HEALTHY ENVIRONMENTS FOR CHILDREN
Workshop on the "*Promotion of Collaborative Research"*

Organized by World Health Organization (WHO)
Hosted by Chulabhorn Research Institute (CRI),Bangkok

Pattaya,Thailand, 3-5 February 2003

Background and objectives

Children's exposure to environmental threats has been recognized as an increasing problem in many countries of the South East Asia and Western Pacific Regions. Both traditional threats, such as lack of access to safe water and sanitation and new, emerging environmental risks, such as those posed by endocrine disrupters, are a cause of concern. In addition, more is known–but not enough- about the special "windows of susceptibility" in children, periods when the timing of exposure may be more important than the dose. Despite the rising concern of the scientific community, progress has been slow in the identification and study of some environmental threats on children's health and the efficacy of interventions.

This issue was raised at the International Conference on Environmental Threats to the Health of Children kindly hosted by Her Royal Highness (HRH) Princess Chulabhorn Mahidol which took place at the Chulabhorn Research Institute (CRI) in Bangkok, Thailand from 3-7 March 2002. This conference was an opportunity for WHO's South East Asian and Western Pacific Regional Offices (SEARO and WPRO respectively), to join efforts with the National Institute of Environmental Health & Sciences (NIEHS), the United States Environmental Protection Agency (US/EPA), and donors to enable almost 300 scientists and health officials from more than 30 countries, to meet, exchange experiences and strengthen cooperation in the area of children's environmental health. Participants stressed the need to promote the recognition, assessment and study of environmental factors that have an impact on the health of children. Specific recommendations were made in the Bangkok Statement (see **Annex I**), where WHO is urged to support efforts in the area of Health Care and Research, namely:

To promote the recognition, assessment and study of environmental factors that has an impact on the health and development of children which includes:

- *Establishing centers to address issues related to children's environmental health*
- *Developing and implementing cooperative multidisciplinary research studies in association with centers of excellence, and promote the collection of harmonized data and their dissemination*
- *Seeking financial and institutional support for research, data collection, education and prevention programmes*
- *Developing risk assessment methods that take account of children as a special risk group.*

An important development took place at the September 2002 World Summit on Sustainable Development, where the WHO Director- General, Dr. Gro Harlem Brundtland, called for a global movement to create ***Healthy Environments for Children (HEC)***. The proposal of a global alliance called Healthy Environments for Children Alliance (***HECA***) was backed by many countries and people representing non-governmental organizations, the private sector, academia and international organizations. The support of HRH Princess Chulabhorn was pivotal in this worldwide

call to action, a first of its kind, holding up children, both girls and boys, as the essence of sustainable development and binding nations together around the world to seek healthy and safe lives for children.

During the WHO Consultation on the publication of "Scientific Principles for Assessing Risks from Chemical Exposures in Children" *(22-23 October 2002, Gex, France),* the opportunity was taken by CRI, NIEHS and WHO/IPCS (International Program for Chemical Safety) to discuss the next steps: the organization of a workshop for the promotion of collaborative research in the area of children's environmental health. It was recommended that emphasis should be placed on: (a) existing examples of research in developing countries such as arsenic, lead, mercury, air pollution; (b) on the interactive roles of toxicologists, clinicians, epidemiologists, engineers and other professionals in doing research on children's health and environmental matters, and, especially, (c) on the promotion of collaboration among experts from different countries. Another priority research area proposed for discussion was the identification of unique exposure situations and populations where gene-environment interactions may be contributing to increased susceptibilities to exposure and disease.

The President of CRI, Prof. Dr HRH Princess Chulabhorn visited WHO headquarters in Geneva on 9th December 2002 and personally supported the proposal of a meeting to discuss research needs and promote collaborative studies on healthy environments for children and kindly offered to host this Workshop.

WHO's HQ and SEARO efforts are supported by the NIEHS and the EPA in the United States, organizations deeply concerned about the fate of children and adolescents in a changing environment.

Following the main recommendations of the Bangkok conference 2002, the current workshop focused on these four **objectives**:

1. To review progress and follow-up activities;
2. To discuss in depth some specific on going or planned CEH research activities in the two regions;
3. To discuss and make recommendations on strengthening and building research capacity in CEH, particularly in developing countries, and
4. To develop and implement specific research collaborations and networks.

Four countries from the SEA region (Bangladesh, India, Nepal and Thailand) and 5 from the WP region (Australia, Malaysia, Mongolia, Philippines and Singapore) attended the meeting. There were 32 workshop participants drawn from Ministries of Health and Environment, academia and NGOs from SEA and WP Regions, as well as from institutions and organizations working in the area of children environmental health. In addition to WHO staff from the South-East Asia Regional Office and headquarters, there was participation from NIEHS, USEPA, the University of Arizona, the Dartmouth Medical School and the University of Albany, New York (see **Annex II** for the list of participants).

Methodology and working documents/facilitation

The method of work included presentations of scientific papers and country situation, plenary sessions, group work, discussions and experience sharing among the participating countries and organizations.

Professor Dr HRH Princess Chulabhorn Mahidol inaugurated the workshop and addressed the participants. HRH highlighted the specific recommendations set out at the Bangkok Conference in March 2002 for research mechanisms to assist in the

assessment of environmental risks to children's health and to provide appropriate monitoring procedures. HRH mentioned that research in environmental health and toxicology and the effects of specific hazards that threaten children's health provides the essential basis for addressing the issues that have been identified and described, thus, guided the participants to determine the ways by which we can build our research capacity through an integrated and multisectoral approach. HRH observed that as a result of the exchange of information and experience on current research initiatives and findings, collaborative efforts can be made to accelerate progress and that this can be achieved through the development of networks among the countries represented by the participants engaged in this workshop. HRH referred to the experience at the Chulabhorn Research Institute, which has amply demonstrated the value of cooperative research projects in order to ensure that scarce resources are optimally used to the benefit of all in a particular research endeavor. HRH said that it is through the development of collaborative support and the rational use of human and material resources that progress in research can be made. By wishing success to the participants, HRH expressed confidence in that the strengthening of our research capability will have an important impact on protecting the health of children.

The workshop was chaired by Dr Mathuros Ruchirawat from CRI, Thailand, and Dr William Suk from the NIEHS-USA, and facilitated by WHO/HQ and SEARO staff. The programme prepared prior to the workshop was followed, but adjustments were made afterwards to cater for the participants' needs and inclusion of other emerging issues (see Final Agenda in **Annex III**).

The following documents were provided to the participants as background/reference documents:

1. Children in the New Millennium, Environmental Impact on Health (UNEP/UNICEF/WHO, 2002).
2. Booklet on Healthy Environments for Children, An Alliance to Shape the Future of Life (WHO, 2002).
3. Healthy Environments for Children, Initiating an Alliance for Action - WHO/SDE/PHE/02.06 (WHO, 2002).
4. Global Assessment of the State of the Science of Endocrine Disruptors – WHO/PCS/EDC/02.2 (WHO 2002).
5. Brochure "Using Indicators to Measure Progress on Children's Environmental Health, A call to Action (2002).
6. World Health Organization - Calendar 2003 (SEARO).
7. Tool Kit and Measuring Tape for World Health Day 2003.
8. Strategy for Research on Environment Risks to Children - US Environment Protection Agency (EPA), October 2000.

Day 1: 03 February 2003

Session A: CEH since the Bangkok Conference

Chair: Dr W. Suk (NIEHS-USA) and Dr M. Ruchirawat (CRI-Thailand)

- Dr Jenny Pronczuk gave an overview of the Global Alliance initiative in Healthy Environments for Children (HECA) launched by Dr. Gro Harlem Brundtland, Director General, WHO at the World Summit on Sustainable Development in Johannesburg, South Africa in September 2002. She mentioned that many countries and non-governmental organizations, the private sector, academia and international organizations backed the proposed alliance, and that the HECA Task Force is developing plans of action.

- Mr. Alexander Von Hildebrand, Regional Advisor On Environmental Health at WHO/SEARO, presented a summary of the responses to the a WHO Questionnaire sent in advance to the participants of this workshop on *"Follow-up action of the 2002 Bangkok Conference on Children's Environmental Health"*. He said that from the responses that were analyzed, it could be concluded that the momentum created at the Bangkok Conference remains alive, and that many participants have effectively managed to integrate CEH into their programmes. It was also concluded that the CEH has helped to move the EH agenda forward but that still more needs to be done, especially in the area of commitment. There is a need as well to produce knowledge, and to translate this knowledge into action.

- Dr J.M. Luna, Regional Advisor for Child and Adolescent Health (CAH) and SEARO Regional focal point for World Health Day, informed about the activities being planned at HQ level as well as at the Regional Office level. He showed some of the material that is being made available among them, the 2003 Calendar produced by SEARO with the theme ***"Healthy Environments for Children"***. He also informed the participants on the website (***www.who.int/world-health-day/2003/en***) that has been made available at HQ level from where all material related to WHD 2003 can be seen and downloaded. He also invited all participants to post their planned activities for this day on the website.

- Dr W. Suk highlighted the important impact of the Bangkok Statement which has resulted ina number of collaborative activities in CEH. These issues were summarized in the Journal of Environmental Health Perspectives (**need reference**). He stressed the importance of translating research findings into Public Health promotion/intervention programs at the local community level.

- Following, Dr D. Carpenter from the University of Albany, USA, gave a presentation focusing on "*When research, when interventions, when both?*". Dr Carpenter discussed both, the advantages and benefits of research and interventions giving some practical examples of where the interventions derived from the research lead to positive effects in the communities where they took place. As a conclusion Dr Carpenter pointed out that interventions should always be based on research evidence, and that if the research comes from the community concerned by the intervention, it is often more readily accepted. Nevertheless, he pointed out, the ultimate goal is to do something about the environment health problems, not just to study them.

