CRI/ICEIT
NEWSLETTER

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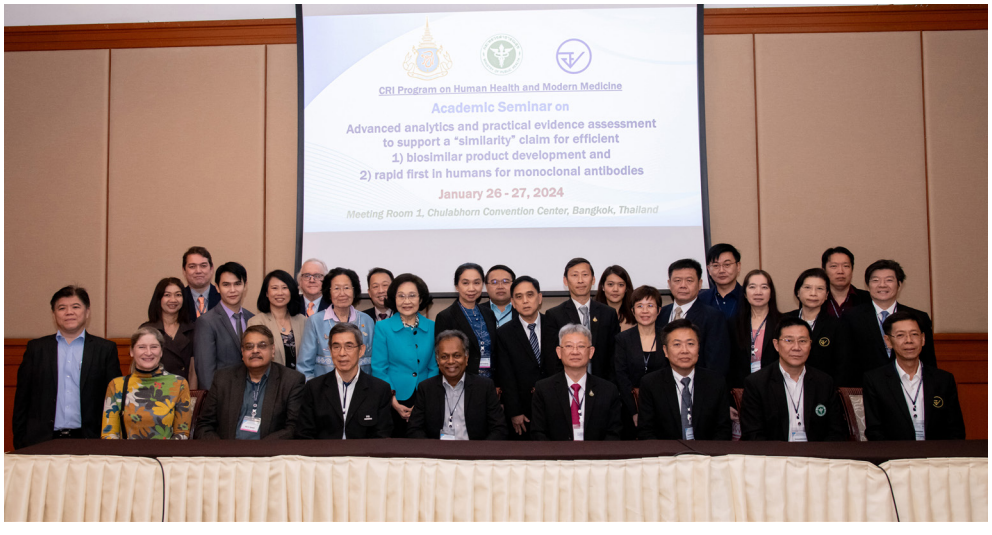
Chulabhorn Research Institute

INTERNATIONAL CENTRE FOR ENVIRONMENTAL AND INDUSTRIAL TOXICOLOGY (ICEIT)

CRI's ICEIT has been designated as a
"UNEP Centre of Excellence for Environmental and Industrial Toxicology".

CRI AND THAI FDA CONVENE AN ACADEMIC SEMINAR ON EFFICIENT BIOSIMILAR PRODUCT DEVELOPMENT AND RAPID FIRST IN-HUMANS FOR MONOCLONAL ANTIBODIES



The Chulabhorn Research Institute (CRI) and the Food and Drug Administration (FDA), Thai Ministry of Public Health, convened an academic seminar on January 26-27th, 2024 at the CRI Convention Center on "**Advanced analytics and practical evidence assessment to support a similarity claim for efficient biosimilar product development and rapid first in-humans for monoclonal antibodies**". This is part of CRI's program on human health and modern medicine. The academic seminar was attended over the two days by participants from the Thai FDA, the National Vaccine Institute, Department of Medical Sciences, Chulalongkorn University, the Government Pharmaceutical Organization (GPO), Queen Saovabha Memorial Institute, the National Science and Technology Development Agency (NSTDA), and CRI, with four eminent international scientists as invited speakers, including **Professor Ram Sasisekharan**, the Alfred H Caspary Professor of Biological Physics and Physics, Massachusetts Institute of Technology, USA; **Dr. Ajaz Hussain**, former President of the National Institute for Pharmaceutical Technology and Education, former Global Head for Biosimilar at Sandoz, and former Deputy Director of the Office of Pharmaceutical Sciences, US FDA; **Professor Steven P. Schwendeman**, the Ara G Paul Professor and Chair of Pharmaceutical Sciences, Professor of Biomedical Engineering, and the Biomaterials and Drug Delivery Thrust Leader of the University of Michigan Bio-interfaces Institute; and **Dr. Gillian Woollett**, Vice President and Head of Regulatory Strategy and Policy at Samsung Bioepis.

