conceptualized as a workshop on arsenic but later the scope was expanded to cover more metals which are rapidly becoming a regional concern. He hoped that the experts invited from outside the Region would provide valuable inputs for formulating guidelines, which can be used to develop action plans on return to their countries.

This was followed by introduction of the participants.

6. Business Session

6.1 Session 1: Lead

Dr Vikas Kapil, Senior Medical Offficer, Centers for Disease Control and Prevention (CDC)/Agency for Toxic Substances and Disease Registry (ATSDR), Atlanta, Georgia, USA, chaired the first session and introduced the speakers and moderated the panel.

Health Effects and Epidemiology of Lead

Dr Kathy Shea, Professor, University of North Carolina and Duke University, USA

An overview of the major health effects of lead was reviewed with emphasis on the neurodevelopmental toxicities which affect the most vulnerable individuals, children (from fetal life through early brain development). The sources and epidemiology of South Asia were discussed and it was noted that there is no systematic biomonitoring for population lead exposure in the Region. Studies available throughout the Region show that children and women of child-bearing age, have lead levels that are on average above the CDC / WHO level of concern. According to WHO (2004), 12 million children worldwide suffer form mental retardation due to lead exposure. The experience in USA was presented as a "case study" in science and policy actions related to prevention of childhood lead poisoning. It was suggested that this experience could provide inputs to the policy and scientific efforts in the Region to jumpstart prevention efforts and move forward quickly.

Toxicology and Analytical Issues of Lead

Dr Donald Smith, Professor, University of California, Santa Cruz, California, USA

The toxicodynamics of lead in the human body were discussed and again the increased vulnerability of children was highlighted. Various aspects of lead metabolism as they apply to biomonitoring were discussed. A critical issue, especially at low dose exposures, is that maternal plasma lead levels are better

predictors of infant outcomes than the traditional whole blood lead levels. This is likely because plasma lead is the bioavailable form and under 10 mg/dL, lead splits first into plasma. Stable isotopes of lead allow analysis of the molecular fingerprinting and make it possible to identify sources of exposure. Abatement procedures reduce blood lead levels in children only by about 20-25%, probably because as Blood Lead Levels (BLL) are reduced, lead is mobilized from bone back into the plasma/blood compartment. The emerging technology is important, but collaboration across sectors will be most useful in identifying sources of exposure, screening for population exposures and developing preventive policies which will be the ultimate way to protect the health of children and their parents.

Tracing the Sources of Atmospheric Particles through Carbon and Lead Isotopes

Dr JS Ray, Physical Research Laboratory, Ahmedabad, India

The Physical Research Laboratory now has a "clean laboratory" which is capable of high quality environmental analysis. Early reports from 2005 suggest that there is still significant anthropogenic lead in the atmosphere in Ahmedabad, India, despite the fact that officially no leaded petrol has been sold in the country since 2000 and several cities phased lead out of petrol before that date. Stable and radio isotopes of lead and stable isotopes of carbon (the substrate for atmospheric particles to which lead adheres) will allow molecular fingerprinting which can greatly assist determination of natural and anthropogenic sources. While there is considerable overlap in the isotopic patterns from various anthropogenic sources, the possible sources necessary to investigate can be reduced to a few and tracked down. This is important for both enforcement of current laws and development of new policies.

Case study 1: Exposure to Metals in the Household; Lead and Children's Environmental Health

Dr Irma Makalinao, Department of Pharmacology and Toxicology, University of the Philippines College of Medicine, The Philippines

IFCS IV took up issues of children and chemical safety and produced a background document from this initiative which covers special vulnerabilities of children to environmental hazard. With children's environmental health (CEH) both the **dose** and the **timing** of the exposure are critical because of the windows of vulnerability *in utero* and after birth correlating with structural and functional development.

Several case studies from the Philippines were described which were crucial in getting the attention of policy-makers and local pediatricians and were drivers in producing action to move toward protection of children from lead poisoning and other environmental hazards. A discussion of the mining disaster in Marinduque Island and the government response hitherto showed the importance of community involvement and actions to insist on protection. The Philippines now has an interagency committee on environmental health which is a multi-stakeholder, including a poison control center. Interested physicians are able to work for two months at the national poison centre on a rotation basis. The importance of the precautionary principle in protecting children's environmental health was emphasized.

Case Study 2: Relationship between Lead and Reproductive Development in Girls

Dr HN Saiyed, National Institute of Occupational Health (NIOH) , Ahmedabad, India

A review of the information on reproductive toxicity of lead showed that occupational lead exposure is known to alter sex hormones and gonadotrophin levels at relatively low levels. A study was described looking at children in a school near a lead smelter to study the temporal relationship of BLL and the onset of puberty. A correlation was noted between higher BLL and later onset of puberty, but temporality could not be determined from the study design. Various hypotheses were explored using data from the literature and the strongest hypotheses seems to be that BLL drops as lead is moved to the bone because of the onset of puberty. A longitudinal cohort study is required to test this hypothesis and should be done.