Session B: Research on CEH issues in SEA and WP countries

Chair: Dr Carole Kimmel (US-EPA) and Dr J.M. Luna (WHO/SEARO)

RESEARCH ACTIVITIES IN SEA COUNTRIES

- D. K. Saxena from the Industrial Toxicology Research Center, Lucknow, India, presented a summary of various studies conducted in recent past in India and other countries of South East Asia that shows a correlation between various etiological factors and child health.

  In the area of **child health and lead**, Ali et al (1978); Abdullah (1984) and Sprinke (1995) reported high blood levels of lead on Indian and Pakistani children using leaded eye cosmetics ("suma") compared to those not using such cosmetics. Studies in India by Gogte et al (1991) and Awasthi et al (1996) did not find any such links. More detailed study is required in India which would help clarify the risk from this cosmetic. Shenoi et

al., (1991) conducted a school based study to trace various sources of lead exposure in urban slum children in Mumbai. Elevated venous blood lead detected in some cases indicated a common source which was identified (a nearby factory manufacturing lead storage batteries) after systematic family and environmental studies were conducted.

Chatterjee and Banarjee (1999) conducted a community based study amongst 50,000 people residing in the vicinity of a lead factory that produced lead ingots and lead alloys. Many people especially children were found affected by lead toxicity. A study on children directly exposed to lead through their nature of occupation by Dinesh and Krishnaswamy (1999) found that 35% of children working in petrol bunks, 17% of those engaged in bangle making industry and 47% of those involved in pica eating had high blood lead levels around. In another study by the same institute (NIN, 1995-96), children were screened to assess the extent of lead toxicity after some reports of cattle population deaths in Western India. Children living within the vicinity of 0-5 km of an industry engaged in preparation of packing material, the mean blood lead levels were 35.2 μg/dl with some clinically symptoms of lead poisoning as compared to children living farther away (23-28 μg/dl).

Bhattacharya et al. (2001) conducted a study of 405 children selected from the vicinity lead smelting units in the suburbs of a metropolitan city where the ambient lead level was found to be high as compared to WHO recommended prescribed level of 0.5 $\mu g/m^3$. Statistical evaluation of the psychological tests and blood lead of the subjects showed that the performance of high blood lead group of boys was significantly adversely affected compared to those of the low blood lead group, with significant lowering of verbal IQ in the high blood lead group of boys and girls with respect to their low blood lead counterparts. Patel et al., (2001) conducted a community-based cross-sectional study of 297 children aged 6 months to 6 years in an Indian city, assessed the prevalence of elevated blood lead (PbB) levels, their risk factors, and the lead contents in potential environmental sources. The prevalence of elevated PbB was 67 %. Anticipated risk factors of elevated lead were living in houses painted with lead-based paint, recent exposures to lead-based paint, and the use of the eye cosmetic. Analysis of various environmental sources such as paint, pencils, crayons, and clay revealed high lead levels. These results demonstrate the existence of a major environmental health problem in Indian children, with risk factors that differ from those in other countries.

Average concentration of Pb in atmospheric air particulates in different suburbs of Mumbai was studied (Tripathi et al., (2001) for almost a decade and its spatial and temporal profiles are discussed in relation to emission sources. Kaul (1999) demonstrated that Iron deficiency among children predisposes them to increased lead absorption thus aggravating further the detrimental effects of lead as observed in a screening study of children carried out in Jammu city.

Arsenic and child health: In a preliminary study by Rahman et al (2001), 18,000 persons in Bangladesh and 86,000 persons in West Bengal were clinically examined in arsenic-affected districts. Of them, 3695 (20.6% including 6.11% children) in Bangladesh and 8500 (9.8% including 1.7% children) in West Bengal had arsenical dermatological features. Children appear to have a higher body burden than adults despite fewer dermatological manifestations.

Fluoride and child health: Gupta et al (1996) studied 25 children selected from an area consuming water containing 4.5 ppm. of fluoride, All the children were in the age group 6-12 years and weighed 18-30 kg. They were graded for clinical, radiological and dental fluorosis and relevant biochemical parameters. Grade I skeletal fluorosis and all grades of the manifestation of dental and clinical fluorosis were observed. A cross-sectional

clinical dental examination of schoolchildren was carried out in Goa (India) by Mascarenhas & Burt (1998), along with a self-administered questionnaire to their parents. The prevalence of fluorosis was 12.9%. Results of the crude, stratified, and logistic regression analyses showed that use of fluoride toothpaste before the age of 6 years was a risk indicator for fluorosis.

Other environmental factors and child health: Sharma et al (1998) conducted a prospective study at two urban slums of Delhi in the peak winter season from November 1994 through February 1995 to determine the incidence of acute lower respiratory infection (ALRI) and its relationship to indoor air pollution due to fuel used for cooking (wood or kerosene); 642 infants were included in this study. Behera et al (1998) carried out a detailed study on passive smoking, domestic fuels and lung function in 200 school children from north India. Awasthi et al. (1996), studied the association between ambient air pollutants (AAP) and respiratory symptoms complex (RSC) in a cohort of 664 children between the ages of 1 month to 4.5 years from 28 slums of Lucknow. They concluded that to improve the respiratory health of preschool children, ambient air SPM and SO2 levels should be kept as low as possible and mothers should be advised to keep children in another room while cooking.

Poisoning cases and child health: A study (Mehta et al., 1996) comprised 120 children brought to the hospital with the history of acute poisoning. In infants kerosene and medications accounted for 72 cases (60%) of poisoning exposures. None of the care-takers of children received any instruction regarding prevention of accidents and poisoning prior to the episode, in spite of multiple contacts with health-care providers. Role of health education and other preventive measures are stressed.

Gupta et al., (1998) studied the trends in poisoning in children. of children (age group: 1 month and above) admitted to the Department of Pediatrics, King George's Medical College, Lucknow, Uttar Pradesh in three alternate calendar years and compared it with a 1977-79 study. Results showed that kerosene poisoning continues to be responsible for a substantial part of the morbidity and also that poisoning due to insecticides and pesticides has increased.

Other studies on child health: The levels of heavy metals, such as Pb, Cd, Cu, Zn and Fe, in whole blood samples of Mumbai and Hyderabad children were determined by Raghunath R et al (1997). Khan and Eswari (1993) analyzed the health status of two hundred children living in the immediate vicinity of solid waste in Pondicherry, India, compared to a non-exposed control group. The data showed significant occurrence of fever, skin disease, diarrhea, dysentery, vomiting, cough, breathlessness, anemia and eye infections. The relatively high incidence of skin diseases throws light on direct or indirect physical contact with solid wastes. A ITRC study (1998) on 120 children attending pediatric OPD at NTPC Hospital (Shaktinagar) was carried out. No positive correlation could be established between findings of hyper pigmentation of the skin, anemia, black line over gums, high B.P. and fine tremors with blood and hair mercury levels.

- Dr S. Bhave, from India, said that research is very important for success of CEH plans and related programs and would require partnership of various agencies. Practicing medical doctors are a vital link in this Research process. A child affected by environmental hazards and with physical or mental symptoms will first be taken to a physician but an environmental factor diagnosis may be missed if the physician is not properly trained. If he/she picks up an index case then he can refer it to researchers in order to initiate proper environmental epidemiological investigation in the community or area.

Physicians are aware of medical conditions (illness) but the question is: how many physicians while seeing routine patients think of environmental factors? In India medical doctors are trained to look for medical illness and the history taking and examination is centered around these factors. Physicians need to be more aware of CEH. At present this knowledge and practice is restricted to occupational and environmental health specialists. There is a need to build environmental health into undergraduate medical and nursing curricula. All specialists should be made aware and capable of recognizing environmental health diseases in routine practice.

Clinical research is very important in environmental diseases. Physicians, especially pediatricians, should be trained to take environmental history in each patient. The environmental history should include: **C**ommunity, **H**ome, **H**obbies, **O**ccupation and **P**ersonal exposure (i.e., not change or shower after work).

The environmental history has to be taken in pregnant women or women planning pregnancy as well. Anemia in children is a common presentation in developing countries and can be caused by malnutrition, worms, lead and other factors.

RESEARCH ACTIVITIES IN WP COUNTRIES

- Dr Irma Makalinao from the University of Philippines, College of Medicine began by saying that a research that attempts to establish the link between children's health to environmental exposures must take into account some understanding of "children's environmental health". In many instances some researchers will have a clear concept of children's health and environmental health but not the unique intersection between "children" plus "environment" plus "health" Children's environmental health deals with disease outcomes following exposures in the settings where a child lives, grows, learns, plays and works. The unique vulnerabilities of children and the timing of exposure during the critical windows in the lifetime of the child highlights the need to promote collaborative research that will allow for a better understanding of what affects children during their lifetime. Such studies will have to take into perspective the socio-cultural, political, spiritual and economic factors that may modify the effects of physical, psychological and biochemical hazards to children.

  There are thirty-seven countries comprising the Western Pacific Region, a diverse geographic area with varying ethnicity and economic growth making it a fertile ground for comparing the issues that affect children in the developed, developing and extremely underdeveloped areas of the world including gene-environment interaction on the background of malnutrition and poverty. When comparing the basic indices of gross national income per capita (GNI) with either infant mortality rate (IMR) and more importantly with mortality among children under five, there seems to be an inverse relationship between GNI and the health indices previously mentioned. For example, in the WPR, Cambodia had the lowest GNI and the highest mortality rate for children under five. According to the UNICEF report, not all children in Marshall Island, Nauru, Niue, Samoa, Solomon Islands and Vanuatu are registered at birth denying them of their identity, recognized name and nationality. Thus, there must be some measures taken to give those children a way for meaningful participation in society before even embarking on CEH research.

