Med Uni Graz

human exposome assessment platform

BBMRI.at
Biobanking and BioMolecular resources Research Infrastructure Austria

Symposium
Frontiers in Human Exposome Research

Date: Wednesday 1st June, 13:00 - 17:00 (CEST)
Venue: Medical University of Graz, MED CAMPUS or online

Researchers have made huge advances in understanding environmental exposures and their biological effects in recent years. Despite this, there are still many gaps in knowledge. For example, the incidence of diseases such as cancer is rising, and the role of the exposome in this increase is not fully understood.

The "Frontiers in Human Exposome Research" symposium, organized by the Human Exposome Assessment Platform (HEAP) project, BBMRI.at and Medical University of Graz, presents the latest exposome research on epigenomics, microbiomics, metabolomics, explores legal and ethical issues, data management best practice, and presents the data analysis solution that the HEAP platform will offer to future generations of researchers.

Programme

13:15 Welcome video message
Caroline Schober
Vice Rector for Research and International Affairs,
Medical University of Graz, Austria

13:30 Biobanking and the exposome
Kurt Zatloukal
Head of the Diagnostic and Research Centre for Molecular BioMedicine, Medical University of Graz,
Director BBMRI.at, Austria

New frontiers in exposome research
Joakim Dillner
Head of Centre for Cervical Cancer prevention,
Karolinska Institutet, Sweden

Measuring the exposome: Delusion or next frontier?
Benedikt Warth
Head of Exposome Austria and the Global Exposomics & Biomonitoring Laboratory, University of Vienna, Austria

EIRENE – new European research infrastructure for human exposome research
Jana Klánová
Director of RECETOX, Masaryk University, Czech Republic

14:30 Coffee Break

15:00 Globalisation of exposome research – approaches and cancer research
Zisis Kozlakidis
Head of Laboratory Services and Biobank Group, International Agency for Research on Cancer (IARC), France

Ethics and legal aspects of exposome research
Evert-Ben van Veen
Director, MLC Foundation, the Netherlands

HopsWorks and the HEAP technical platform
Jim Dowling
CEO, Logical Clocks, Sweden

The HEAP FAIR toolbox
Heimo Müller
Group Leader, Information Science and Machine Learning, Medical University Graz, Austria

16:00 Coffee Break

16:15 Personal exposome profiling
Michael Snyder
Head Dept. of Genetics and Director of the Center for Genomics and Personalized Medicine, Stanford University School of Medicine, USA

Ageing and environment -> epigenome -> disease
Martin Widschwendter
Director European Translational Oncology Prevention and Screening (EUTOPS) Institute, Austria

Monitoring lifestyle intervention in the human exposome - the HEAP LifeStyle cohort
Chiara Herzog
European Translational Oncology Prevention and Screening (EUTOPS) Institute, Austria

How your everyday purchases affect your health
Frederik Trier Møller
Statens Serum Institut, Copenhagen, Denmark

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Venue

Medical University of Graz, or online
MED CAMPUS Graz
Hörsaal MC 2
Stiftingtalstraße 6
8010 Graz, Austria

Presenters' introductions and presentation abstracts

Kurt Zatloukal

Head of the Diagnostic and Research Center for Molecular BioMedicine, Medical University Graz. Director of BBMRI.at, Austria

Kurt Zatloukal is a Professor of Pathology whose research focuses on biobanking and digital pathology, development of molecular diagnostics, and molecular pathology of diseases. He coordinated the preparatory phase of the European biobanking and biomolecular research infrastructure (BBMRI-ERIC) and is director of the Austrian node (BBMRI.at). He is coordinator of the H2020 project INSTAND-NGS4P on Next Generation Sequencing (NGS) in medical diagnostics, and is a Work Package leader in the IMI project BIGPICTURE, whose aim is to build a central repository for digital pathology.He is the Austrian delegate on the CEN and ISO Technical Committees for diagnostics standard development, and a scientific board member for genetic testing and human gene therapy at the Austrian Ministry of Health and the Academia Europaea.