Panel Discussion and Recommendations

Participants raised questions about surveillance, source identification, interaction of nutritional status and lead toxicity, soil and lead paint abatement, and effective policy-making and taking action. Indonesia, the only country in the region still using leaded petrol, will ban its use by end of 2005. Yet, a number of participants expressed concern that policy makers often consider that nothing else needs to be done to reduce lead beyond removing it from petrol. The participants were made aware of additional anthropogenic lead sources in this part of the world including coal combustion, lead smelters, mine tailings, battery recycling, jewellery-making, soldering in semiconductor industry, contaminated alum coagulant for water treatment, traditional medicines, cosmetics, *sindoor* (ceremonial powder) contaminated produce especially leaves of food plants,

and sewage sludge. Several people noted that the blood lead levels of children in areas where lead has been removed from petrol for years have not fallen substantially suggesting that they derive from the other significant sources of lead. It was suggested that a national study with standard methodology and biomarkers should be conducted for getting an accurate picture of the lead contamination in the population. Such a study should be coordinated by a UN agency.

Hazardous battery recycling on the streets of New Delhi, India

Emphasis was put on the need to further explore chelation therapy**.** The group pointed out the need for more awareness amongst physicians, para-medical staff and the general public. Here is a role for NGOs.

Other needs identified are laboratory capacity, health care provider capacity building, involvement of nurses and primary care givers to effect behavioural change and strategies and action plans to combat the forces of industry and non-cooperative policy-makers. Multisectoral cooperation and common regional approaches are necessary to be effective.

6.2 Session 2: Mercury

The session was chaired by Dr P.K Seth, former Director of the Industrial Toxicology Research Centre (ITRC), Lucknow, India

Health Effects, Analytical Issues and Biomarkers for Mercury

Dr Bruce Fowler, Centers for Disease Control and Prevention (CDC)/Agency for Toxic Substances and Disease Registry (ATSDR), Atlanta, Georgia, USA

Sources of mercury in the environment were noted and coal burning, chlor-alkali production and dental use were highlighted. Careful quality control and choice of technology is required for useful mercury biomarkers, especially since mercury is ubiquitous and a ready contaminant of samples from collection to laboratory analysis. CDC / ATSDR has determined that Cold Vapor Atomic Absorption Spectrometry (CVAAS) is the most reliable method for Mercury, it is highly selective. CDC / ATSDR is working on a process to speciate the various forms of mercury in blood at the level of being able to determine methyl, vs. ethyl mercury, etc.

Case study 3: Management of Mercury Containing Medical Devices in Health Care Facilities

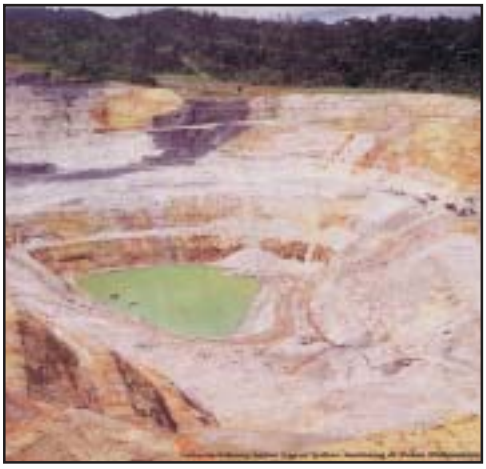
Mr Ravi Agarwal, Coordinator, NGO Toxics Link, New Delhi, India

After a review of the scope of Hg imports and uses in India, data from 5 hospitals were presented. Sources of mercury emissions / pollution from health care include incineration of medical waste, breakage of thermometers, sphygmomanometers, mixing of dental amalgam, as well as disposal of a variety of other devices such as gastrointestinal tubes, laboratory chemicals, pharmaceutical products, electrical applications, lights, switches, etc. It was noted that there is enough mercury in hospitals to declare them hazardous units. The cost of the digital thermometers and trust in the accuracy of non-mercury blood pressure devices are major barriers to converting to mercury-free hospital units. All five hospitals studied have entered into voluntary agreements to phase out mercury use, which is 80% complete. Dental amalgam is 45-55% Hg and mixed by hand without precautions by dental assistants. Overall there is a lack of appreciation of the amount of Hg used in medical and dental units and of the potential toxicity and persistence of this toxic metal. The lack of awareness is particularly true in case of most health workers directly involved.