  An investigator trying to determine the status of CEH research done in the region will have to take into account published and published research. Many of the published research on specific hazards (air pollution, water and sanitation, biohazards, radiation) or health outcomes (autism and other neurological diseases, asthma, cancer, endocrine disruption) based on a PUBMED search engine were from countries in the higher GNI bracket like Japan, Australia, New Zealand and Singapore focusing on asthma and air

pollution. However, studies directly linking the disease outcomes with environmental exposures were lacking. MEDLINE search will provide an incomplete picture of research, as most of the CEH research in the developing countries remains unpublished. Thus, an inventory or directory of on-going research and the people doing them is of utmost importance. In most instances, the impetus needed to embark in research from the perspective of the developing country comes from a NEED or a sentinel case. For example, a child with keratosis from chronic arsenic poisoning in the community has called the attention of researchers in the Philippines to go back to a mining community where only biological monitoring for lead was being done to now include arsenic among the metals being monitored in the area even if this would mean increasing the funds necessary to do the community health assessment. The motivation to do research among developing countries arises from the need to do intervention and move policy. The story of the deadly dancing firecracker "watusi" which contains white phosphorus illustrates a decade of scientific research as it contributed a treatment protocol not previously found in medical literature but more importantly a research done to convince policy makers to ban "watusi" and prevent the unnecessary loss of children's lives.

Possible areas of country specific community health assessments which can build the blueprint for collaborative research include the following: metals like lead, mercury and arsenic, chronic effects of pesticide exposure, indoor air pollution from second hand smoke and biomass burning, outdoor air pollution, lack of safe water and sanitation and the over-all impact of global climate change. Promoting collaborative research in the region would allow for sharing of human and technical resource capabilities and address the need for a reliable laboratory. Clearly, a multisectoral, multistakedholder collaborative research using a child centered paradigm cutting across different developmental life stages while identifying priority areas of concern will help promote translational research in the western pacific region. In this way, we can move policy to take a bold step in promoting healthy environments for children.

REVIEW OF THE EXISTING INFORMATION AND ACTIVITIES UNDERTAKEN IN SELECTED COUNTRIES:

- **Bangladesh**: A densely populated country, Bangladesh is one of the two countries most threatened by global warming. It is estimated that a sea-level rise of one meter, can inundate 17% of the coastal land displacing around 11 million people from shelter. Data from the World Bank estimate, 500,000 premature deaths and 4-5 million new cases of chronic bronchitis develop each year due to air pollution, and that about 15,000 children in Dhaka city die, and a million in the whole country become ill every year due to excess of lead in the air. Use of traditional bio-mass fuels for household cooking in ill/unventilated kitchen is the usual picture in rural areas. An issue of high concern is that about 2/3 of the population is at risk of being affected by Arsenic because of their exposure to high level of this metal in drinking water. Thirteen 13 types of internationally banned pesticides are being sold in the country and farmers are spraying them in the crops. Key priority research issues identified for Bangladesh are: Air pollution and its health impact; arsenic, water and sanitation problems; noise pollution and its health impact on children; insecticides, fertilizers and factory emissions; food additives, and solid wastes and their health impact.

- **India**: India suffers from the double burden of diseases. While children continue to be under the siege of traditional diseases like malaria and diarrhoea, and unsafe water continues to be the biggest killer in India, the country is being faced now with the onslaught of modern diseases like asthma, lead toxicity, cancer and endocrine disruptors. Interventions exist for dealing with traditional diseases, though they are awfully inadequate. On the other hand, there exists virtually no data and no research

on the extent of asthma incidence due to air pollution, or the rise in paediatric cancer. Research in India is primarily carried out by the Indian Council for Medical Research (ICMR) which has just 6 per cent of its total annual budget, allocated to children's health. Private medical colleges and independent researchers either work in isolation or have no platform to raise their voice and bring the issues at the policy level. India now has the new "Lalit Kant" draft report on health research policy which again highlights the importance on research. It however does not take into consideration the various other parameters that affect health like environmental, genetic, biological, behavioural and economic aspects.

In view of the above, it is suggested that the gaps in research be minimized by focusing on the following:

- Development of standardization protocols to carry out research
- Focus on vulnerable and susceptible populations like children, pregnant women
- Need to have exposure based studies like on indoor air pollution
- Correlating data existing with private practitioners and private hospitals
- Working on developing transparency and accountability in existing health systems
- Need to identify actions and policies for bringing about change
- Investment in knowledge and data generation to bring about policy decisions and at the same time **making use of existing research** based study so that duplicity of work is avoided.
- Research to act as a tool to trigger public support for change and regulations.
- Research may be focused on asthma, cancer, fluorosis, health of children who work as scavengers and rag pickers and children exposed to heavy metals like mercury and lead.

Malaysia: Key children's environmental health issues in Malaysia includes the following: Air Pollution (open burning, haze problems, asthma in children; water borne diseases related to safe water & sanitation; vector borne diseases (dengue and other viral infections); chemical hazards (lead poisoning and cancers); injuries and accidents (drowning, fires, falls and MVA), and emerging issues (endocrine disruptions, radiations, climate change).

There is no centralized agency that deals with CEH, and access to a database that might contain these information is currently lacking.

With respect to activities that are either related directly or indirectly to CEH, the organizations that may be involved are: the Ministry of Health (under the Child Health Unit, DPH), Environmental Health Unit (DPH) which also conducted a healthy setting programme including safe school; the Environmental Health Research Center; and the Institute of Medical Research. There are a number of universities that are known to be carrying out work in this area such as: the Universiti Sains Malaysia (including the National Poison Center), the Universiti Kebangsaan Malaysia, the Universiti Malaya and the Universiti Putra Malaysia.

- **Mongolia**: A large, landlocked country situated in the northern part of Central Asia, its climate is defined as semi-arid continental, with long severe winter with average temperatures ranging from -32^{o}C in the north to -15^{o}C in the south. Most health research projects are in the fields of biomedical and clinical research. Research in public health and epidemiology is conducted by the Public Health Institute with most of the research based on laboratory sciences. The number of research workers in health research is over 500. Currently health and medical research is organized through the

Ministry of Health and Sub-Assembly of Medical Sciences, Academy of Sciences of Mongolia. The funding of research for all sectors (including health) is supported by the Science and Technology Foundation under the Prime Minister. In 2002 the amount of allocated budget for health research was increased by almost three times compared to 1997.

Key children environmental health issues in Mongolia includes: Disease vectors, Air pollution, Injuries and accidents, Water security and homeless, Poor hygiene and sanitation, Chemical hazards, Emerging issues such as radiation, endocrine disrupters and climate change, and Alcohol use and smoking. The main sources of pollution are: Power plants (use coal), Small heating plants (use coal), and Motor vehicles (increasing number, use of leaded benzene, bad technical quality). Since 1990 Mongolia has conducted several research in the field of environmental health and published more than 60 research papers, and in 1996, organized a national conference. Main research works include: Correlation analyses between the air pollution and respiratory diseases, asthma and bronchitis, correlation analyses between the air pollution and children's physical growth, correlation analyses between the air pollution and nonspecific immunity of children, Lead contamination of the environment and blood lead level of children, and Mercury and child health (in areas of gold mining)

Potential partners in CEH research include: Public Health Institute; the Environmental health laboratory (with Chemical, Physical and Bacteriological facilities), the Maternal and Child Health Research Center and all clinical departments and clinical laboratory. Others are the Ministry of Health, Ministry of Nature and Environment, Central Environmental monitoring laboratory and Hydrology and Meteorology Institute, Ministry of Social Welfare and Labor, INGOs (Family welfare association, Pediatrician association) and international organizations like , ILO and WHO.

- **Nepal**: With a population of 23 million, children constitute nearly 50% of the population. Although drinking water coverage is above 80%, sanitation coverage is very low, and most water is contaminated with coliform bacteria in many sites. Diarrhoea contributes to 25% of childhood deaths, and water related diseases are very common. Most schools lack of safe drinking water, latrines, hygienic canteen and safe playground. Acute respiratory infections accounts for 50% of hospitalizations in the <1 year age group, with air pollution and tobacco smoking being major contributors. Asthma and bronchitis are precipitated by emissions from motor vehicles. Vector borne diseases (Japanese encephalitis, visceral leshmaniases-*Kalazar*, and malaria) are rampant in the Terai region and chemical hazards due to the use and inadequate storage of unlicensed pesticides are a reality. Injuries and accidents due to fall injuries at the school, home, playground and working places along with burns, road traffic accidents, poisoning, drowning, dog and snake bites and child abuse are common causes of emergency admission in Kanti Children's hospital (only children hospital in the country). Emerging issues such as child trafficking, child laborers, street children, carpet children and drug abuse are of concern. Recently, contamination of underground water with Arsenic has been identified and comes to add to the emerging issues affecting the health of the general population, and especially that of the children of Nepal.

  Different government and agencies are working in the area of environmental health, but not focused on children's issues. Ministries involved in environmental protection include the Ministry of Population and Environment, Ministry of Forest and Soil conservation, Ministry of Education, Ministry of Agriculture, Ministry of Tourism and Civil Aviation, Ministry of Youth and Culture, and the Ministries of Industry, Health, Construction and Transportation. Partnerships with NGOs and international organizations are also critical.

In November 2002, the Nepal Health Research Council (NHRC) established an Environmental Health Unit through a tripartite effort of the NHRC, the MoH and WHO country office. It limits its activities to research only, thus a need for an institution that can execute and implement health projects; still, there is a need to define a "children's environmental health unit" within this body.

Few studies have been published in the area of indoor air pollution and ARI in children, as well as studies related to health hazards in children working in the carpet industry. Reports on diarrhoeal diseases and parasitic infestation have been conducted as well, but none had come out with concrete suggestions in the area of CEH.

Main research priority areas for CEH in Nepal include: Respiratory disease and Child Health, Diarrhoeal diseases, and Emerging Issues such as Persistent organic pollutants, and heavy metals (lead, arsenic mercury and chromium).

