr Settachan spoke of the different types of biomarkers of exposure and effect, the exposure-disease paradigm and suggested some of the ways in which human biomonitoring data could contribute to chemical risk assessment and management.

3. Participants were welcomed to the meeting on behalf of WHO by Dr Kersten Gutschmidt, who briefly described WHO's HBM activities over past years. Dr Gutschmidt mentioned that the WHO Chemical Risk Assessment Network participants had expressed their interest to discuss the use of HBM to support human health risk assessment, especially those methodologies suitable for use in resource poor and developing countries. The present Workshop had been organized at the time of the Eighth Princess Chulabhorn International Science Congress to take advantage of the presence of a number of network participants in that event.

4. The five objectives of the Workshop were to (i) provide a forum for network members in the Asian region to meet with other network members engaged in HBM, as well as invited experts to exchange information and knowledge and facilitate future collaboration related to HBM chemical risk assessment; (ii) provide information on tools available to support HBM activities; (iii) contribute to reviewing existing HBM methodologies suitable for supporting risk assessments in resource poor and developing countries; (iv) identify HBM case studies undertaken by network members for further dissemination through the WHO Chemical Risk Assessment Network to build capacities in the use of HBM in risk assessment; and (v) prepare conclusions and any recommendations to be presented to the broader network.

5. The meeting elected Dr Daam Settachan (Chulabhorn Research Institute, Thailand) and Dr Kersten Gutschmidt (WHO, Headquarters) as co-chairs. The provisional meeting programme was adopted without additions (Annex 2).

HBM and human health risk assessment – case studies

6. Dr. Marta Esteban from the National Centre for Environmental Health (CNSA-ISCIII), Spain described HBM activities in her country. Activities had been initiated in 2007 to define reference values for the Spanish population, identify exposure determinants and observe geographical differences. Over the period 2009 to 2012 Spain became an active partner in two key European studies: i) Consortium to Perform Human Biomonitoring on a European Scale (COPHES) which had focused on the development of harmonised procedures to ensure reliable and comparable data, and ii) a pilot study to demonstrate the feasibility of a coordinated human biomonitoring action on a European scale (DEMOCOPHES). Both of these studies concluded in 2012. Dr Esteban described the HBM activities at the national level and the efforts done to create a stable national HBM network in Spain as well as participation in a new European HBM programme (HBM4EU). She drew the attention of participants to a key European publication summarizing the results of recently conducted international, national surveys and research projects as well as the relevant major accomplishments, data gaps and priority environmental health issues in the WHO European Region[1]. This publication has been made to provide information to support the evaluation of the status of the Palma Declaration commitments on children's environmental health.

7. Dr Clemens Rueperts, Universidad Nacional Costa Rica spoke about some of the needs and challenges of conducting HBM in resource poor and developing countries, illustrating his comments with reference to pesticide exposures including in banana and sugar cane plantations where aerial spraying was widely used. He drew attention to the different climatic conditions affecting the use of pesticides and summarized research that had

[1] http://www.euro.who.int/en/media-centre/events/events/2015/04/ehp-mid-term-review/publications/human-biomonitoring-facts-and-figures

examined pesticide exposures in pregnant women using biomarkers of exposure and the adaptation of neurotoxicity testing protocols for studies involving children and infants. The importance of sharing HBM protocols was emphasized as well as the potential usefulness of data from the pesticide manufacturer that could inform selection of metabolites as potential biomarkers of exposure. International collaboration had been an important part of capacity-building for the Universidad National.

8. Kristin Macey of Health Canada presented the use of HBM data under Canada's Chemical Management Plan. This initiative had been launched in 2006 as a commitment to protect human health and the environment from the risks of harmful chemicals and had focused on approximately 4,300 substances prioritized for further attention. Of the 2,700 substances assessed so far, about 10% had HBM data. She outlined a number of relevant HBM initiatives including the Canadian Health Measures Survey; Northern Contaminants Programme; First Nations Biomonitoring Initiatives; and other targeted cohort studies such as regional initiatives in Alberta and Quebec and those focusing on environmental impacts on maternal and child health. Ms Macey described how the use of HBM data in Canadian risk assessments had evolved considerably over recent years to the point where it was now being used to examine exposure trends and patterns, assess potential association with health outcomes from cross-sectional health surveys, deploy in prospective or retrospective epidemiological studies, and to test and compare exposure estimates with health effects data. While there were still a number of uncertainties in its use, the use of HBM data in a tiered approach and use of biomonitoring equivalents or HBM values were being actively supported.