(Continued on page 2)

CRI and Thai FDA Convene an Academic Seminar on Efficient Biosimilar Product Development and Rapid First In-Humans for Monoclonal Antibodies

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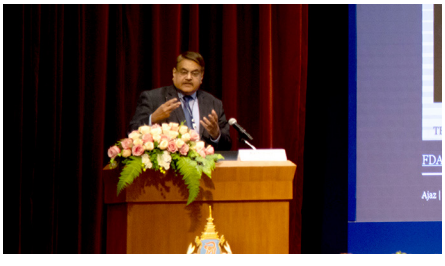
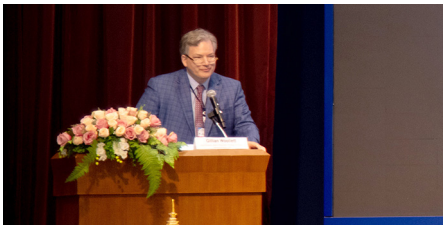
The first day was attended by 185 participants and included presentations by the four invited speakers and the Thai FDA.

Professor Sasisekharan gave the opening introductory lecture to set the scene for the subsequent discussions.

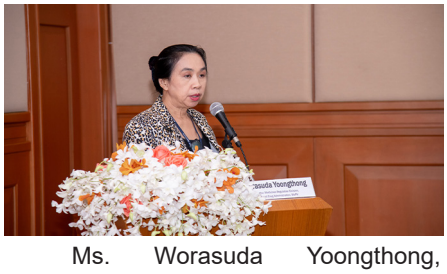


Dr. Hussain gave a presentation on a leapfrog opportunity to take the lead in implementing science-based regulatory reforms that streamline new and biosimilar monoclonal antibody development.

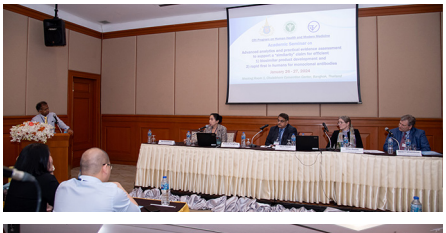
Dr. Woollett gave an overview of the current state of mAbs science, the EU and US biosimilar regulatory pathways, accumulated evidence, and efforts to update and streamline current guidance documents.



Professor Schwendeman gave an overview of science-based formulation development for new injectable formulations and considerations for rapid first human development of new monoclonal antibody products.

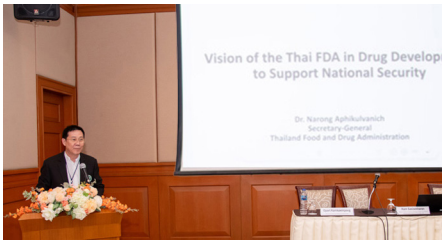


Ms. Worasuda Yoongthong, Director of the Medicines Regulation Division of the Thai FDA then gave a presentation on the current approach at the Thai FDA and visions for the future.

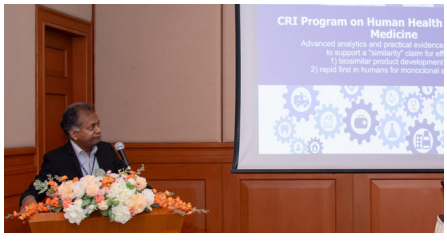


A workshop session on day two was led by Dr. Hussain and attended by 32 participants from the Thai FDA, National Health Commission Office, Department of Medical Sciences, GPO, and CRI.

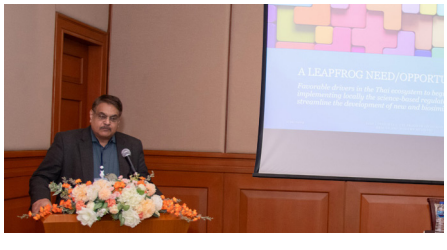
The concluding panel discussion session on policy and recommendations for innovative regulatory consideration in biologics approval included presentations



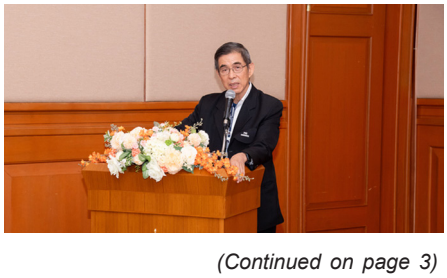
by Dr. Narong Aphikulvanich, Secretary General of the Thai Food and Drug Administration;



Professor Ram Sasisekharan; Dr. Ajaz Hussain; Ms. Worasuda Yoongthong;



and Dr. Suvit Wibulpolprasert, Advisor to the Office of the Permanent Secretary, Ministry of Public Health.