- **Philippines**: According to data from the Department of Health (DOH 1998) the leading causes of infant mortality in the Philippines are respiratory conditions of the fetus and newborn, pneumonia, congenital anomalies, birth injury and difficult labor and diaorrheal diseases. As in the case of developing and even developed countries, the country is faced with the burden of both, infectious diseases and increasingly of chronic non-communicable diseases. Infectious diseases remain as the leading causes of morbidity in the country. Data showed that 91% of the urban population and 71% of the rural population have access to safe water supply (DOH, 1998). Another emerging area of concern is air pollution. Results of baseline health profile among children in Metro Manila showed that the level of exposure to lead in 24.6% (N=51) exceeded the WHO standards. Equally a cause of concern is air quality in the indoor environment caused by the use of biomass fuel, kerosene, liquefied petroleum gas which contributed significantly to indoor air quality. Water pollution soil degradation, solid waste management, food contamination and climate change remain as a public health concern.

  Health and environmental studies were undertaken among children exposed to chemical hazards such as mercury in small-scale gold mining activities (i.e. ballmilling/ blowtorching etc). Analysis for total and methyl mercury levels for environmental and biological biomarkers were done at the National Institute for Minamata Disease in Japan. At present the country has also taken part in the Coordinated Research Project on Mercury sponsored by the International Atomic Agency on the Health and Environmental Impact of Mercury. Physical and neurological examinations were done including detoxification, whenever necessary. Other possible exposures include mercury thermometer bulbs, mercury injection and vaccines. Studies have also been done on the environmental exposure to lead among community residents affected by a mine spillage, large and small-scale battery recycling plant. Currently, a health and environmental study on the impact of arsenic on the mother and child population in the Southern Philippines is being undertaken. Likewise, health studies are being done to determine exposure to environmental contaminants among mother and child residents near a former military base. These activities are being undertaken in collaboration with the UP-National Poison Control and Information Service.

  Priority areas for research include mercury, lead and pesticides. Other recommended areas include: Toxicological endpoints; effects of chronic low-dose exposure on health; neurodevelopmental studies; laboratory procedures/biomarkers; interaction of 2 or more toxicants, and intervention measures (i.e. management and treatment).

- **Singapore**: The prevalence of allergic diseases, such as asthma, hay fever and atopic dermatitis, has increased over the past three decades in many countries. The prevalence

of doctor-diagnosed asthma is 20% in 6-7 year-old children and in preschool children the prevalence of asthmatic symptoms, such as nocturnal cough, reaches 30%.

The exact etiology for the increase in asthma cases has not been identified, but it seems that a number of environmental factors are involved and that a close relationship with a 'western life style' might be responsible. Most researchers agree that *a decreased bacterial load* at an early age might be one of the most important causative factors for the increased prevalence of allergic diseases. Other factors that have been associated with the increased prevalence of allergic diseases are: indoor and outdoor pollution, vaccination programmes, viral infections (such as infections with respiratory syncytial virus), parasites and increased usage of medication (such as antibiotics and antipyretics).

In many studies, air pollution has been associated with increased morbidity and mortality rate of respiratory diseases, including childhood asthma. Various methods, including experiments on laboratory animals, clinical evaluations of the effects on human volunteers, and epidemiological studies, have shown and quantified the risk of exposure to ambient levels of air pollutants.

Monitoring of the levels and trends of air pollution has been handled by the Anti-Pollution Unit (APU) since its formation in 1970 and, more recently, by the Environmental Monitoring and Assessment Section of the Ministry of the Environment. In 1994, an episode of increased air pollution due to forest fires and agricultural burning in southern Sumatra and Kalimantan, popularly known by Singaporeans as the "haze", again highlighted the adverse effects of air pollution on health.

On the other hand, it was found that exposure to diesel exhaust particles (DEP) was associated with increased severity of allergic reactions.

In conclusion, a marked increase in childhood allergic diseases was noted during the last three decades. A number of changes of the environment seem to be responsible for that increase, including a decreased bacterial load to young children in combination with increased allergen exposure (i.e. a western life style). However, the role of other factors, such as the effect of DEP on young children, seems obvious and needs further study.

- **Thailand**: Key priority environmental health issues affecting children in Thailand include:Air pollution (big cities, industrial areas), Disease vectors (dengue hemorrhagic fever, diarrhea), Chemical hazards (lead and arsenic in old mines, pesticides), and Accident injuries (traffic, school, home, drowning). Public awareness is high, interventions are implemented.

  The top five causes of illness and death in the group of 0-4 year old children (respiratory infection, accident injuries, diarrhoea, conjunctivitis and hemorrhagic fever) are related to environmental factors.

  State of the science in the area of CEH: Research in CEH in Thailand is rather limited; the capability to conduct research include institutions involved in conducting CEH research such as universities, government agencies and NGOs.

  Limitations are funding for macro projects and difficulty to form multidisciplinary, multisectorial research teams.

  Lessons learned in CEH research are as follows:

- Some research led to strengthening of policy and program development and implementation
    - air pollution in BKK, industrial areas
    - lead contamination in Kanchanaburi
- Strengthening and empower local authorities to manage local environmental health program
- Building of multisectorial allies

Priority research areas include:

- Air pollution – home, school, public places
- CEH of urban poor
- good practice models for local implementations
- appropriate technology for rural community
- CEH indicators development
- climate change and children health

Session C: Overview of Existing Collaborative Research Initiatives

Chair: Dr P. Sly (Australia) and Dr B.Shrestha (Nepal)

- Dr V. Aposhian from the University of Arizona-USA presented their experience with arsenic in different countries. By his observations and experiences, concluded that studies in developing countries although not easy to conduct, they are very gratifying in many ways. He pointed out that WHO needs to reconsider on the way funds are distributed in the area of research and on projects to improve the health of developing countries. Arsenic in drinking water is a major public health problem in Asia. He pointed out that this is a calamity affecting mainly the children of the poor; there is no "environmental justice" for these children. Finally he mentioned that now, we are able to understand arsenic's bio-transformation, but still lack of understanding arsenic carcinogenicity or its toxigenomics.

- Dr M. Karagas from the Darmouth Medical School-USA, summarized the adverse health effects of arsenic associated with exposure. She highlighted that early epidemiologic evidence from the southwest of Taiwan linked skin cancer occurrences to ingestion of arsenic contaminated well water. Later studies indicated a dose-related risk of bladder cancer, and more recently lung cancer. There is also evidence that arsenic enhances risk of other malignancies, cardiovascular disease and diabetes in adults. The effects of arsenic on pregnant women, newborns and children are poorly understood. However, a number of epidemiologic studies raise the possibility that arsenic, even at relatively low concentrations, may increase the risk of spontaneous abortions, still births, pre-term deliveries, and low birth weight. Also, there is limited epidemiologic data suggesting a link between arsenic exposure during pregnancy and the development of cardiac anomalies.

  In New Hampshire, private wells serve roughly 40% of the households and approximately 2% of these wells are estimated to have arsenic levels above 50mcg/L. Over 20% have levels between 2mg/L and 50 mcg/L, the range of exposure suspected of being harmful to humans, but for which epidemiological data are lacking. Epidemiologic studies underway in New Hampshire are investigating (1) ways to quantify human exposure to arsenic, and (2) the pre-clinical (e.g., early biologic response) and clinical health effects of these exposures. Planned investigations include pregnant women and infants. The study also will attempt to identify potential subgroups of the population that may be risk of arsenic-induced health conditions. Results of this study

may aid future international collaborative efforts on the effects of environmental arsenic exposure on children's health.

- Dr D. Carpenter from the School of Public Health from the University of Albany-USA, made a presentation on "Neurotoxicants: Lead, Mercury, and PCBs", focusing into the neurobehavioral effects of these environmental contaminants. He started by saying that lead, mercury and polychlorinated biphenyls have each been convincingly demonstrated to cause decrements in IQ in children exposed in the prenatal period or in the early years of life. However, it is not known how these contaminants interact if one person is exposed to two or more contaminants. The interactions might be additive or synergistic.

  A study in China is in the process of development in which neurobehavioral tests will be made in children exposed to mercury in the vicinity of a gold mine, to PCBs in the vicinity of a PCB transformer recycling facility, and to both, mercury and PCBs in the vicinity of chlor-alkali plants. Lead levels will also be monitored since China has only recently removed lead from gasoline. We hope these studies will indicate the form of interaction between mercury, lead and PCBs on neurobehavioral outcomes.

- Dr Mathuros Ruchirawat from Chulabhorn Research Institute (CRI) made a presentation on air pollution including a report on the partial results of a study on exposure to genotoxic substances in ambient air in Bangkok and their potential health effects in collaboration with the University of Aarhus, Denmark.

  In Southeast Asia air quality has been routinely monitored in the capitals and major cities of some countries for the levels of CO, O_3, SO_2, NO_x, NO_2, HC and PM10. Exposure to air pollutants has mostly been assessed mostly by measurement of the pollutants at fixed monitoring stations. In tropical environments like Thailand, very little has been done to link environmental pollutants with their seasonal variations and health effects. This study has been designed to permit comparison of results to other countries in Europe for example.

  Bangkok has been cited as a megacity with more than 8 million people and with air pollution problem. Air pollution from motor vehicles has caused 300 to 1400 cases of excess mortality per year due to respiratory health problems and other air pollution related diseases. Routine air quality monitoring covers gasses and particulate matters but not substances which pose serious, long term adverse health effects on man, such as genotoxic substances. The levels of benzene, toluene, ethyl benzene and xylene on Bangkok roadsides are relatively high but comparable to major cities of developing countries.

  The project is now entering the second phase and will be expanded to study exposure for benzene and 1, 3 butadiene and lead in Bangkok ambient air in adults as well as in school children. The exposure for genotoxic compounds in Bangkok ambient air was assessed in traffic policemen by determination of the eight carcinogenic PAHs in the breathing zone and by using different biomarkers.