Presenting on "Biobanking and the exposome"

One of the most important open questions for prevention of disease is to understand how environmental factors interact with the genetic make-up of individuals, thereby determining individual health and diseases conditions. In order to address this question structured and standardized information on individual's exposome from different populations is urgently needed.By combining exposome data with biosamples that are linked with health data, the individual genome can be sequenced and by using multi –omics approaches insight into molecular diseases mechanisms and disease outcomes can be obtained.

Biobanks have developed major expertise in how to collect, preserve and provide access to biosamples as well as how to process health data in an ethically and legally compliant, and quality controlled manner. However, most biobanks lack detailed exposome data. Therefore, close collaboration of exposome initiatives with biobanks could create essential added value to address the grand health challenges of today and tomorrow.

Joakim Dillner

Head of Center for Cervical Cancer prevention, Karolinska Institutet, Sweden, and Coordinator of the HEAP project

Joakim Dillner, MD, PhD, is Professor of infectious disease epidemiology at Karolinska Institute, Head of Unit at the Karolinska University Hospital, Center for Cervical Cancer Prevention, and Director of Research & Development at Medical Diagnostics Karolinska, Karolinska University Hospital.

He conducts Human Papillomavirus (HPV) research into molecular biology, immunology and vaccinology, clinical virology and epidemiology, and runs the International Papillomavirus Reference Center (www.hpvcenter.se), the National Quality Registry of Cervical Cancer Prevention, and the Nordic Information for Action eScience Center of Excellence (www.nordicehealth.se).

Presenting on "New frontiers in exposome research"

Advances in molecular analysis, "omics", have propelled a transformed a major new goal for health care, Precision Medicine. Knowledge of the specific health determinants– be it genomics, transcriptomic, proteomics, metabolomics or other clearly identifiable determinants of health and disease- will jointly enable identification of optimal specific treatments for the individual patient.

Exposome research corresponds to "Precision Public Health" aiming to use modern analytic technologies to move aggregated measures of the environment to specific identification of exactly which environmental factors that affect health and disease. For example, studies of diet now aim to identify specific products. Studies of hygiene now aim to identify the specific fungi, molds, bacteria or other microbes. Studies of pollution now aim to identify specific chemical compounds.

Although technologies already exist, a concerted and interdisciplinary effort is required.

Benedikt Warth

Head of Exposome Austria and the Global Exposomics & Biomonitoring Laboratory, University of Vienna, Austria

Benedikt is an Associate Professor at the University of Vienna, where he founded the 'Global Exposomics and Biomonitoring Laboratory'. His team develops novel mass spectrometric methods to solve questions in the fields of systems toxicology, cancer research, and exposure science. His current research focus is omics-scale exposure assessment and analytical toxicology, with the aim of better understanding the in vivo and in vitro effects and interactions of environmental and food contaminants.

He is the national coordinator of 'Exposome Austria', a newly funded large-scale infrastructure for integrated environmental health research, and he recently received an ERC Consolidator Grant to investigate breast cancer exposome by novel analytical technologies.

Presenting on "Measuring the exposome: Delusion or next frontier?"

Throughout our lifetime we are exposed to a multitude of food and environment-related molecules. These exposures may impact the etiology and course of a large share of human disease. Analytical technology remains a major limitation to enable exposome-wide assessment of chemical exposure. This contribution will present innovative workflows for the omic-scale investigation of toxicants that are highly diverse in terms of physico-chemical properties, concentrations found in vivo, and toxicological impact/mode of actions. Newly established workflows based on liquid chromatography coupled to mass spectrometry (LC-MS) will be presented. This includes targeted, non-targeted and stable isotope-assisted approaches that have been thoroughly tested in first pilot applications. Abundant exposure data derived from proof-of-principal experiments will be presented to showcase the dynamics and complexity of different exposure scenarios. A particular focus will be on early-life chemical exposure as exemplified by the analysis of plasma samples from extremely premature infants. Moreover, the capacity of the newly established, broad methods will be demonstrated by reporting xenobiotics in breast milk and urine samples from diverse populations.