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Ambient $PM_{2.5}$ Exposure and Bone Homeostasis

The exposure to fine particulate matter ($PM_{2.5}$), with an aerodynamic diameter of ≤2.5 μm, has been linked to various adverse health effects in the respiratory and cardiovascular systems. Recent evidence also suggests its impact on metabolic diseases, neuro-degenerative diseases, and osteoporosis.

Osteoporosis is a prevalent skeletal disease characterized by reduced bone mineral density (BMD) and an increased risk of osteoporotic fractures. Disturbances in bone turnover, involving both bone formation by osteoblasts and bone resorption by osteoclasts, can lead to bone disorders.

Factors such as hormone levels, age-related bone loss, and failure to achieve optimal peak bone mass during early adulthood are recognized as main risk factors for osteoporosis and fragility fractures.

It has been shown that exposure to $PM_{2.5}$ may trigger the expression of proinflammatory factors and cause systemic inflammation, which could potentially disrupt bone homeostasis. However, only a limited number of studies have explored the potential association between long-term $PM_{2.5}$ exposure and bone homeostasis.

The present study was conducted to elucidate the relationship between long-term $PM_{2.5}$ exposure and bone homeostasis, as well as the potential underlying biological mechanisms by which $PM_{2.5}$ could affect bone health. This research included both an observational epidemiological study and experimental *in vivo* and *in vitro* examination.

Based on human data from UK Biobank, the results showed that long-term exposure to $PM_{2.5}$ was significantly associated with lower BMD at different anatomical sites in the human (such as heel, femur neck, and lumbar spine), according to the analysis of UK Biobank data which were measured during 2014-2020.

For the experimental animal study, C57BL/6 male mice exposed to ambient $PM_{2.5}$ or filtered air for 6 months via a whole-body exposure system, exhibited excessive osteoclastogenesis, dysregulated osteogenesis, higher tumor necrosis factor-alpha (TNF-α) expression, and shorter femur length than control mice, but they demonstrated no significant differences in femur structure or BMD.

TNF-α has been shown to be involved in bone homeostasis by directly potentiating the expression of RANKL (receptor activator of nuclear factor kappa beta ligand) to enhance the bone resorption process and impairing the osteoblast performance. Thus, the higher expression of TNF-α in $PM_{2.5}$-exposed cells/animals may disturb the balance by activating osteoclastogenesis as well as by inhibiting osteogenesis.

In vitro, cells stimulated with conditional medium of $PM_{2.5}$-stimulated macrophages had aberrant osteoclasto-genesis and differences in the protein/mRNA expression of members of the TNF-α/Traf6/c-Fos pathway, which could be partially rescued by TNF-α inhibition.

In conclusion, the prospective observational evidence suggested that long-term exposure to $PM_{2.5}$ was associated with the dysfunction of bone metabolism and the pathogenesis of osteoporosis, which may be mediated by inflammation-induced osteoclasto-genesis around the growth plate.

These findings provide a novel insight into bone homeostasis in response to long-tern $PM_{2.5}$ exposure.

Source: Environmental Health Perspectives, Vol. 131, No. 10, Article 107002-1, October 2023.

CRI and Thai FDA Convene an Academic Seminar on Efficient Biosimilar Product Development and Rapid First In-Humans for Monoclonal Antibodies

(Continued from page 2)

Closing remark by Dr. Opas Karnkawinpong, Permanent Secretary of the Ministry of Public Health.

The suggestions of the international invited speakers can be summarized as follows: (1) the over-arching point is the flexibility of the regulatory framework and the ability to make a case based on science; (2) a legacy issue for biosimilars is the tendency to solve everything with a clinical trial; however, now that we have advanced analytics, we should be able to lower the risk based on things like structural differences, binding, binding analytics for the antibody, etc; (3) it would be useful to contextualize the 505b2 approach for new antibodies with improved/gain of function (US overall framework) but with a differentiated target profile and to validate the target; (4) Thailand should target products that don't currently have biosimilars, prioritizing based on criteria such as disease burden, etc; (5) risk analysis should be viewed in terms of how we put systems in place, in a structured format for decision-making under uncertainty (protocol-driven methodologies with an expert panel and reference sources to be brought into the discussion); (6) on-the-job training/learning/courses towards a certificate or master's degree (continuing professional development) with courses on regulatory science and drug development would help build capacity for the country and improve prospects for the trained staff; (7) a "safe haven" concept should be exercised to bring different players/stakeholders together in open dialogue as a mechanism where more science gets discussed towards problem-solving; and (8) don't reinvent the wheel on standards and don't tap into an existing "consensus" but develop your own approaches and come to your own conclusions based on actual experience and expertise.