Case Study 4: Gold Mining in Indonesia

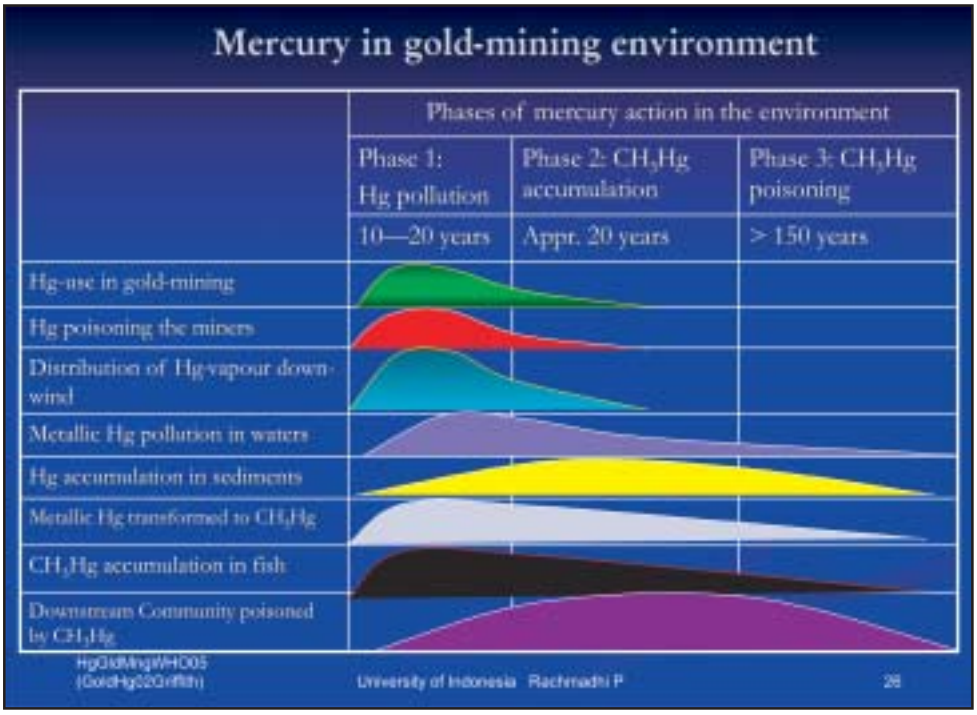
Dr Rachmadi Purwono, University of Indonesia, Jakarta, Indonesia

In 2002, 44000 industrial and small-scale gold mining operations were recorded, more than 200 tons of mercury are employed annually. Small-scale gold mining co-exists with large-scale mining and is economically viable. It is simple to do, and can be a part-time job before harvest. Large amounts of mercury are used in the process. Big mining operations ultimately convert to toxic swamps where mercury-contaminated waters are used by local populations for all purposes and contaminated fish becomes a regular part of local diet. A schematic presentation of long-term environmental and health problems from mercury pollution showed that human and environmental toxicity persists for over 150 years once and affects multiple generations. A comprehensive



Industrial gold mining, Indonesia: a potential source of mercury poisoning

Phases of mercury action in the environment



Source: Wilcke, J. & Merkle, M. (2002):1-8

scheme for managing the health aspects of mercury pollution was offered which describes the pathways for screening, diagnosis, treatment and surveillance in these populations.

Case Study 5: Small scale gold mining in Kalimantan, Indonesia and Mindanao, The Philippines

Dr Stephan Boese O'Reilly, Institute of Forensic Medicine, Ludwig-Maximilians-University, Munich, Germany

Two epidemiological studies sponsored by the United Nations Industrial Development Organization (UNIDO) were described. These studies done in the Philippines (1999) and Indonesia (2003) have demonstrated the acute health effects to gold miners, smelters and local inhabitants from elemental mercury fumes, and the chronic health risks to down-stream populations from mercury fall-out and methylation and subsequent contamination of local fish used in subsistence diet. These studies involved simple biomonitoring, screening neurological examination and neuropsychological testing with statistical analysis to determine

Courtesy: Dr Claus Bogh

Small scale gold miner separating the mercury gold amalgam, Indonesia

the scope and severity of mercury intoxication. Biomonitoring data mirror clinical findings with amalgam smelters and occupationally-exposed children at highest risk for extreme elevations.

72 percent Philippines amalgam smelters, 69% Kalimantan smelters, and 54% children in Sulawesi were found to have acute mercury intoxication. Worldwide, 6-10 million people are endangered by mercury in gold mining, especially in Asia. This is a global problem which will persist for generations and needs to be addressed. Child labour in gold mining has to stop and smelting needs to be contained with simple, affordable technology. Training of the local populations is required and intersectoral solutions to poverty which drive this sort of subsistence gold mining need to be developed and implemented.