Jana Klánová

Director of RECETOX, Masaryk University, Czech Republic

Jana Klánová is Professor of environmental chemistry at Masaryk University in Brno, Czech Republic, Director of the RECETOX Centre, and coordinator of the ESFRI Research Infrastructure for human exposome (EIRENE). Her research interests are in environmental health sciences and environmental determinants of health. Jana is a member of the ESFRI Strategic Working Group on Environment and the Czech national Board on Large Infrastructures for Research and Innovation. She is a lead of the Group of Earth Observation Initiative GOS4POPs (Global Observation System for Persistent Organic Pollutants), and leads multiple large-scale projects from the European Structural and Investment Funds and EU Horizon 2020 projects.

Presenting on "EIRENE – new European Research Infrastructure for Human Exposome Research"

Research infrastructures are key entities enabling high-level research and fostering innovations in any research area. They provide an access to necessary capacities, innovative technologies, and expert human resources. Numerous research infrastructures have been developed in Europe during the last decades but none of them addressed chemical exposures.

EIRENE RI (Research Infrastructure for EnvIRonmental Exposure assessmeNt in Europe) fills this gap in the European infrastructural landscape and pioneers the first EU infrastructure on human exposome. It will advance new scientific developments and enable a large-scale interdisciplinary research providing harmonised workflows covering all processes between the data and sample collection and knowledge provided to the end users accessible to academic researchers, private companies, public authorities and citizens. This will lead to improved understanding of an impact of exposome on the European population, characterization of the risk factors behind development of chronic conditions, and discovery of novel tools for their prevention and treatment.

Zisis Kozlakidis

Head of Laboratory Services and Biobank Group, International Agency for Research on Cancer (IARC), France

Dr. Zisis Kozlakidis is the Head of Laboratory Services and Biobanking at the International Agency for Research on Cancer (IARC/WHO). Dr Kozlakidis has significant expertise in the field of biobanking, and has served as President of ISBER. He is a virologist, with a PhD in Microbiology from Imperial College London. He is an elected Fellow of the Linnean Society of London, the Royal Academy of Sciences, UK, and a Turnberg Fellow of the UK Academy of Medical Sciences. Dr. Kozlakidis has contributed to seminal studies in the adoption of innovations into routine healthcare and their associated financial impacts.

He is a scientific advisor to the PTEN Research Foundation, holds an MBA from the Business School, City University of London, and holds visiting faculty positions in China and the UK.

Presenting on "Globalisation of exposome research – Approaches and cancer research"

Over 15 years ago, Dr Christopher Wild from IARC introduced the word exposome to the scientific community, articulating his vision for a field that provided the environmental complement to the genome.

Since then, there has been a significant research investment into the field of the exposome research, including the creation of dedicated research calls by national and international funding organizations, as well as a dedicated peer-reviewed scientific journal.

Evert-Ben van Veen

Director of MLC Foundation, the Netherlands

Evert-Ben van Veen is a lawyer with more than 30 years' experience in health and privacy law. His ambition is to combine a practical and realistic approach with fundamental questions. His contributions to Dutch legislation in the 1980s and 1990s still stand in the statutes. He helped to ensure that the final text of the GDPR showed a more balanced approach to scientific research than the version suggested by the European Parliament. He leads the Ethics and Regulations Work Package of HEAP, and chairs the European Human Exposome Network's Law and Ethics Working Group.Working with others, he recently published a paper in Open Research Europe on joint controllers in large research consortia.