Exposure to Heavy Metals and Cancer: A Bibliometric Study

Industrialization and urbanization have led to heavy metal pollution, posing a serious threat to human health. Molecular epidemiologic research has confirmed that environmental factors are the primary cause of human cancer, with over 90% of cancers being caused by external environmental factors that directly or indirectly impact DNA.

Awareness of heavy metals' carcinogenicity is growing, raising concerns about their adverse effects on human health due to their persistence in the environment and ability to accumulate in the food chain. Also, these metals indicate toxic properties while appearing not only in elemental form but also in the form of compounds.

Various international and national organizations set the threshold limit values (TLVs) of heavy metals in different components, like air, waste soils, food, and feed in order to avoid adverse health effects in the populations. However, these TLVs might vary between countries, and in the case of the international agencies often have only the status of guidelines.

International Agency for Research on Cancer (IARC) and the US Environmental Protection Agency (US EPA) classified arsenic (As) and cadmium (Cd) as carcinogenic (Group 1) and chromium (Cr), lead (Pb), and mercury (Hg) as possibly carcinogenic (Group 2B) to humans.

In recent decades, researchers worldwide have collaborated to investigate the impact of heavy metal exposure on health. However, efforts to integrate this research with cancer incidence have been limited, and existing reviews have often focused on narrow aspects instead of providing a comprehensive perspective.

In the present study, the human exposure to heavy metals and cancer knowledge epistemology was investigated in the Scopus database using bibliometric analysis, and focused on the investigated scientific area with the usage of this new tool in order to gain new knowledge.

This technique has received a wide-spread consideration for the purpose of conducting an all-inclusive review of literature. Bibliometric reviews are considered as systematic literature reviews, which are more robust and offer a replicable, transparent, and scientific procedure to analyses extant literature.

The study aims to analyze published articles related to human exposure to heavy metals and their connection to cancer. It will look at the number of publications per year, types of journals, most cited papers, keywords used, and contributing authors in this field. The study also seeks to understand the main topics addressed by researchers and how this research area has evolved over time.

Using bibliometric techniques and visual tools, it aims to overcome the limitations of narrative reviews and significantly contribute to the advancement of research in this field.

The bibliometric data of the research articles were retrieved using the following keywords: “heavy metal,” “trace element”, “cancer”, “carcinogen”, and “tumor” in the Scopus database. Specifically, 2,118 articles published between 1972 and 2023 were found, covering a total of 1,473 authors, 252 sources, and 2,797 keywords. The number of studies conducted in this field increased from one article published in 1972 to 18 articles published in 2022.

In the majority of the published papers, the most popular keywords were “cadmium” and “carcinogenicity”. However, in recent 4 years, the emphasis has been placed more on epidemiology studies.

The results of the investigations showed that from 1972 to 1994, the only main topic in the field of cancer development caused by exposure to heavy metals was “cadmium” which was repeated in 51 studies (20.2%) as a keyword.

From 1995 to 2010, the most discussed basic topics included “heavy metals,” “arsenic,” “heavy metal,” “environmental exposure,” and “copper,” while the main topic of the previous period was also expanded and continued to be investigated.

This scientific trend changed during the years 2011–2018 in such a way that “cadmium” occupied more than one third of the subjects of studies.

In years 2019–2023, the research topic switched to a new direction and included “epidemiology,” “lung cancer,” “cadmium,” “heavy metals,” “cancer,” “heavy metal,” and “thyroid cancer”. During this period, “apoptosis” was removed, and the terms “epidemiology” and “thyroid cancer” emerged. These new topics can provide physicians with valuable results in the field of cancer prevention and treatment.