  The total PAH exposure, was significantly higher in the traffic police group than in the office police group. The levels of biomarkers of exposure such as urinary metabolites, DNA and protein adducts were higher in traffic police than in the office group indicating higher level of exposure and perhaps risk

  This study indicated that people living in Bangkok and who spend most of their day inside an air conditioning building are exposed to levels of PAH at a level that is not significantly different from what has been reported in Western European cities.

However, people who spend most of their day outside an air-conditioned building are exposed to significantly higher levels.

- Dr Peter Sly from the Telethon Institute for Child Health Research-University of Western Australia, shared his experience in Asthma and Air Pollution. He said that asthma is the most common chronic medical condition affecting children and adults in developed countries. The prevalence of asthma in these countries has increased significantly over the last few decades. In Australia 26-32% of school children now have current wheeze. As asthma is such an important health problem in countries like Australia, a significant research effort has been developed which continues to study the mechanisms involved in the development of asthma in western countries.

  In general, Asian countries currently have a much lower prevalence of asthma and allergies than the west. Although prevalence rates vary considerably from region to region, there are indications that asthma and allergies are increasing in Asia. Data from countries such as Singapore, India and Thailand show increasing prevalence over time. Almost nothing is known about the physiological, genetic, immunological, environmental & developmental factors that result in asthma in Asia.

  Asthma and allergies could potentially become an enormous health problem in Asia as the region moves towards a more western lifestyle. Therefore it is important to understand what has happened in the west and to implement comprehensive research programs in Asia that will help the region predict and plan for the future.

  In western countries the increase in the prevalence of asthma and atopy has been attributed to the following:

  - Decreased microbial exposure, changes in diet, and increased exposure to allergens and environment irritants.
  - The “Western lifestyle” has been blamed for the increase in prevalence of asthma and allergies in developed countries. As Asian countries move toward a more “Western” way of life an increase in asthma and allergy could be predicted. However, differences may exist between “the West” and Asia which may affect our ability to predict the impact of asthma and allergies in Asia. There may be significant differences between:
  - Environmental influences(e.g., infections, diet, genetic susceptibilities and clinical patterns)

  As per the opportunities for collaborative studies he highlighted that There are two types of study needed to understand the problems of asthma and allergies in Asia:

  - Cross-sectional studies to determine prevalence (and changes over time) at different ages
  - Longitudinal cohort studies to examine mechanisms with a view to developing preventative strategies

- Finally, Mr J. Speets, Advisor, Environmental Health, WHO-Nepal, presented "The case of PM10 in the Kathmandu Valley".

  Particulate matter less than 10 micrometer (PM_{10}) normally falls in the range of 0-2.5 µm in the fine mode and in the range of PM 2.5-10 µm in coarse mode. The predominant contributors to PM_{10} mass in the atmosphere include industries and road traffic, secondary particles and coarse particles arising from a number of sources such as re-suspension of surface soils and dusts and bio-mass combustion, mining and quarrying

activities and tire wear etc. However for the easy understanding of the sources of PM_{10}, in this study sources have been characterized as fugitive emission and fuel combustion.

The air we breathe has not only life supporting properties but contains also other harmful constituents. If the air has higher concentration of PM_{10} pollutant than the benchmark level, it could pose damage on life also. The total daily exposure of an individual to air borne PM_{10} is the sum of the separate contacts to air PM_{10} experienced by that individual as s/he passes through a series of environments during the course of the day (also called micro-environments, e.g. at home, while commuting in the streets, etc). Exposures in each of these environments can be estimated as the product of the concentration of the PM_{10} in question and the time spent in the micro-environment.

The study demarcated four micro-environments:

- City Core
- City Sub-Core
- Residential
- Industrial

The adverse health effect of PM_{10} depends very much on the characteristics rather than on mass. PM_{10} from ambient and non-ambient sources also may have different physical and chemical characteristic and thus different health effects. However, there is a scientific consensus that very small rises in concentrations even from a baseline level PM_{10} irrespective of chemical character can be associated with measurable increases in death rates and hospital admissions. PM_{10} affects lungs and heart of children and elderly. It promotes high risk of cancer. It has potential to cause a number of respiratory diseases such as upper respiratory infection and otitis media, asthma etc.

The PM_{10} situation in the urban areas of Nepal, particularly Kathmandu is getting worse. There is a general tendency of PM_{10} deterioration year after year. In the Kathmandu valley, the annual average of PM_{10} is estimated at 156$\mu g/m^3$, exceeding the WHO guideline by a factor 3 to 4.

From the observed monitoring data on the PM_{10} in Nepal and particularly in the urban area of Kathmandu, it could be well stated that it has a direct linkage with the overall health of the people exposed to the elevated PM_{10}. ARI cases are increasing over but there are no direct epidemiological studies/researches to objectively evaluate the relationship of respiratory and other related health problems of the PM_{10} in Nepal. The lack of centralized health records also limit the studies.

However, based on the available database on air quality monitoring combined with limited on site monitoring, estimations on the mortality and morbidity related to PM_{10} for the Kathmandu area population has been made with the help of the researches conducted outside Nepal. Calculations have been based on the application the Ostro-formula. The calculated values are quite alarming. In this scenario, 9-14 children of less than 5 years of age are estimated to die prematurely annually in the Kathmandu valley. About 65000 cases of respiratory problems related to PM_{10} occur annually with a direct economic cost (estimated at approx.US$1million).

The above results are based on the estimated annual PM_{10} average in the ambient air. The picture of PM_{10} on health could be worse if the indoor air quality is also viewed collectively. Indoor air quality in the Nepalese households is very poor. It is related with the fuels used as well as the inadequate house ventilation systems. The poor section of the community in Nepal has the worse indoor air quality and they are more likely to be impacted by the PM_{10} related indoor air quality health risks. Obviously, the child, old and woman are the victim of the PM_{10} health risks.

Recommendations from the study are focusing on improvement of the quality of data, better coordinated research and inclusion of research topics in the WHO's Country Programmes.

- Dr W. Suk from the NIEHS-US made a presentation on "Dioxins". Dioxins are highly toxic, persistent and global pollutants produced as unwanted by products of industrial process. The potential health effects of dioxin include cancer, birth defects, and immune, reproductive, neurobehavioral and endocrine impairment. Further data on the potential effects in children is needed, particularly as it relates to chemical mixtures. Collaborative studies between US and Vietnam on the health effects of dioxins are being established.

- In her presentation on "Persistent Organic Pollutants and Endocrine Disrupters", Dr Terri Damstra from (WHO,IPCS/IRRU-USA), mentioned that there is sufficient evidence to warrant concern about the potential health effects in children to the exposure to POPs and EPCs. Data on exposure during critical periods during development are urgently needed.

- Dr W. Suk talked about "The Work of CEH Research Centers" in USA. He explained that these Research Centers were developed by the National Institute of Environmental Health Sciences (NIEHS), the U.S. Environmental Protection Agency(EPA), and the Centers for Disease Control and Prevention (CDC) in 1998, and designed around a central scientific theme (growth & development, respiratory diseases, asthma, autism, learning disabilities, hearing loss, and cognitive, sensory and motor deficits). The goal of these centers is to promote translation of basic research findings into applied intervention and prevention methods and its objectives are:

  - to conduct multidisciplinary basic and applied research in combination with community-based prevention research projects to support studies on the causes and mechanisms of children's disorders having an environmental etiology
  - to identify relevant environmental exposures
  - to intervene to reduce hazardous exposures and their adverse health effects, and
  - eventually, hope to decrease the prevalence, morbidity and mortality of environmentally-related childhood diseases

  The centers are located in twelve different locations along the United States of America, being these: Columbia University, Mount Sinai Medical Center, New Jersey's University of Medicine and Dentistry, Johns Hopkins University, Cincinnati Children's Hospital Medical Center, University of Illinois, University of Michigan, University of Iowa, University of Washington State, University of California (Davis), University of California (Berkeley) and University of South California.

  The centers will be having multidisciplinary interactions among basic, clinical, and behavioral scientists coordinating program of research/prevention of environmental aspects of children's diseases in different areas like exposure assessment, health effects research, developmental and validation of risk management and health prevention strategies, and will try to establish an international network that fosters communication.

- Dr Carole Kimmel from the US Environmental Protection Agency (EPA) presented the background and activities regarding the US National Children's Study (NCS).

The U.S. National Children's Study (NCS) is a large long-term study of environmental influences on children's health and development. This study will explore a broad range of environmental factors, both helpful and harmful, that influence the health and well-being of children. For this study, environment is broadly defined to include chemical, physical, social and behavioral influences on children, and to better understand the role of these factors on health and disease.

The NCS grew out of the President's Task Force on Environmental Health Risks and Safety Risks to Children, and was authorized in the Children's Health Act directed The National institute of Child Health and Human Development (NICHD/NIH) to conduct the study along with a consortium of federal agencies, including the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC) and the National Institute of Environmental Health Sciences (NIEHS).

The study will examine about 100,000 children across the United States and follow them during prenatal development, through birth, childhood, and into adulthood. The study will allow the evaluation of exposure and outcome links in the context of life stages of development. Sample core hypotheses include:

- Prenatal/early childhood exposures (e.g., pesticides) increase the risk of neurodevelopmental conditions (such as *autism* and other *developmental disabilities*)
- Prenatal/early childhood exposures with potential immune-modulating effects influence *asthma* incidence and severity.
- Individual, family, and community factors affect the incidence, severity, and outcome of childhood *injuries*.

Planning and organization of the study are underway, as well as methods development studies for exposure and outcome measures. The NCS Advisory Committee and several working groups have been established to consider issues such as hypotheses and study design, ethics, development and behavior, chemical and physical exposures, injuries, emerging technologies to measure exposures and outcomes, and community outreach/participation. Careful integration and communication with community groups and health care providers, a state-of-the-art data collection and management system, strong partnerships between federal and non-federal scientists and community, parent, advocacy, and industry groups all are being emphasized throughout the planning process.