Case Study 6: Mercury Emissions from Power Plants

Dr Diksha Gupta, Senior Scientist, Himachal Pradesh Pollution Control Board, Simla, India

A review of the emissions of mercury and other air pollution from thermal power plants was undertaken. India has 7% of the world reserves in coal. Annual coal production increased from 30 million tons in the late 1970s to over 238 million tons in 1999, and is expected to increase to close to 500 million tons by 2010. Above 250 million tons or 70% of the total coal produced is consumed for power generation (81 coal-based power plants, with a capacity of 63000 MW). The total mercury pollution potential from coal in India is estimated to be 78 tonnes per annum. Considering average concentration of mercury in coal as 0.27ppm/kg, about 60 tonnes per annum mercury is emitted from coal-fired thermal power plants.

Over 100 million tons of fly ash are produced annually.

Clean coal technologies are of major concern and interest in India because they pollute less and energy demands will go up dramatically over the next decades.

A review of emission requirements and current status with respect to stack height and ash control was followed by a list of needs and actions to improve air quality and decrease emissions and pollution from power plants in the future.

Panel discussion and recommendations

Accessible technologies to separate mercury from gold in a safe manner, such as this UNIDO retort, need to be promoted.

Discussion centred on public awareness of risks of Hg used in gold mining, considerations of the need to develop, in partnership with industry, cost effective non-mercury containing medical instruments and products and alternative technologies and ways to eliminate or limit availability of Hg to miners. Both supply controls (eliminating manufacture, sale and export of Hg) and demand controls (fair trade gold or eco labelled gold) are options, but widespread corruption and extreme poverty of gold miners make local controls in most locations an unrealistic option. Global agreements to control and limit the transboundary movement of mercury would help the development and implementation of national regulations. Other important mercury sources were mentioned: chlor-alkali factories, gold mining (country-specific), coal combustion, instrumentation (health care and others), household appliances, switches and fungicides. A point was made concerning women and children who are the most vulnerable target groups. Need was also expressed for increasing awareness of health workers regarding the teratogenic effects of mercury and the effect of improper dental amalgams on the skin in addition to the well-established immunomodulatory effects of mercury.

WHO should update its mercury database and create useful documents and fact sheets for web distribution in addition to doing local training and awareness building for communities where gold mining is most prominent. WHO was also requested to clarify its position concerning the use of mercury in the health sector.

6.3 Session 3: Cadmium

Dr G.K. Pandey, Senior Adviser, Ministry of Environment and Forests, India chaired the session.

Cadmium: Health Effects and Epidemiology

Dr Gunnar Nordberg, University of Umea, Umea, Sweden

The general population Cd intake ranges from 0.1 to 8.4 ug/kg/day. The maximum level recommended by the Joint Evaluation Committee on Food Additives -JECFA in 2003 is of 1 ug/kg/day. Cd uptake is mostly from food up to 50%, but intake can also be significant from cigarette smoking.

Symptoms of Tai Tai disease from cadmium poisoning, Japan

Occupational exposures can be very high. The main adverse effects involve bones and kidneys. The health outcomes are osteomalacia, osteoporosis, kidney stones, calciuria and also proteinuria.

Kidney is affected first followed by bone. Cadmium is mainly deposited in kidney and liver – so cannot be safely chelated because Cd passes through kidney and worsens the disease. Treatment lies in eliminating exposure and optimizing nutrition.

Initial concern reported was that effects of cadmium in Japanese populations were unique, but these have also been found in China and there are reports of similar syndromes in Europe. The Tai Tai (*Ouch Ouch*) disease is the result of cadmium damage to bone which is treatable with vitamin D and calcium.

Contamination of rice from industrial pollution including smelting can lead to the presence of 1 mg Cd/kg rice. A strong correla-tion has been found between cadmium exposure and renal dysfunction and osteoporosis in areas where rice is heavily exposed to Cd. It appears from current studies that lower doses than previously believed can cause damage to kidney and bone. Old documents from 1972 about recommendations for exposure limits should be reconsidered in view of new studies.

Use of Biomarkers in Cadmium Risk and Exposure Assessment

Dr Monica Nordberg, Karolinska Institute, Stockholm, Sweden

Cd has a biological half life in humans of 20-30 years. Cd has very complex mechanisms of toxicity at the cellular level.

Speciation of cadmium has impact on the choice of biomarkers. A direct biomarker would be Cd in the kidney; surrogates are Cd in urine and blood. Blood measurements include whole blood Cd and isolation of lymphocyctes for Metallothionein or Metallothionein RNA (MTmRNA). Urine has a variety of proteins and enzymes that are surrogates of Cd. Differences in men and women, pH of urine, etc. are significant.