The research articles that were investigated in the present study in order to establish a link between heavy metal exposure and cancer development based either on experimental toxicological studies on animals (mainly rats) or on epidemiological studies performed by investigating occupational exposure of humans in specific exposure conditions.

Both approaches have limitations that might affect the results obtained in the bibliometric analyses. Thus, researchers suggest in further expanded bibliometric analyses to include research articles that specifically use non-animal testing methods together with new approach methodologies (NAMs) and are gaining popularity among researcher and authorities.

In summary, the bibliometric analysis of investigated scientific papers revealed as the key finding, the carcinogenic potential of investigated heavy metals in cancer development. However, the research examined the effect of cancer occurrence after organism exposure, and the mechanism of the carcinogenesis was not investigated.

These findings can offer valuable insights for future researchers and help highlight changes in societal health concerns, calling attention to the importance of updating public health policies and strategies.

Source: Environmental Science and Pollution Research, Vol. 30, Pages 109867–109888, October 2023.

Global Health Burden and Lead Exposure in Children and Adults: Health Impact and Economic Modelling Analysis

Lead exposure remains a significant health risk globally, despite reductions in blood lead levels after the phase-out of leaded gasoline, particularly in low- and middle-income countries.

According to the World Health Organization (WHO), lead is one of the ten chemicals posing major public health concerns. Lead exposure is ranked as the fourth major environmental health risk, following ambient particulate matter air pollution, household air pollution from solid fuels, and unsafe household drinking water, sanitation, and hand-washing, according to the Global Burden of Diseases, Injuries, and Risk Factors (GBD) Study 2019. Health issues associated with lead exposure include cardiovascular disease, chronic kidney disease, and idiopathic developmental intellectual disability.

Cardiovascular disease accounts for 94% of lead exposure-related mortality and 82% of disability-adjusted life-years (DALYs). It's important to note that the estimate of cardiovascular disease mortality in the GBD studies is limited to the impact of lead exposure on increased blood pressure, and the estimate of idiopathic developmental intellectual disability does not account for effects on the intelligence quotient (IQ) of the vast majority of children.

The present study aimed to provide a new estimate of global cardiovascular disease mortality attributable to lead exposure using an alternative method to GBD studies to capture effects that could be mediated through mechanisms other than blood pressure.

This study applied complete global blood lead level estimates from GBD 2019 to estimate IQ loss in the child population aged 0-4 years and cardiovascular disease mortality in adults aged 25 years or older in both low- and middle-income countries (LMICs) and high-income countries.

It used an alternative methodology to the one used in GBD 2019 to estimate cardiovascular disease mortality that is mediated through other mechanisms than increased blood pressure; and estimated for the first time the global cost of IQ loss and cardiovascular disease mortality from lead exposure.

IQ loss (presented as estimated loss in IQ points) in the global population of children younger than 5 years was estimated using the blood lead level-IQ loss function from an international pooled analysis.

The cost of IQ loss was calculated only for the proportion of children expected to enter the labour force, as the present value of loss in lifetime income from the IQ loss (presented as cost in US dollars and percentage of gross domestic product with a range).

The estimated cardiovascular deaths due to lead exposure among people aged 25 years or older were calculated using a health impact model that captures the effect of lead exposure on cardiovascular disease mortality that is mediated through mechanisms other than hypertension.

Finally, the values of statistical life were used to estimate the welfare cost of premature mortality, presented as cost in US dollars and percentage of GDP.

All estimates were calculated by World Bank income classification and region (for LMICs only) for 2019.

The study estimated that children younger than 5 years lost 765 million IQ points and that 5,545,000 adults died from cardiovascular disease in 2019 due to lead exposure. 729 million of the IQ points lost (95.3% of the total global IQ loss) and 5,004,000 (90.2% of total) cardiovascular disease deaths due to lead exposure occurred in LMICs.

IQ loss in LMICs was nearly 80% higher than a previous estimate.

Cardiovascular disease deaths (5.5 million) were six times higher than the GBD 2019 estimate (0.85 million), close to the number of estimated global deaths from $PM_{2.5}$ ambient and household air pollution combined (6.45 million).

The global cost of lead exposure was US$ 6.0 trillion in 2019, which was equivalent to 6.9% of the global gross domestic product. This cost exceeds the combined cost of $PM_{2.5}$ ambient and household air pollution estimated by the World Bank at 6.1% of the global GDP in 2019. 77% of the cost was the welfare cost of cardiovascular disease mortality, and 23% was the present value of future income losses from IQ loss.