9. Dr. Tamar Berman, Public Health Services, Ministry of Health, Israel presented activities relating to the assessment of pesticide exposures and persistent organic pollutants (POPs) in the general population in Israel, including through monitoring of POPs as part of WHO coordinated surveys of human milk and through assessment of urinary levels of organophosphate pesticides and other environmental contaminants. Other uses had been successful in identifying demographic, behavioural and dietary predictors of pesticide exposure from the consumption of fruit and vegetables. Dr Berman spoke of the challenges inherent in communicating results of HBM to policy-makers particularly given the lack of health-based HBM thresholds. Consultation and collaboration with foreign experts had been critical to developing and extending HBM work in Israel.

10. Dr Nalinee Sripaung, Bureau of Occupational and Environmental Diseases (BOED), Ministry of Public Health, Thailand presented a 2012-2014 case study from Thailand assessing risks to the general community in Rayong Province from arsenic, cadmium, lead, benzene and styrene exposures and a study on use of reactive paper for screening anti-cholinesterase levels among farmers. Ms Naravadee Chinnarat, Ministry of Public Health, Thailand described the analytical capacities of the BOED's laboratory. The setting of a biological exposure index (BEI) for occupational exposure was currently being discussed among senior officers from Members of the Association of Southeast Asian Nations (ASEAN) as part of their collaboration on occupational health.

Consideration had been given in Thailand as to whether a BEI could be useful for assessment of community or general population exposures. However, results from the case study in Rayong Province had shown that there was need to establish a separate reference value for general population as part of a community health surveillance system rather than using the BEI set for occupational exposures. A number of participants voiced their interest in the experience of Thailand on community exposures. This was relevant for developing countries where the informal sector was an important part of the workforce as health impacts could be more widely dispersed among the general or community populations. A number of participants referred to the potential use of drinking water values as surrogate reference limits in some instances.

11. Dr. Daam Settachan from the Environmental Toxicology Laboratory of the Chulabhorn Research Institute introduced the Institute's capacity-building programme of short and long term training in environmental health and toxicology, distance learning material and courseware. The detection of environmental pollutants and monitoring of health effects was one of the short courses including both theoretical and practical aspects. Dr Daam also presented a brief overview of the research undertaken at Chulabhorn Research Institute including DNA damage in the case of genotoxic air pollutants studied in traffic police, school children, gasoline service attendants and temple workers and in-utero arsenic exposures in tin mining communities.

12. Dr. Koula Zeigler-Skylakis, MAK Commission Secretariat, Germany gave an overview of the activities of the Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area. This Commission had been engaged in the setting of guidelines for the prevention of disease on the basis of biological indicators since 1979. The occupational and medical documentation used to support the decisions of the Commission was a valuable reference source and was regularly published and freely available on the internet. A range of guideline values had been determined including Biological Tolerance Values (BAT) for 146 substances, exposure equivalent values (EKA) in the case of carcinogenic substances and biological guidance values (BLW – Biologischer Leitwert) in the case of substances where information was judged as insufficient. These values are intended to protect employees from impairment at work and are not intended to be suitable for derivation of biological threshold values for long-term non-occupational exposures such as those resulting from air pollution or contaminants in food. The quality of HBM data is given a particularly high importance and is recommended at four stages: pre-analytical, analytical, internal and external control. A list of commercially available control materials is published on the website of the Commission. External control is monitored by a programme of inter-laboratory comparison. Such comparisons have further highlighted the importance of quality control as they have found that even among experienced laboratories the percentage of correct analyses can be as low as 50%.

13. Dr. Stylianos Kephalopoulos from the European Commission's Joint Research Centre gave a presentation of its collaborative activities with the European Environment Agency

and the Organisation for Economic and Cooperative Development (OECD). An OECD HBM database had been created to share monitoring activities for approximately 340 substances. Further work is underway to investigate the feasibility of integrating the OECD HBM database with the European Commission's Information Platform for Chemical Monitoring (IPChem) database[2]. The IPChem has a number of modules including HBM and environmental monitoring data, food and feed monitoring and product and indoor air monitoring data presented in different formats and visualizations. Dr Kephalopoulos also drew attention to a new five-year plan to establish a European HBM Initiative (HMB4EU) in which further synergies with IPChem would be built. He suggested that a webinar or other virtual training in the use of the IPChem database could be arranged should it be of interest to participants.

14. Dr Ovnair Sepai, Public Health England gave an overview of HBM activities in the United Kingdom of Great Britain and Northern Ireland (UK) which aimed to improve the exposure assessment, risk assessment and risk management of environmental substances. A number of unlinked studies including UK Biobank, the Health Survey for England, the Avon Longitudinal Study of Parents and Children, the Small Area Health Statistics Unit, as well as different sources of environmental monitoring were currently used. A more systematic approach was becoming increasingly significance with a greater emphasis on reliable and comparable data, and improved interpretation and harmonization with European countries. The new HMB4EU initiative would also promote linking HBM to evidence-based policy making and was expected to further strengthen capacity-building and encourage the spread of best practice.