Presenting on "Ethics and legal aspects of exposome research"

The ethical and legal aspects of exposome research can be subsumed under two themes. 1: How can the results of exposome research further the right to health for all? 2: How can the methods of exposome research be performed in an ethical way and respect the rights of the participants whose data and tissue are being used for that research? The second theme often focuses on data protection issues, individual control over data and tissue being used for research and the sheer impossibility to achieve that with big data research. We propose that the first theme is the overarching principle in exposome research. This should also influence the second theme. It would lead to a balancing of fundamental rights. The balance can be achieved via good governance of cohorts which clarifies in an accountable way the choices made for sub studies using data and tissue from that overarching principle.

Jim Dowling

CEO of Logical Clocks, Sweden

Jim Dowling is CEO of Hopsworks and an Associate Professor at KTH Royal Institute of Technology.

He is lead architect of the open-source Hopsworks platform, a horizontally-scalable data platform for Machine Learning that includes the industry's first Feature Store.

Jim is a regular speaker at industry events on data and AI, and is authoring the first book on feature stores for Machine Learning for Manning.

Presenting on "Hopsworks and the HEAP technical platform"

The Human Exposome Assessment Platform is an open-source software platform for development, operation, and management of both applications and data at scale, with specific support for the requirements of exposome data. It builds on the Hopsworks platform, a scalable data and compute platform with support for Data Science tools, such as Jupyter notebooks, a wide number of programming languages (Python, Spark, Flink, SQL) and deep learning, with GPU resource management.

In this talk, we will give an overview of the HEAP platform capabilities, and how we are using the platform in the HEAP project.

Heimo Müller

Group Leader, Information Science and Machine Learning, Medical University Graz, Austria

Heimo Müller studied mathematics in Graz and Vienna. He began his professional career in computer graphics and multimedia at Joanneum Research. As Marie-Curie Research Fellow at the Free University of Amsterdam he was modelling the semantic structure of film and video. Back in Graz, he was the founding head of the Information Design course at the Joanneum University of Applied Sciences. For more than a decade, he has now been working at the Medical University of Graz on data management in biobanking, digital pathology and explainable AI.Within HEAP, he leads the FAIR data management (WP7) and coordinates the development of an open source platform for data exchange, the FAIR toolbox.

Presenting on ""The HEAP FAIR toolbox"

Exposome research is very much reliant on high-quality data produced throughout the whole chain, from data generation and processing to final data analysis and sharing. In the last decade, the scientific methods have undergone significant changes, from single projects with a very limited number of data processing tools to transnational consortia working with a wide range of commercial and open-source software packages. To meet the above demands, we compiled a set of software tools for data management, harmonisation, and cataloguing and making the analysis results interoperable according to the FAIR (Findability, Accessibility, Interoperability, and Reusability) data management principle. The so-called HEAP FAIR toolbox is a set of dockerized open-source tools accessible through an app store. Each of the software tools is supplemented by a FAIR Data Point (FDP) providing metadata about the catalogue and datasets and a Provenance Access Point (PAP) for recording and accessing provenance information for samples and data records.

Michael Snyder

Head of Dept. of Genetics and Director of the Center for Genomics and Personalized Medicine, Stanford University School of Medicine, USA

Michael Snyder received his Ph.D. training at the California Institute of Technology and carried out postdoctoral training at Stanford University. Dr. Snyder has pioneered the use of "big data" and multiomics to advance scientific discovery and transform healthcare. His laboratory has invented many technologies that are widely used in medicine and research, including methods for characterizing genomes and their products (e.g. RNA-Seq, NGS paired end sequencing, ChIP-Chip and later Chip-Seq, protein arrays, machine learning for disease gene discovery, and wearables for monitoring personal health and exposures). His application of omics and wearables technologies to perform longitudinal profiling of people when they are healthy and ill is transforming medicine and healthcare. Indeed, his laboratory's recent work to use smartwatches and wearables to detect illness, including infectious disease such as COVID-19, prior to symptom onset is being used by many thousands of people. He has helped colead many large scale projects including ENCODE, HMP, HuBMAP and HTAN. He has cofounded many biotechnologies companies, including Personalis, Qbio, January AI, Filtricine and RTHM.