Metallothionein or Metallothionein RNA can be measured in a variety of ways in the laboratory and are good biomarkers for Cd as well as Zn, Hg, Cu which can also be measured. Protein is induced by Cd and Zn. There are several isozymes which are distributed in various tissues (MT III in brain and kidney) and are age and sex dependent. MT gene expression in peripheral blood lymphocytes is also a good biomarker of susceptibility to renal Cd damage.

Bioremedial Technology for reduction of Cadmium Exposure

Dr Nuzhat Ahmed, University of Karachi, Karachi, Pakistan

Bacterial systems are renewable, inexpensive or cost-effective, harmless to eco systems, easy to handle, gene expression can easily be observed in several generations and pollutant may be recovered and recycled.

The process consists of identifying resistant bacteria from contaminated sites. Bacteria are recovered and the most resistant and best accumulators selected. In this case, for Cd it was *Pseudomonas aeroginosa.*

Resistance mechanisms basically include membrane permeability, efflux system, bioaccumulation / uptake, precipitation, reduction and biosorption on surface of cell. Following the immobilization of bacterial cells on biofilms biofilters are developed. Immobilization on cheap and available products like wood chip or PVC pipes (recycled / waste fragments).

PVC pipes are great biofilm platforms. A column filter was developed filtering up to 80% Cd from effluent. Cadmium can be recovered in pure form and recycled.

Case Study 7: Cadmium in Paddy Fields in Thailand and Viet Nam

Dr Robert Simmons, International Water Management Institute (IWMI), Bangkok, Thailand

Cadmium almost always causes silent damage. Rice is deficient in Fe, Zn and Ca for human needs, which makes people more susceptible to Cd damage if they are living in a rice-consuming population where rice agricultural systems are contaminated by Cd. Acidic soil mobilizes Cd and makes it more bioavailable to rice and other crops.

Thai case study: Soil samples taken in Mae Tao Mai and Pha Dei riverside villages - downstream from a Zn mineralized area, close to the border with Myanmar - showed that 84.59% of the fields exceeded EU standards for Cd content in soils. The levels found were up to 1893 times above standard set in Thailand. Almost 70% of fields produce rice grain with Cd above international

standard. Locally-grown rice is highly contaminated; therefore most of the population consumes rice that is way above weekly intake values recommended by international bodies and likely to cause adverse health impacts. Health studies are being done to determine the level of damage. So far over 5% of sampled population had evidence of potential renal disease.

Viet Nam case study: Even where soil and rice are marginally contaminated, but low pH increases Cd uptake. Lower body weight and high daily consumption of rice will result in Cd intakes that are above RDI. Cd in many areas of Viet Nam and Thai soils are below international standards and rice is below, but standards are based on temperate soils not tropical.

Rice is the staple food throughout South-East and Southern Asia. Are we due to lack of visual clinical manifestations and lack of awareness ignoring a hidden localized impact of potentially significant regional public health issue? Can Zn and Fe supplementation improve health?

Panel and Group Discussion

Phyto-mining and phyto-remediation of contaminated soil were discussed as mitigation measures. Problems in South-East and Southern Asia are that laws have been enacted, but compliance and enforcement do not exist.

Need to combine environmental markers, exposure markers and effect markers simultaneously and prospectively to get the best case study.

Preventive action needs to be taken at source, such as wastewater treatment in the cases of direct or indirect Cd polluting mining activities in the countries concerned.

6.4 Session 4: Arsenic:

Dr Bela Shah, Chief, Non Communicable Diseases Division, Indian Council of Medical Research, India, chaired the session.

Arsenic Exposure and Epidemiology of Chronic Arsenic Poisoning

Dr C.J. Chen, Taiwan National University, Taiwan

Groundwater naturally contaminated is the most common source of excess As exposure. As is a human carcinogen of skin, lung, liver and kidney in dose response relationship, (International Agency for Research on Cancer – IARC, 2004). There is a synergistic relationship between Arsenic and cigarette smoking. Multiple organs are affected including association with increased diabetes, cardio vascular diseases, skin and lens disease. Individual susceptibility to

Arsenic can be acquired (nutritional) or inherent. There are several nutritional and genetic polymorphisms that increase susceptibility.

Interventions must be coordinated and multi-factorial.

Reports suggest that children may be at unique risk for loss of IQ from Arsenic exposure. The presenter noted that the WHO CD distributed at the workshop has extensive reviews on Arsenic.