15. Dr Naveen Puttaswamy and Dr Krishnendu Mukhopadhay introduced the HBM projects taking place at the newly established Centre for Advanced Research on Air Quality, Climate and Health at Sri Ramachandra University, Chennai, India. The Tamil Nadu Air Pollution and Health Effects Study was highlighted which had investigated the association between PM2.5 exposures and selected maternal, child and adult health outcomes in over 1,000 pregnant women. A study involving the biomarkers of poly-aromatic hydrocarbon exposure in women using solid fuels for household energy purposes and one involving mercury exposure in pregnant women as part of the WHO/UNEP Mercury biomonitoring project were also described. A range of biomarkers were being investigated as a part of the work on household air pollution as they helped to establish mechanistic pathways and were indicators of non-communicable disease occurrence and severity, particularly cardiovascular disease and cancer. A number of practical issues such as urine collection in the field, cold storage, the cost of internal standards as well as availability of analytical equipment had been important and were common in several projects undertaken.

[2] https://ipchem.jrc.ec.europa.eu

UNEP/WHO HBM mercury project

16. On behalf of Dr Dorata Jarosinska, WHO European Centre for Environment and Health, Dr Marta Esteban presented the key aspects of the WHO/UNEP project on the development of a plan for global monitoring of human exposure and environmental concentrations of mercury. This multi-country project will be an important contribution to international discussions on arrangements to obtain mercury monitoring data to support implementation of the Minamata Convention. The project involves seven countries, China, Costa Rica, Ghana, India, Kyrgyzstan, Mongolia and the Russian Federation and uses standard operating procedures building upon the work of the pan-European COPHES and DEMOCOPHES projects and WHO survey work in Europe on exposure to metals. Training of participants in sampling of hair, urine and cord blood as well as analytical techniques had been important parts of the project so far. Project results were expected in 2017.

Round table discussion

17. Participants from developing countries discussed their experiences with building risk assessment capacity and with the use and generation of HBM data. A number of countries drew attention to specific exposures of concern particularly those due to mercury from artisanal and small scale gold mining, electronic waste processing, dentistry, the use of skin lightening creams, emissions from industrial plants and thermal power plants and from healthcare waste disposal. Lead exposures from lead in petrol, and lead-acid battery recycling were also identified as a priority for a number of countries.

18. Dr Yulinar, National Agency for Drug and Food Control, Indonesia spoke of the experience in Indonesia particularly with mercury, lead and pesticide poisonings and of research to investigate, decrease and prevent future episodes. A common difficulty was the fragmented response to such cases and the difficulty in getting access to research findings. A greater awareness of the potential use of HBM among decision-makers would be helpful. Greater cooperation with relevant stakeholders was needed including agreements with hospitals for data collection and the development of communication materials to disseminate research findings.

19. Mr Karma Wangdi, Ministry of Public Health, Bhutan spoke of the increasing awareness of the need for the sound management of chemicals in his country. He said that capacities were being built and implementation of relevant regulations on occupational health and safety prioritized. Completion of a capacity-building project under the Strategic Approach to International Chemicals Management had provided a quick-start to the work needed but ensuring a continuation of such efforts was important, particularly work on occupational surveillance given increasing industrialization in many parts of the country.

20. Dr Wai Phyo Aung, Ministry of Health and Sports, Myanmar, described the occupational and environment health activities of his department and experience in medical surveillance and monitoring of heavy metals from battery recycling, nickel and lead smelting. Training of health professionals as well as building-up laboratory facilities to establish a national reference laboratory were among the key actions needed. Cooperation with neighbouring countries such as Thailand and other countries of the Mekong region would be useful.

21. Dr T.K Joshi summarized the different types of biomarkers available for exposures of concern including those of genomic and metabolomic origin. He provided an update on biomonitoring in India particular for heavy metals and pesticides and drew attention to the paucity of laboratories able to carry out biomonitoring analysis, the relative high costs and lack of reference values for interpretation.

22. For many of the developing country participants HBM work had undertaken as part of research dissertations or had evolved from participating in WHO coordinated studies such as those for human breast milk. Institutions from Costa Rica, Ghana and India were in the process of participating in a global project on mercury biomonitoring being coordinated by WHO and UNEP and spoke of their progress in this regard. A number of participants drew attention to the usefulness of an action level for the prevention and treatment of lead poisoning based on a population-based blood levels. Awareness about HBM in the health-sector could be increased and infrastructure strengthened in the majority of countries. The small number of reliable laboratories and limited analytical competence were two issues highlighted in particular. In some countries occupational surveillance was carried out in formal enterprises involving the biological measurement of heavy metals particularly cadmium, nickel and chromium but reference levels were not always used or available and a comparison of data from different laboratories was not always possible.