The research findings indicate that global lead exposure has significant health and economic costs similar to $PM_{2.5}$ air pollution. However, there is still much work needed to improve the quality of blood lead level measurement data, particularly in LMICs.

In conclusion, the projected impact of global health effects and costs of lead exposure underscores the need to reduce population exposure to lead as a matter of urgency.

An implication for future research and policy is that LMICs bear a disproportionately large share of the health and cost burden of lead exposure. Therefore, there is an urgent need for improved quality of blood lead level measurements, lead exposure identification, research, policies, and practices to address this burden.

It is important to note that the global health effects and costs of other chemicals besides lead could also be substantial and have yet to be fully quantified at national population levels.

Source: The Lancet Planet Health, Vol. 7, Issue 10, Pages e831-e840, October 2023.

Monitoring Progress on Universal Health Coverage and the Health-related SDGs in the WHO South-East Asia Region: 2023 Update

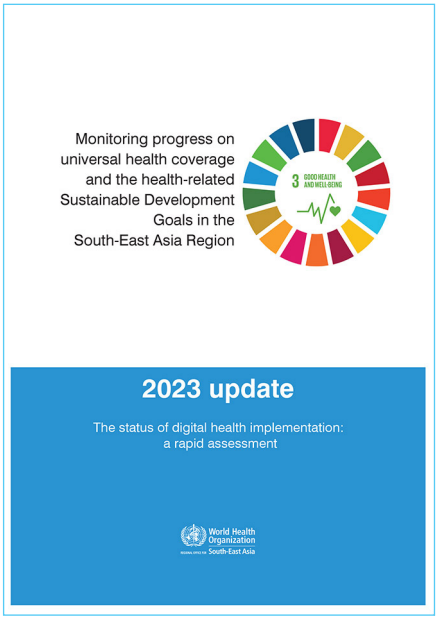
The eighth annual report on **"Monitoring progress on universal health coverage (UHC) and the health-related Sustainable Development Goals (SDGs) in the WHO South-East Asia Region – 2023 update"** provides a comprehensive overview of the status and trends for the 46 health-related SDG indicators and the additional five indicators for the WHO Thirteenth General Programme of Work (GPW13) for all 11 Member States of the Region.

Now at the mid-point to the 2030 timeline, the report presents the patterns of change in recent years in the areas of maternal and child health, malnutrition, infectious diseases, noncommunicable diseases and risk factors, mental health, injuries, environmental health, financial protection, health workforce, and health security.

The thematic focus of this report is **"The status of digital health implementation in the SE Asia Region – a rapid assessment"**. This is a proxy measure of digital health maturity in the Region as a paramount accelerator of progress towards UHC and the health-related SDG targets. The highlight of the report is the section on enhanced country profiles on the health-related SDGs and the status of digital health implementation.

More information, please visit https://www.who.int/publications/i/item/9789290210917

Source: WHO Publications. Monitoring progress on universal health coverage and the health-related Sustainable Development Goals in the WHO South-East Asia Region: 2023 update, November 2023.



Enhancing Urban Governance for Health and Well-being in South-East Asian Cities: Regional Laboratory, Framework, Cases and Assessment Tool

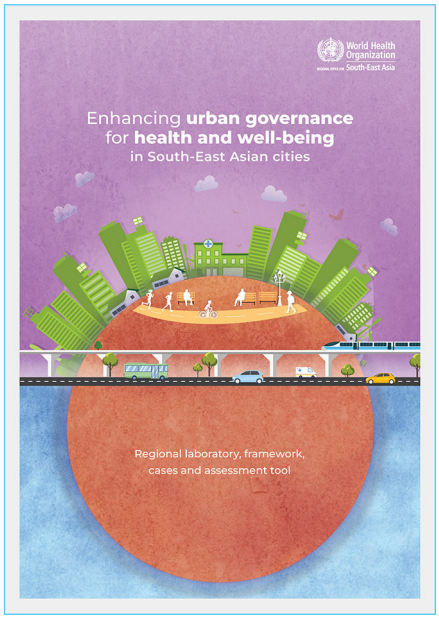
The documant **"Enhancing urban governance for health and well-being in South-East Asian cities: Regional laboratory, framework, cases and assessment tool"** is developed by the WHO Regional Office for South-East Asia in collaboration with the Regional Social Laboratory on urban governance for health and well-being of Chulalongkorn University, Thailand.