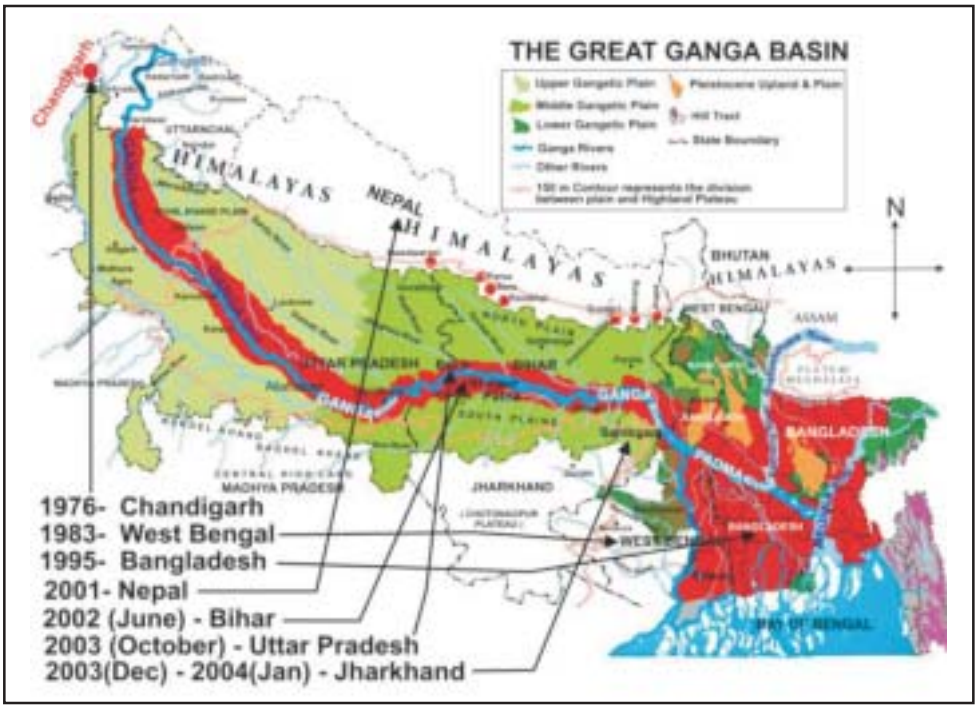
Overview of Arsenic Issues in India

Dr Bela Shah, Chief, Non Communicable Diseases Division,
Indian Council of Medical Research, India

Globally there are several arsenic hotspots – The Great Ganga Basin is a large one in India. In West Bengal As presence in water, mainly tube wells, is exceeding 0.05mg/l, currently putting 15 million people at risk. Recent data show that overall 25% of the tubewells in the affected states are contaminated.

Arsenic has also been found to be present in vegetables and fruit (tomato, green chilli, lemon, papaya, litchi, Annona ata etc). Food cooked in As-contaminated water will also indicate high As levels (rice, dhal, potato curry,

Mapping of potential arsenic sources, India



tea). Thus the food intake may exceed drinking water intake (one estimate is 57% cooked food, 43% drinking water). Dietary detoxification options as well as possible chelation can decrease burden of disease in affected individuals.

Molecular Biomarkers for Arsenic Toxicity

Dr Bruce Fowler, Centers for Disease Control and Prevention (CDC) /Agency for Toxic Substances and Disease Registry (ATSDR), Atlanta, Georgia, USA

As with many metals, As has multiple forms at different valence states with different toxicities. As causes specific pattern of porphyruria that can be used in the field as marker of As exposure. This occurs early and at low dose poisoning, e.g. before liver cell damage as measured by SGOT and SGPT. Cellular defense systems from As include heat shock and stress proteins. Boys and girls have different capacity to respond by producing these protective proteins. This is likely due to imprinting. Reactive Oxygen Species (ROS) are actors in the pathogenesis.

Arsenic Speciation in Biological Samples

Dr Kazuo Suzuki, Chiba University, Narita, Japan

Speciation is a critical component of understanding toxicity of As and it is very useful to be able to measure As levels in biological samples. these are: arsenate (DMA in urine), arsenite (DMA in urine), arsenosugars (DMA in urine) and arsenobetaine (arsenobetaine in urine not metabolized, is excreted intact).

Arsenicals in urine, fingernail, hair, RBCs and plasma were tested. The conclusion is that As in water correlates with total As in nails.

General inorganic As is methylated both in pentavalent and trivalent forms. In the liver, the trivalent form is GSH conjugated and excreted into the bile (or maybe blood, depending on form).The trivalent conjugated As can also bind to proteins. Pentavalent As is not conjugated, but does get methylated and forms thioarsenicals. It is likely that there is inter-conversion of tri and pentavalent methylated forms. Also, demethylation to SH- form may happen and some may appear in blood. HPLC-ICP MS can be used to detect these various metabolites. Iron can be used as a screening test for As in water since Fe and As are highly correlated. Iron testing is easier than As.