An International Interest Group has recently been established to facilitate exchange of information among investigators worldwide who currently are working on or are interested in establishing longitudinal cohort studies on children's environmental health. A network has been established to facilitate communication and sharing of ideas. A survey of studies is being conducted, and the possibility of collaboration among investigators internationally will be explored.

- Dr Chanpen Choprapawan from the Department of Medical Science,Ministry of Health-Thailand, gave the background and update on the "**The Prospective Cohort Study of The Thai Children (PCTC)**". She explained the PCTC is currently an organization working under the auspice of **The Health System Research Institute (HSRI),** Thailand. The PCTC was established with the purposes of (1) tracing the development of Thai children from fetus to young adults; and (2) training new and competent researchers in health-related science. This is the first prospective cohort community-based multilevel research on the biological, psychosocial and moral development outcomes of Thai children, which also covers most variables potentially determining child development such as physical environment, family structure and functions, and community profiles. The PCTC is an observational study and does not involve intervention. The overall

design consists of both quantitative and qualitative elements. The PCTC employs prospective design and follows subjects, selected from five regions, in their 28th to 38th week of pregnancy. The birth cohort is observed and followed up until the off-springs reach the age of 24. The project was launched in July 2000 and is targeted for completion in 25 years. Thailand Research Fund, Health System Research Institute, the Ministry of Public Health, and the World Health Organization have provided financial support for the first phase of the project.

Day 2: 04 February 2003

Session D: Towards collaborative research in CEH

Chair: Dr R. Awang (Malaysia) and Dr D. Carpenter (Albany-USA)

BREAKOUT SESSION 1:

Three working groups were tasked to discuss the following:

Group 1:

1. Identification of priority research areas and main needs in Asia
2. Roles of NGOs: interaction with researchers
3. How to set up research collaborative partnerships: types of collaboration, challenges and opportunities

Group 2:

4. Roles of international organizations and centres of excellence
5. First steps into collaboration

Group 3:

6. Promoting action at governmental levels and among governments
7. Establishing a CEH research network

The specific recommendations of the working groups are summarized below:

Group 1: CEH PRIORITY ISSUES AND RESEARCH NEEDS

Country research priorities and their health impacts were reviewed. These were discussed further to create a priority research list (see **Table 1**) and intervention strategies for the Asian region. Any research and interventions specifically in developing countries should consider the role of malnutrition, the possibility of hazardous exposures in the context of child labour, gender issues, the specific settings of children (e.g. urban, rural) and the need for sustainability.

Group 2: HOW TO SET UP RESEARCH COLLABORATIVE PARTNERSHIPS

Collaborative partnerships start at the individual level “bottom up” which means a priority issues is taken up by researchers with mutual interests. Whenever possible, a source of funding must be identified early during the planning stage. Once individuals set up collaborations, the next levels are groups of interested participants and finally institutions.

Table 1: CEH PRIORITY ISSUES AND RESEARCH NEEDS

Air pollution (ambient and indoor)
- Interventions for reducing air pollution
- Research on reproductive effects and cancer in relation to air pollution

Water and sanitation
- Research to better identify the problems (levels of exposure)
- Research on metals in water (Arsenic, lead, mercury) and fluorides.

Injuries and accidents
- Incidence and characterisation of injuries (e.g. drowning, falls,)
- Intervention: Regulations

Vector borne diseases
- Alternatives to the use of DDT

Pesticides and POPs
- Research to better identify and characterize the problem
- Research on long-term effects (POPs)

Metals (As, Pb, Hg, Cr) and fluorides
- Incorporated under water and food

Food contamination
- Additives (colouring) and contaminants (Mustard oil) and metals
- Microbial contamination

Noise
- Research on the effects of noise, sources and interventions

Infections and allergies
- Role of exposure to environmental agents inducing immunosuppression and allergens

Cognizant of the fact that there is a need beyond individual researcher's need to have a bigger picture of CEH concerns, the group recommended that a coordinating body be set up. The main functions of this body would be to disseminate information, and to facilitate interactions between researchers. Such a group could be called for example "The Bangkok Coordinating Group on Research on Children's Environmental Health". Thus, a mechanism can be developed to harmonize interests and methodology, and to match funding with scientists. For example, sources of funding such as the Gates Foundation would be better approached through such a coordinating body. Follow-up meetings to evaluate progress and to focus on specific CEH should be convened. The coordinating body is expected to evolve into a Center (s) of Excellence in different regions, with more defined roles, such as training (capacity building). However, setting up the Center(s) of Excellence requires identification of funding sources.

International organizations such as the World Health Organization play a very important role in this process. While WHO is not a funding agency, it has the capacity to network with agencies that can provide funds or mobilize resources. In some circumstances, a small amount of money may be available through the WHO country and regional offices. Equally important is the technical assistance that may be rendered and extended by WHO.

Group 3: PROMOTING ACTION AT GOVERNMENTAL LEVELS AND AMONG GOVERNMENTS

The strategic plan of action to promote action at the governmental level and among governments may vary from country to country depending on their existing structures. The governmental agencies primarily involved in CEH should be targeted. In addition, the organization of national workshops and public symposia involving agencies of government will help develop awareness about the most immediate research needs. Efforts should be made to establish/ integrate with existing inter-agency organization and create task forces. Advocacy at the level of other agencies (science and technology, education, environment, agriculture, social welfare, children's welfare council, urban planning, industry, transport), as well as local government executives and legislators is necessary. Sustained tri-media campaigns may prove useful. The aim would be to establish an action plan or continuing programme including a Regional Alliance for funding support and technical assistance. Twinning agreements between developed and developing countries should be promoted. The possibility of being linked up with Healthy Environment for Children's Alliance (HECA) was proposed. The Clearinghouse for Tobacco Control based at the National Poison Centre USM was cited as an example of a coordinating group between four countries in Southeast Asia funded by the Rockefeller Foundation. There has been some recommendations to institutionalize CEH programmes with the creation of pediatric environmental health units by suitable institutions like the academia with training hospitals or organizations such as pediatric or family health societies. Inclusion in the medical and allied medical curriculum of simple, basic but fundamental issues is important in increasing the knowledge on the link between children's health and the environmental exposure.

The group made the following recommendations for the establishment of the CEH Research network:

1. Create an informal, dynamic network of researchers (i.e. list of researchers or research activities/Directory of participants)
2. Create a mechanism to update its members about on-going CEH research and training activities
3. Organize workshops to deal with specific issues should be promoted, as well as capacity building.

BREAKOUT SESSION 2:

The participants were divided into three working groups to discuss the following specific issues:

Group 1: Air pollution/Asthma
Group 2: Arsenic, lead, mercury, chromium
Group 3: Pesticides and POPs

Group 1: AIR POLLUTION AND ASTHMA

- Make an inventory of people working on asthma in the country and a review of research already done
- Identify a representative from each country to make a comprehensive report of the status of air pollution in the country and a review of published literature.
- Define the clinical phenotypes and sub-phenotypes in various countries by using same protocol and definitions
- Define severity and quality of symptoms e.g. for asthma wheezing, cough, other
- Create an Air Pollution Steering group that will network through e-mail

- Design a standard protocol taking into account country specific variables, pros and cons of cross-sectional versus longitudinal studies, growth & development and changing environment In developing countries different socioeconomic sections are needed to be studies

Group 2: HEAVY METALS

1. **Which metals represent a problem, and where?** The significance and magnitude of the problem linked to a particular metal is not fully known. . Therefore some countries wish to start accordingly:

Country	Mercury	Arsenic	Chromium	Lead
Philippines	Yes	Yes	No	Yes
Indonesia	Yes	No	No	Yes
Mongolia	Yes	?	No	Yes
Nepal	Yes	Yes	No	Yes
India	Yes	Yes	Yes	Yes
Thailand	Yes	Yes	No	Yes
Malaysia	?	?	?	Yes
Myanmar	?	Yes	?	Yes
Singapore	?	?	?	?
Bangladesh	Yes	Yes	Yes	Yes

2. Possible CEH research topics

- Is **arsenic** a risk to human health in my country? (MON, PHL)
- Exposure levels to **arsenic** in children in ten districts (NEP)
- **Arsenic** exposure and gene-environment interactions (THA)
- **Lead** and its association with neurodevelopment in children (BAN, IND, MON)
- Urinary metabolites of **arsenic** in children up to one year (BAN)
- Correlation of **chromium** exposure during pregnancy
- Neurodevelopment of **mercury** on infants and children (PHL, MON)
- Birth defects form **mercury** exposure (MON)
- Neurobehavioral an intelligence evaluation in young children exposed to elemental **mercury** vapor – IQ and blood (NEP, MON)

Group 3: CHILDREN'S HEALTH, PESTICIDES AND POPs

Within Malaysia, the potential for performing studies on exposure to PCBs, pesticides, and POPs is good in the country because funds may be identified and excellent laboratory facilities are available. The Doping Laboratory of the Universiti Sains Malaysia could become a regional reference and resource lab. Exchange of information and technical advise is required, as well as expert consultation to provide guidance on how to prepare study protocols.

Within India, the Regional Research Laboratory of Tiruvanthapuram in Kerala can also do dioxin analysis. Thus it also has the potential of becoming a regional reference laboratory. The Industrial Toxicology Research Centre (Lucknow) could also act as a regional resource centre (e.g. POPs, pesticides and metals).

Within the Philippines, there is a need to network with other centers that have quality assurance for good laboratory practice to allow for analysis of the more hazardous chemicals (e.g., dioxin). At the moment, a group of researchers is trying to evaluate the use of RBC cholinesterase as biomarker for chronic exposure to organophosphate pesticides

among children, in the absence of markers like neurotoxin esterase. There is an on-going longitudinal research that looks at exposure of children to pesticide beginning at birth using meconium as one of the biological samples tested in the cohort.