It studies current practices related to urban governance in select cities of the WHO South-East Asia Region to present a framework and assessment tool for urban health conditions that can help improve the health profiles of cities. Such a health profile is key to conclude evidence-based planning to create 'heathy cities'.

WHO's guidance on relevant actions in the healthy city domain is adapted to support low- and middle-income countries and draws from consultations with Member States of the Region on the well-being of city-dwellers. Urban and municipal authorities are encouraged to utilize the framework and tools presented in this document and collaborate with regional healthy city networks. While the context of urban health will continue to evolve, the tools and guidance enumerated in this document can be updated and adapted as appropriate.

More information, please visit https://www.who.int/publications/i/item/9789290210702

Source: WHO Publications. Enhancing urban governance for health and well-being in South-East Asian cities: Regional laboratory, framework, cases and assessment tool, November 2023.



EHT PERDO

HUB OF TALENTS in ENVIRONMENTAL HEALTH

NRCT

International Conference on

Environmental Pollutants and Toxicants Affecting Health: Collaborative Efforts for Improving Quality of Life

June 19 - 21, 2024

at Convention Center, Chulabhorn Research Institute, Bangkok, Thailand

Organized by Center of Excellence on Environmental Health and Toxicology (CoE EHT)
(Program: Hub of Talents in Environmental Health with Support of the National Research Council of Thailand)

HTAPC Hub of Talents on Air Pollution and Climate

Collaborating Institutions:
Hub of Talents on Air pollution and Climate, Thailand
Health and Environmental Sciences Institute, U.S.A.

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ANNOUNCEMENT AND CALL FOR ABSTRACTS

The Center of Excellence on Environmental Health and Toxicology, of which the Chulabhorn Research Institute (CRI, Bangkok, Thailand) is a member institution, is organizing the international conference which has the aim of creating partnerships within the Asia Pacific region among countries that share environmental health issues of concern. It will provide a forum for representatives from these countries to meet with world authorities on various environmental health issues, and exchange of ideas and expertise that would foster collaborations.

International Speakers (Partial list):

- Air Pollution - Source, Health and Environmental Effects: ***Herman Autrup*** *(University of Aarhus, Denmark)*
- Children's Environmental Health: ***William A. Suk*** *(University of North Carolina in Chapel Hill, USA)*
- Climate Change and Impact on Toxic Pollutants and Human Health: ***Henry Falk*** *(Emory University, USA)*
- Effects of Chemicals in the Early Life Stage: ***Martin van den Berg*** *(University of Utrecht, The Netherlands)*
- Electromagnetic Fields and Children's Health: ***Denis L. Henshaw*** *(University of Bristol, UK)*
- Mechanisms of Food Chain Transport/Biomagnification of Contaminants: ***Michelle Embry*** *(Health and Environmental Sciences Institute, USA)*
- Novel Toxicological Effects and Personalized Health Hazards in Workers Exposed to Low Doses of Benzene: ***Willian W. Au*** *(University of Texas Medical Branch, USA)*
- The Last Mile Problem in Health Protection Sciences: ***Syril Pettit*** *(Health and Environmental Sciences Institute, USA)*
- The Potential Hazard of Engineered Nanomaterials: ***Bengt Fadeel*** *(Karolinska Institute, Sweden)*
- The Use of High-resolution Mutational Fingerprints to identify Past Exposures to Environmental Carcinogens: ***John M. Essigmann*** *(Massachusetts Institute of Technology, USA)*

SYMPOSIA / WORKSHOP SESSIONS:

- Air Pollution: Solution for the Transboundary Issue in the Mekong Subregion
- Collaborative Network in Environmental Health in the Region
- Developmental Origins of Human Health/Diseases
- Environmental Accumulation and Magnification Towards Human Exposure and Health
- Environmental Health Issues of Concern in Developing Countries
- Environmental Pollutants and Toxicants Affecting Health
- E-waste: Collaborative Efforts for Improving Quality of Life