Arsenic Monitoring and Mitigation in Pakistan

Dr Muhammad Aslam Tahir, Director, Ministry of Science and Technology, Technology, Islamabad, Pakistan

The presenter reminded that As is more toxic than Hg. Arsenic is tasteless, odorless and colourless. The WHO guidelines, based on 2 litre daily intake and

68 kg body weight, may not be adequate for hot climates where intake is higher and / or people are smaller. Pakistan's national standards are 10 ppb in drinking water.

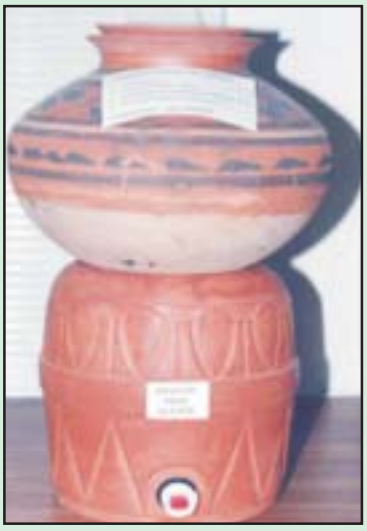
Several As programmes are progressing in Pakistan following the preliminary investigation and national survey. The arsenic mitigation project has been implemented over two years – the problem is certainly smaller than in Bangladesh, but in some places 1000 ppb has been found.

Mitigation projects undertaken target actions such as identifying high As water and have population use alternate water sources. Because imported available technologies were expensive and not user-friendly, low cost easy-to-use test kits (30 Rupees test kit up to 1 ppb detection) and simple treatment technology were locally developed. A removal filter containing sand, iron, As removal media and silver coated sand is now being used, costing 1200 Rupees / unit and is fitted on water containers in the households. Another household filter for tap water costs Rupees 1500 Rupees / unit. A gravity flow As removal filter is available at 1700 Rupees / unit and an As and turbidity and bacterial removal unit handling 250 litres of water costs 30000 Rupees (1000 Pakistan Rupee = 13.80 Euro).

Gravity Flow Arsenic Removal Filter

Rs. 1700 / unit (24 Euro)

Clay Pitcher Arsenic Removal Filter



Rs. 1200 / unit (16.5 Euro)

Examples of adapted technology to meet needs at the field level, Pakistan.

Disposal of sludge from backwash higher volume system can be mixed with cow-dung where bacterial convert into air-borne-arsine and discharge into the air. It is anticipated that these technologies will be deployed rapidly and be effective on a large scale.

Case Study 8: Remediation measures for arsenic mitigation in Banga district, Bangladesh

Dr Monwar Ali, Department of Public Health, Ministry of Local Government Rural Development and Cooperatives, Bangladesh

In Bangladesh arsenic contaminated pumps are painted in red to prevent drinking polluted water. Yet, using that water for other purposes is admissible.

Ninety-five percent of drinking water in the country comes from the aquifer. One hundred and forty four million tube-wells have been built, out of which 5 million are contaminated with As. Suspect wells have been tested and labelled as safe or unsafe. Alternatives are deep well, rain water harvest, pond sand filter and new well. Two hundred and eighty village maps have been prepared in Banga district.

Important: stakeholder involvement, community focus not top down, sustainability, use community leaders, capacity building, teachers and religious leaders give health messages.

Epidemiology approach to control health impacts form Arsenic

Dr Harry Caussy, Environmental Health Adviser, World Health Organization (WHO), Regional Office for South-East Asia , New Delhi, India

Some symptoms of arsenic poisoning

Focus was on the normative functions of WHO in arsenic mitigation. The epidemiology of arsenic contamination in South-East Asia concerns some 40 million persons who are exposed to unsafe levels of arsenic primarily from drinking water. WHO has been active in arsenic mitigation since 1953 through production of arsenic monographs that have been recently updated, and through a mitigation strategy initiated in 1997. It is a kind of blue-print for donors and governments to take action. WHO has developed, together with partners, a field guide on case

definition, detection and management for clinical workers. These modules have been used to train over 100 health care workers from the arsenic-affected countries of the South-East Asia Region, including Bangladesh, Nepal, Myanmar, India and Thailand. WHO has also provided technical support in the formulation of both SOP and ETV protocols for arsenic testing and removal technologies.