Conclusions and recommendations from the workshop

23. In drawing conclusions and possible recommendations, the workshop participants remarked on the range and extent of work on HBM, from both developed and developing country perspectives. While HBM had its origins in the context of occupational health surveillance in several countries the scope was now much wider. Linkage of data with population-based surveys and the establishment of reference values for assessing community health impacts was an area of common interest. HBM research continues to evolve and suggest new biomarkers which promise further understanding of the links between chemical exposure and health impacts. There was a strong interest in sharing information about the areas of work being undertaken, the protocols being used and the results obtained and the commitment of the MAK Commission, OECD and European authorities to share protocols provided a much needed resource.

24. Use of HBM in risk assessment is rapidly emerging in many countries and there would be further value in documenting, sharing and learning from case studies demonstrating the value of HBM in this area. Key among the considerations to extend the use of HBM in risk assessment are issues of data quality and inter-comparability. The availability of standardized protocols for sample collection, analysis and data recording have important prerequisites of successful multi-country projects. Great attention needs to be given to laboratory proficiency and the availability of standard control materials continues to be a challenge not only for developing countries.

25. While BEI and other reference values continue to be useful in an occupational setting there is a need for other reference values to foster the use and interpretation of HBM data particularly in public health and in assessing the health impacts of environmental contaminants in community settings. Experience in interpreting and communicating results of HBM to technical and non-technical audiences and to subjects involved in HBM studies needed to be gained in several settings.

Annex 1

WHO Workshop on Human Biomonitoring (HBM)
to Support Chemical Risk Assessment

17-19 November 2016
Bangkok, Thailand

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Annex 2

WHO Workshop on Human Biomonitoring (HBM) to Support Chemical Risk Assessment

17-19 November 2016

WHO Collaborating Centre, Chulabhorn Research Institute, Bangkok, Thailand

Programme

Day 1: Thursday, 17 November 2017	
12:30 – 14:00	**Lunch and registration**
14:00 – 14:45	**Opening Session**
	Welcome (Mathuros Ruchirawat, CRI)
	Opening remarks and WHO Chemical Risk Assessment Network (WHO)
	Introduction of participants
	Election of chair
14:45 – 15:30	**Introductory session on Human Biomonitoring (HBM) and Human Health Risk Assessment (HHRA)**
	WHO/EURO Report on HBM – facts and figures (Marta Esteban Lopez, Spain)
	HBM and HHRA – Needs and challenges in resource poor developing countries (Clemens Ruepert, Costa Rica)
	Discussion
15:30 – 16:00	**COFFEE BREAK**
16:00-17:00	**Session on HBM and HHRA**
	HBM data use and regulatory risk assessment in Canada (Kristin Macey, Canada)
	HBM – Exposure to pesticides and POPs in the general population in Israel (Tamar Berman, Israel)
	Discussion
17:00	Close of day 1
Day 2: Friday, 18 November 2016	

09:00-10:00	**Session on HBM and HHRA (continued)** Biological Exposure Indices (BEI) (Nalinee Sripaung, Thailand) HBM and risk assessment – Research and capacity building (Daam Settachan, Thailand)
10:00 – 10:30	**Session on developing country experiences – Roundtable and discussion** Thailand, Indonesia, India, Ghana, Costa Rica, Myanmar, Bhutan, Malaysia Discussion on situation, needs and gaps
10:30 – 11:00	**COFFEE BREAK**
11:00 – 12:30	**Session on developing country experiences – Roundtable and discussion (continued)**
12:30 – 13:30	**LUNCH**
13:30 – 15:00	**Session on developing country experiences – Roundtable and discussion (continued)**
14:30 – 15:00	**COFFEE BREAK**
15:00 – 16:00	***Video Presentations*** **Session on HBM on HHRA (continued)** Biological tolerance values (BAT) (MAK Commission, Germany, BY VIDEO) OECD biomonitoring database (Stylianos Kephalopoulos, EC, BY VIDEO) UK HBM Programme and harmonization of HBM methodologies in Europe (Ovnair Sepai, UK, BY VIDEO)
16:00-17:00	UNEP/WHO HBM mercury project (WHO, Ghana, India and Costa Rica)
17:00	Close of day 2
	Day 3: Saturday, 18 November 2016
09:00 – 10:30	**Plenary – Presentation of Group Work** Formation of groups Group discussion: • Identify case studies to be addressed by Network members • Discuss conclusions and recommendations

10:30 – 11:00	**COFFEE BREAK**
11:00 – 12:00	**Plenary – Conclusions and recommendations**
	Presenting of group discussions
	Discussion
12:30 – 14:00	**LUNCH**
14:00 – 16:00	**Plenary – Conclusions and recommendations**
	Discussion and adoption
16:00	Closure of day three and the meeting

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