The specific recommendations made by the group were:

1. Importance of developing Quality Control and Quality Assurance for the whole region for laboratories analysing environmental and human samples.
2. To prepare standard protocols for assays of chemical contaminants to be made available in WHO/PCS website (e.g. lead, pesticides, dioxins, arsenic, mercury, and other….), including also information on appropriate biomarkers for exposures to different POPs and pesticides.
3. Approach UNEP and the IPCS requesting support for POPs – related research activities in children

Day 3: 05 February 2003

Session E: The way ahead – next steps

Chair: Dr W. Suk (NIEHS-US) and Dr M. Ruchirawat (CRI-Thailand)

Plenary Session:

In reviewing the progress made since the International Conference held in Bangkok in 2002, the participants acknowledged that a number of initiatives have been taken to promote activities in areas concerning environmental factors and children's health. Although progress has been made in information exchange and promotion of CEH, awareness raising and the support of national and international organizations are still needed. There was general consensus about the need to further promote and implement research activities, to translate research into interventions, to increase knowledge and information flow, to collaborate with existing networks and organizations and to follow-up efforts initiated in the area of CEH. It was noted that although research is conducted in the area of children's health and on environmental issues, this is usually done separately, as no links are established between these two areas. One of the main reasons is the lack of awareness about children's special vulnerability to environmental threats.

Participants mentioned specifically the need to involve relevant partners in the research initiative, including the pediatricians and health care providers, the International Pediatric Association and the NGOs working at the community level.

The roles of NGOs was considered relevant in raising awareness about the need to do research, promoting and/or implementing interventions, measuring their efficacy, promoting education and disseminating information. NGOs may help identify problem areas requiring research and interventions and provide the education for policy making.

The ultimate goal is to reduce exposures that constitute a threat to the health of children. There is sufficient knowledge of many of these hazards, such that active intervention programmes should be implemented immediately, whenever possible based on the existing technology. This should include public education at every level of society, development of governmental regulation, and application of technological interventions. While additional research into remediation methods and human health effects is important, the immediate application of current knowledge to reduce exposure is critical. This requires communication and cooperation between the research, governmental and NGO communities.

Reference was made to the fact that animal experimentation may provide data for mechanistic approaches of environmental pollutants as well as on the influence of confounding factors on children's environmental health (e.g., protein malnutrition, iron and calcium deficiency).

Participants proposed some examples of collaborating schemes:

1. Health effects of arsenic in **pregnant women and their children** in the US and in Asian countries. Focal points could be CRI and US colleagues (Drs. Karagas and Aposhian). Some of the elements that this study should include are:

- The examination of urinary arsenic profiles
- The study of the effects of genetic variation on urinary profiles
- The impact of arsenic ingestion during pregnancy and gene expression of the mother and the new born
- Compare the results of urinary profiles, polymorphism's and gene expression with those in other parts of the world
- Intervene, translating the results of research into effective community actions (e.g. community based prevention and intervention)

2. **Asthma and allergies** was the theme proposed by participants from Australia and Singapore, eventually involving other countries, as well as their pediatric societies. Proposed focal points are Dr P. Sly (Australia) and Dr Van Bever (Singapore). The first task will be to provide definition and circulate existing protocols. A birth cohort pilot study on asthma in children could be developed in India, with the participation of the Ministry of Environment and Forestry (MoEF), the Industrial Toxicology Research Centre (ITRC) and the Pediatric Department of Perth Australia (initiative of the participants from India). In view of the existing memorandum of understanding between USEPA and the MoEF, the possibility of further USEPA collaboration should be explored.

3. **Pesticides /POPs** collaborative studies could involve the identification of reference laboratories in the region, such as the existing ones in the Universiti Sains Malaysia in Penang (Malaysia) to be coordinated by Dr Rahmat Awang, and Lucknow (India) and also the approach to potential funding organizations, such as the Global Environment Facility (GEF) of UNEP, UNDP and the World Bank.

4. Feasibility of longitudinal cohort studies –**national children's studies**- so that data can be compared and conclusions made about similarities and differences in different countries and population groups. This may start with the preparation of an inventory of existing cohort studies, maintaining network and communication channels among researchers doing LCS, promoting the sharing of protocols, data and analysis capabilities Drs. Kimmel and Pronczuk were proposed as focal points.

CONCLUSIONS AND RECOMMENDATIONS

At the end of the meeting, the participants concluded that the objectives of the workshop were fulfilled, as they were able to:

(a) Review progress made since the Bangkok Conference
(b) Discuss future specific collaboration initiatives
(c) Discuss how to strengthen research (who is doing what, and where)
(d) Develop specific collaboration schemes

Whilst recognizing that there is a myriad of environmental threats to children's health, the major objective of this workshop was to identify and discuss specific examples of collaborative research that can be implemented immediately following this event.

The following topics of CEH research, both exposures sources and health outcomes were singled out and prioritized for research and intervention:

A. Air pollution (indoor and outdoor)
B. Water and sanitation
C. Injuries and accidents (as a result of unsafe settings)
D. Vector borne diseases
E. Pesticides and POPS
F. Metals (lead, mercury, arsenic, chromium) and fluorides
G. Food contamination
H. Noise pollution

The main health outcomes addressed in relation to the above include asthma and allergies, respiratory diseases, immune and neurodevelopmental disorders (educational outcomes), birth defects, and the health effects due to both acute and low-level chronic exposure to specific contaminants.

These research areas require in depth consideration to define the specific gaps in knowledge, taking into account gender issues, settings of children (rural, urban), the importance of malnutrition and the genetic susceptibility.

The workshop participants addressed the need to strengthen and build research capacity in CEH, particularly in the developing nations of the WPO and SEA regions. The main recommendations for action at the country level include to:

- Identify existing CEH research capacities and current CEH research related programmes in the countries, in order to build upon existing efforts and on-going activities.

- Select and define the priority areas of research (exposure sources, health outcomes, interventions, evidence-based activities)

- Ensure as far as possible the sustainability of research efforts (e.g. focusing on a client's needs)

- Prepare guidelines for standardized procedures to conduct CEH collaborative research to reduce uncertainty factors.

- Collect data in a harmonized manner and using standardized methodologies and protocols, as to enable the comparability of data from different geographic regions.

- Promote interdisciplinary / multi-stakeholder collaboration for CEH research (e.g. links to poison centres, pediatric societies, academia, health institutes, laboratories, NGOs, decision makers and other)

- Ensure the follow-up of research efforts and interventions, as a means to evaluate progress made and lessons learned.

- Set up a CEH collaborative research network in the country(e.g. email group, informal Secretariat).

- Implement specific collaborative research projects on children's health in areas such as (a) air pollution, asthma and other health effects; (b) arsenic and other metals and (c) pesticides and POPS, or other, as necessary.

- Advocate for the incorporation of CEH-related research into the WHO country health programmes

To help implement some of these recommendations, an informal network of research on CEH was set up as a means to exchange information and CRI has been nominated as the Secretariat (E-mail: bbk.ceh@tubtim.cri.or.th).

At the regional and international levels, collaborative research activities were proposed in the areas of:

- Arsenic exposure in pregnant women and children (USA and Asian countries)
- Asthma and allergies (Australia, Singapore and India)
- Pesticides and POPs (UNEP, GEF and World bank to be approached by WHO)
- Feasibility of national children's studies (USEPA, WHO and Thailand)

The participants agreed that it is time for a multisectoral, multistakeholder collaborative research that integrates aspects of prevention and intervention as well as translating the evidence into policy whether public or regulatory. Thus while we advance the science of children's environmental health, we move closer to promoting and ensuring healthy environments for children.

ANNEX I

THE BANGKOK STATEMENT

A pledge to promote the protection of Children's Environmental Health

We, the undersigned scientists, doctors and public health professionals, educators, environmental health engineers, community workers and representatives from a number of international organizations, from governmental and non-governmental organizations in South East Asian and Western Pacific countries, have come together with colleagues from different parts of the world from 3 to 7 March 2002 in Bangkok, Thailand, to commit ourselves to work jointly towards the promotion and protection of children's health against environmental threats.

Worldwide, it is estimated that more than one-quarter of the global burden of disease (GBD) can be attributed to environmental risk factors. Over 40% of the environmental disease burden falls on children under 5 years of age, yet these constitute only 10% of the world population. The environmental burden of paediatric disease in Asia and the Pacific countries is not well recognized and needs to be quantified and addressed.

WE RECOGNIZE

That a growing number of diseases in children have been linked to environmental exposures. These range from the traditional waterborne, foodborne and vector-borne diseases and acute respiratory infections to asthma, cancer, injuries, arsenicosis, fluorosis, certain birth defects and developmental disabilities.

That environmental exposures are increasing in many countries in the region; that new emerging risks are being identified; and that more and more children are being exposed to unsafe environments where they are conceived and born, where they live, learn, play, work and grow. Unique and permanent adverse health effects can occur when the embryo, fetus, newborn, child and adolescent (collectively referred to as "children" from here onwards) are exposed to environmental threats during early periods of special vulnerability.

That in developing countries the main environmental health problems affecting children are exacerbated by poverty, illiteracy and malnutrition, and include: indoor and outdoor air pollution, lack of access to safe water and sanitation, exposure to hazardous chemicals, accidents and injuries. Furthermore, as countries industrialize, children become exposed to toxicants commonly associated with the developed world, creating an additional environmental burden of disease. This deserves special attention from the industrialized and developing countries alike.

That environmental hazards arise both from anthropogenic and natural sources (e.g. plant toxins, fluoride, arsenic, radiations), which separately and in combination can cause serious harm to children.

That restoring and protecting the integrity of the life-sustaining systems of the earth are integral to ensuring children's environmental health now and in the future. Therefore, addressing global changes such as human population growth, land and energy use patterns, habitat destruction, biodiversity loss and climate change must be part of efforts to promote children's environmental health.