Risk assessment: Methodology and case studies

Dr Kersten Gutschmidt, Scientist, World Health Organization (WHO), Geneva, Switzerland

The toxicological properties of lead, mercury, cadmium and arsenic and some of their compounds have been evaluated by WHO for many decades. The *Joint WHO/FAO Expert Committee on Food Additives, Veterinary Drugs and Contaminants* (JECFA), for example, has developed Provisional Tolerable Weekly Intakes (PTWI) for all the metals mentioned above (*http://jecfa.ilsi.org).* In addition, WHO is providing air quality guidelines (*http://www.euro.who.int/air*) and guidelines for drinking-water quality. (*http://who.who.int/water_sanitation_health/dwq /*) as well as classified these metals according to carcinogenicity (*http:// monographs.iarc.fr*).

Comprehensive environmental health information on these metals is also provided in IPCS Environmental Health Criteria documents (*http:// www.inchem.org*). WHO evaluations and guidelines are health-based, and are meant for countries to develop national standards. WHO guidelines can be used as reference levels for conducting risk assessments.

Disability Adjusted Life Years Lost (DALYs) is a measure recently applied by WHO to estimate the disease burden attributable to environmental risk factors in support of health policy (*http://www.who.int/whr/2002*). DALYs take into account both, the life lost because of premature death as well as years lived with disability. DALYs allow for comparing the disease burden attributable to different risk factors (e.g. lead exposure compared to ambient air pollution). Once calculated, DALYs provide the health sector with a better understanding of the disease burden associated with environmental health risk factors. Furthermore, DALYs would give the health sector an advocacy tool at hand to promote health beyond the classical health sector.

So far, WHO has developed a methodology to estimate the burden of disease attributable to lead (*http://www.who.int/quantifying_ehcimpacts/en*). A methodology, at its draft stage, is available for arsenic.

Panel and Group Discussion

The group was informed that there are some variations in As levels with pre-monsoon yielding the highest, but dropping at post-monsoon time due to the water filtering down to the aquifers. However, the variations are not so very marked as to alter the safety of water. The high occurrence of black foot disease in Taiwan, which is not seen as commonly in other countries was also discussed. It was clarified that Blackfoot disease is a peripheral vascular disease and can be easily diagnosed by using an ultra-sound for the peripheral vessels. This disease may also be coming up in other countries since the peripheral vascular disease has a longer latency as compared to other manifestations.

It was clarified that the WHO guideline values are purely health-based while the United States Environmental Protection Agency (USEPA) standards are usually legal statutes which take into consideration various other factors as social and economic impacts in addition to the health effects. Therefore the standards are different for different countries.

A question was also raised regarding the interactions of arsenic with other metals like selenium and lead. Selenium has a dual effect on arsenic, with a good protective effect at lower levels, but in some experiments it has been found that the beneficial effects of selenium are limited to a narrow window and if the selenium content exceeds 1 ppm, selenium starts acting synergistically with arsenic. N-acetyl cysteine is a good protector. In view of local host and environmental factors, the recommendations laid down may need to be revisited.

Different people respond differently to the same levels of arsenic and this aspect needs to be evaluated. There are many aspects which need consideration including genetic differences, differential expression of the protective proteins, genetic programming (males and females) and nutritional status. Familial tendency for fast and slow methylators of arsenic are also well-documented, varying from 10 to 50%. Research is still needed to understand the mechanism of action of various Reactive Oxygen Species (ROS). ROS alone cannot explain the regional differences of disease manifestations and the role of endocrinal damage may also need to be studied.

Biomarkers of arsenic effects include lymphocyte and buccal cell cultures to look for protective proteins expression. Porphyrins and proteinuria patterns can be studied as early markers of exposure. Arsenic also interferes with glucose metabolism and this aspect can also be developed as a bio-marker.

The exposures are never to single metals and due considerations has to be given to the presence and absence of other metals which act synergistically or have protective influence. Areas for further research include the effect of arsenic on children, reproductive health outcomes and food safety of arsenic contaminated foods. The best way forward could be to start networking through a web-based portal for the exchange and dissemination of information on norms, guidelines, modules and tools. The WHO website can be used for this.

7. Reports of Group Discussions

All four working groups presented the results of their discussions in the shape of action plans. Details are given in Annex 5.

At the plenary, the participants discussed overlapping issues such as the urgent need for:

- identification of preventive approaches;
- implementation of risk assessment methods;
- creating more efficient links between research and policy for health;
- aiming priority health interventions at the most vulnerable groups (children, women, workers);
- ensuring higher standards of validation and quality control of laboratories;
- engaging industry to develop cost-effective alternatives;
- stronger role and involvement of public interest NGOs and academia;
- calling for a global regulatory instrument for toxic metals;
- networking at national, regional and global levels, and
- a stronger commitment from WHO.

The organizers thanked all presenters and participant alike. The workshop was closed thereafter.