Topics to be covered and for Platform/Poster Presentation

- Climate Change and Environmental Health
- Environmental Pollution and Human Health
  - Air Pollution
  - E-waste
  - Microplastics
  - Toxic Metals
  - Pesticides
  - Endocrine Disrupting Chemicals (EDCs):- Bisphenol A, Dioxins, Phthalates, and Per- and polyfluoroalkyl substances (PFAS), etc.
- Food Safety and Food Contaminants
- Toxic Wastes and Hazardous Materials
- Developmental Origins of Human Disease
- Children's Environmental Health
- Science and Technology for the Treatment and Management of Environmental Pollutants

FELLOWSHIPS: A limited number of fellowships are available to participants whose abstracts have been selected by the Scientific Program Committee. This will cover the registration fee, discount airfare by low-cost airlines, and accommodation at the Chulabhorn Research Institute Residence for 4 nights. Fellowships are provided by the Chulabhorn Research Institute, Thailand and the Health and Environmental Sciences Institute (HESI), USA.

To apply for a fellowship, please submit a 5-6-page extended abstract and an up-to-date CV. You will be required to give a short presentation (Poster or Platform) on environmental health issues of concern in your country, which should be based on evidence published by a reliable source, e.g., health or environmental authorities in your country.

Abstract Submission Deadline:
May 9, 2024

https://eht.cri.or.th/conference

CALENDAR OF EVENTS

International Training Courses at Chulabhorn Research Institute, Year 2024

	Training Course	Date	Duration	Closing Date
1	Environmental Toxicology and Health	June 24-28, 2024	5 work days	March 31, 2024
2	Environmental and Health Risk Assessment and Management of Toxic Chemicals	December 9-14, 2024	6 work days	September 30, 2024

Course Coordinator: *Khunying* Mathuros Ruchirawat, Ph.D.

Course Description:

Environmental Toxicology and Health (June 24-28, 2024)

Events	Date
International Conference on Environmental Pollutants and Toxicants Affecting Health: Collaborative Efforts for Improving Quality of Life	June 19-21, 2024
International Training Course on Environmental Toxicology and Health	**June 24-28, 2024**

This course provides students and participants with a background of the major groups of toxic substances encountered by man and animals through food and the environment, as well as through exposure at the workplace. These toxicants include toxic substances in air, water and soil; solvents; gases; pesticides; hazardous wastes and other pollutants. The course focuses on the chemistry, fate and distribution in the environment, mechanisms of their action, toxic manifestation in living organisms, as well as toxic syndrome in human beings. The course also provides information on the latest technologies used to study changes and effects in biological systems, e.g. biomarkers, the omics technologies, gene-environment interactions, epigenetics and transgenic models, and covers environmental health issues such as climate change, and their adverse health effects in humans.

Requirement: Participants should have some basic knowledge in chemistry and the biological/biomedical sciences.

Fellowships:

A limited number of fellowships are available that will cover round-trip airfare, accommodation (on site) and meals, training materials, and health insurance.

This year, the course will be held back-to-back with the ***international conference on Environmental Pollutants and Toxicants Affecting Health: Collaborative Efforts for Improving Quality of Life*** *at the Chulabhorn Research Institute Convention Center, Bangkok, Thailand from June 19-21, 2024. More information, please visit the conference website at https://eht.cri.or.th/conference. Participants interested in attending both the conference and training course will be given special consideration.*

Participants receiving travel fellowships to attend the conference will be required to give a short presentation (platform or poster) on Environmental Health issues of concern in their country, based on evidence published by reliable sources, e.g., health or environmental authorities in their country.

Contact: Chulabhorn Research Institute (CRI)
54 Kamphaeng Phet 6 Rd.,
Lak Si, Bangkok 10210, Thailand
Tel: +66 2 553 8535
Fax: +66 2 553 8536

Calendar

More information and application:

Please visit - https://www.cri.or.th/academic-activities-en/activity-calendar/

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Correspondence should be addressed to:

ICEIT NEWSLETTER
Chulabhorn Research Institute
Office of Academic Affairs
54 Kamphaeng Phet 6 Road
Lak Si, Bangkok 10210, Thailand
Tel: +66 2 553 8535
Fax: +66 2 553 8536
CRI Homepage: <http://www.cri.or.th>