That despite the rising concern of the scientific community and the education and social sectors about environmental threats to children's health and development, progress has been slow and serious challenges still remain.

That the health, environment and education sectors must take concerted action at all levels (local, national, global), together with other sectors, in serious efforts to enable our countries to assess the nature and magnitude of the problem, identify the main environmental risks to children's health and establish culturally appropriate monitoring, mitigation and prevention strategies.

WE AFFIRM

That the principle "children are not little adults" requires full recognition and a preventive approach. Children are uniquely vulnerable to the effects of many chemical, biological and physical agents. All children should be protected from injury, poisoning and hazards in the different environments where they are born, live, learn, play, develop and grow to become the adults of tomorrow and citizens in their own right.

That all children should have the right to safe, clean and supportive environments that ensure their survival, growth, development, healthy life and well-being. The recognition of this right is especially important as the world moves towards the adoption of sustainable development practices.

That it is the responsibility of community workers, local and national authorities and policy-makers, national and international organizations, and all professionals dealing with health, environment and education issues to ensure that actions are initiated, developed and sustained in all countries to promote the recognition, assessment and mitigation of physical, chemical and biological hazards, and also of social hazards that threaten children's health and quality of life.

WE COMMIT OURSELVES

To developing active and innovative national and international networks with colleagues, in partnership with governmental, nongovernmental and international organizations for the promotion and protection of children's environmental health, and urge WHO to support our efforts in all areas, especially in the following four:

1. **PROTECTION AND PREVENTION – To strengthen existing programmes and initiate new mechanisms to provide all children with access to clean water and air, adequate sanitation, safe food and appropriate shelter:**
   - Reduce or eliminate environmental causes and triggers of respiratory diseases and asthma , including exposure to indoor air pollution from the use of biomass fuels and environmental tobacco smoke.
   - Reduce or eliminate exposure to toxic metals such as lead, mercury and arsenic, to fluoride, and to anthropogenic hazards such as toxic wastes, pesticides and persistent organic pollutants.
   - Reduce or eliminate exposure to known and suspected anthropogenic carcinogens, neurotoxicants, developmental and reproductive toxicants, immunotoxicants and naturally occurring toxins.
   - Reduce the incidence of diarrhoeal disease through increased access to safe water and sanitation and promotion of initiatives to improve food safety.
   - **Reduce the incidence of accidents, injuries and poisonings, as well as exposure to noise, radiation, microbiological and other factors by improving all environments where children spend time, in particular at home and at school.**
   - **Commit to international efforts to avert or slow global environmental changes, and also take action to lessen the vulnerability of populations to the impact of such changes.**

2. **HEALTH CARE AND RESEARCH – To promote the recognition, assessment and study of environmental factors that have an impact on the health and development of children:**
   - Establish centres to address issues related to children's environmental health.
   - Develop and implement cooperative multidisciplinary research studies in association with centres of excellence, and promote the collection of harmonized data and their dissemination.
   - Incorporate children's environmental health into the training for health care providers and other professionals, and promote the use of the environmental history.
   - Seek financial and institutional support for research, data collection, education, intervention and prevention programmes.
   - Develop risk assessment methods that take account of children as a special risk group.

3. **EMPOWERMENT AND EDUCATION – To promote the education of children and parents about the importance of their physical environment and their participation in decisions that affect their lives, and to inform parents, teachers and caregivers and the community in general on the need and means to provide a safe, healthy and supportive environment to all children:**
   - Provide environmental health education through healthy schools and adult education initiatives.
   - Incorporate lessons on health and the environment into all school curricula
   - Empower children to identify potential risks and solutions.
   - Impart environmental health expertise to educators, curriculum designers and school administrators.
   - Create and disseminate to families and communities culturally relevant information about the special vulnerability of children to environmental threats and practical steps to protect children.
   - Teach families and the community to identify environmental threats to their children, to adopt practices that will reduce risks of exposure and to work with local authorities and the private sector in developing prevention and intervention programmes.

4. **ADVOCACY – To advocate and take action on the protection and promotion of children's environmental health at all levels, including political, administrative and community levels:**

- Use lessons learned to prevent environmental illness in children, for example by promoting legislation for the removal of lead from all gasoline, paints, water pipes and ceramics, and for the provision of smoke-free environments in all public buildings.
- Sensitize decision-makers to the results of research studies and observations of community workers and primary health care providers that need to be accorded high priority to safeguard children's health.
- Promote environmental health policies that protect children.
- Raise the awareness of decision-makers and potential donors about known environmental threats to children's health and work with them and other stakeholders to allocate necessary resources to implement interventions.
- Work with the media to disseminate information on core children's environmental health issues and locally relevant environmental health problems and potential solutions.

For all those concerned about the environmental health of children, the time to translate knowledge into action is now.

Bangkok, 7 March 2002

ANNEX II

HEALTHY ENVIRONMENTS FOR CHILDREN
Workshop on the "*Promotion of Collaborative Research*"
Pattaya,Thailand, 3-5 February 2003

Organized by
World Health Organization (WHO)
Hosted by Chulabhorn Research Institute (CRI), Bangkok

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ANNEX III

HEALTHY ENVIRONMENTS FOR CHILDREN
Workshop on the "*Promotion of Collaborative Research"*

Organized by World Health Organization (WHO)
Hosted by Chulabhorn Research Institute (CRI),Bangkok

Pattaya,Thailand, 3-5 February 2003

Final Program

Monday 3 February

08:30-09:00 Registration

09:00-09:30 *Opening ceremony*
Chairperson: Dr. W. Suk
Report to HRH *(Dr. J. Pronczuk)*
Address and opening remarks *(Prof. Dr HRH Princess Chulabhorn Mahidol)*
Background and objectives of the workshop *(Dr. T. Damstra)*

10:00-10:30 *Coffee break*

Session A CEH since the Bangkok Conference...

Chair: Dr. W. Suk and Dr. M. Ruchirawat

10:30-11:00 **Overview of the Healthy Environments for Children activities and follow–up of the Bangkok Conference**
- The HEC Initiative and Alliance, on-going activities, progress made and plans for the coming World Health Day- 7 April 2003 (Drs. J. Pronczuk, A. Von Hildebrand, J. Luna)
- The impact of the BKK Conference (Dr. W. Suk)

11:00-11:30 **When research, when interventions, when both?**
(Dr. D. Carpenter)

Session B Research on CEH issues in SEA and WP countries

Chair: Dr. C. Kimmel and Dr. S. Luna

11:30-12:00 **Research Activities in WP countries** *(Dr. I. Makalinao)*

12:00-12:30 **Research Activities in SEA countries** *(Drs. D.K. Saxena and S.Y. Bhave)*

12:30-13:00 **Activities developed by Ministry of Environment and Forestry in India** *(Dr. G. K. Pandey)*

13:00-14:00 *Lunch Time*

14:00-15:30 **Review of the existing information and activities undertaken in selected countries : Australia, Bangladesh, India, Malaysia, Mongolia, Nepal, Philippines, Singapore, Thailand (focusing on specialized centres, main CEH issues addresses, existing cooperation schemes and networks)** *(Participants from SEA and WP countries to present in 5'-10' their experience, following the guiding questionnaire)*

15:30-16:00 *Coffee break*

Session C ***Overview on existing collaborative research initiatives***
(Presentation of specific examples of on-going or planned research in specific areas of action, indicating how were they set up, the benefits obtained, main difficulties encountered, lessons learned and the way ahead)

Chair: Dr. Sly and Dr. Shrestra

16:00-16:30 **Arsenic** *(Dr. V. Aposhian)*

16:30-17:00 **Arsenic** *(Dr. M. Karagas)*

19:00 *Welcoming dinner at pool side*

Tuesday 4 February

08:00-08:30 **Neurotoxicants : Lead and Mercury** *(Dr. D. Carpenter)*

08:30-09:00 **Air pollution** *(Dr. M. Ruchirawat)*

09:00-09:30 **The case of PM10 in Kathmandu Valley** (*Dr. J. Speets*)

09:30-10:00 **The experience of LC studio in Thailand** *(Dr. C. Choprapawan)*

10:00-10:30 **Asthma and Air Pollution** *(Dr. P. Sly)*

10:30-11:00 *Coffee break*

11:00-11:30 **Persistent Organic Pollutants and Endocrine Disrupters** *(Dr. T. Damstra)*

11:30-12:00 **Dioxins** *(Dr. W. Suk)*

12:30-13:30 *Lunch break*

12:00-12:30 **National Children's Studies in the U.S.A.** *(Dr. C. Kimmel)*

Plenary discussion on the feasibility of national children's studies in developing regions

Session D ***Towards collaborative research in CEH***

Chair: Dr. R. Awang and Dr. D. Carpenter

13:30-15:00 **Break-out groups to address (tentative issues):**

1. Identification of priority research areas and main needs in Asia
2. Roles of NGOs: interaction with researchers
3. How to set up research collaborative partnerships: types of collaboration, challenges and opportunities
4. Roles of international organizations and centres of excellence
5. First steps into collaboration
6. Promoting action at governmental levels and among governments
7. Establishing a CEH research network

15:00-16:00 Break out groups on specific issues:

A. Air pollution/asthma
B. Arsenic, head, mercury, chromium
C. Pesticides and POPs

16:00-16:30 *Coffee break*

16:30-17:30 Report of break-out groups: observations and recommendations

Wednesday 5 February

Session E The way ahead: next steps

Chair: Dr. W. Suk and Dr. M. Ruchirawat

08:30-09:30 Review and approval of recommendations made

09:30-10:30 Plenary discussion and agreements on next steps
(e.g research networks, centres of excellence and centres "for action", potential for international and intercountry twinning arrangements; how to establish a cooperation scheme; identifying funds for research on CEH, and other issues).

10:30-10:45 *Coffee break*

10:45-12:00 *(Session D to continue)*

12:00-12:30 Closing ceremony (informal)

12:30-13:30 *Lunch*