Presenting on "Precision environmental health monitoring by longitudinal exposome and multi-omics profiling"

Conventional environmental health studies primarily focused on limited environmental stressors at the population level, which lacks the power to dissect the complexity and heterogeneity of individualized environmental exposures. We integrated deep-profiled longitudinal personal exposome and internal multi-omics to systematically investigate how the exposome shapes an individual's phenome. We annotated thousands of chemical and biological components in the personal exposome and found they were significantly correlated with thousands of internal biomolecules, including those that are clinically relevant. In particular, our results showed that agrochemicals (e.g., carcinogenic pesticides, fungicides, and herbicides) and fungi predominated in the highly diverse and dynamic personal exposome, and the biomolecules and pathways related to the individual's immune system, kidneys, and liver were highly correlated with the personal external exposome. Overall, our findings demonstrate dynamic interactions between the personal exposome and internal multi-omics and provide important insights into the impact of the environmental exposome on precision health.

Martin Widschwendter

Director of European Translational Oncology Prevention and Screening (EUTOPS) Institute, Austria

Martin Widschwendter is the Director of the European Translational Oncology Prevention and Screening (EUTOPS) Institute, University of Innsbruck, Austria. He is also Professor in Women's Cancer at University College London, UK, (where he was previously Head of Department of Women's Cancer), and Consultant Gynaecological Oncologist, Guest Professor at the Karolinska Institutet, Sweden, and FRCOG (Fellows ad eundem) of the Royal College of Obstetricians and Gynaecologists, UK.Prof Widschwendter has been PI and Coordinator of several EU projects including FP7, H2020, and was awarded an ERC AdvancedGrant. He is leading the HEAP Epigenomic Analysis Work Package (WP8), which will use the data from cohort studies to analyse the epigenome to identify alterations triggered by environmental exposures.

Presenting on "Ageing and environment -> epigenome -> disease"

There are markers on our DNA that are changed by both genetic and lifestyle factors, called DNA methylation. DNA methylation is part of the epigenome - the software of our cells that informs them which hardware (DNA) to read, so that they know what to become and what to do.

DNA methylation is affected by age, and lifestyle factors such as drugs, hormones, smoking, and nutrition. DNA methylation signatures, called epigenetic 'clocks', can be used to measure the ageing process of cells, and have been found to accurately predict chronological age or how many divisions a cell has undergone. We recently found that the ageing of epithelial cells in cervical samples was reduced after combined hormone replacement therapy. Interestingly, we did not observe this anti-ageing effect in women who developed breast cancer. We aim to use these findings to help monitor the efficacy of hormone replacement therapy.

Chiara Herzog

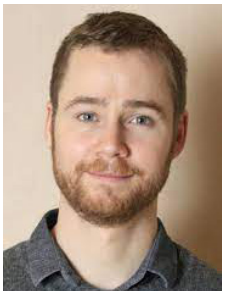
Postdoctoral researcher. European Translational Oncology Prevention and Screening (EUTOPS) Institute, University of Innsbruck, Austria

Dr. Chiara Herzog is a postdoctoral scientist researching ageing and disease prevention, with a focus on epigenetics. Her background is in Molecular Medicine and she holds a PhD in Neuroscience from the University of Edinburgh. Her industry experience includes working for a precision diagnostics company. She is currently leading the bioinformatics team in Prof Martin Widschwendter's research group at the University of Innsbruck, and co-leading a clinical trial to investigate individual longitudinal health changes following smoking cessation or intermittent fasting.

Presenting on "Monitoring lifestyle intervention in the human exposome – the HEAP lifestyle cohort"

Cancers develop through a complex interplay of genetics and environment. Current ways to predict risk either capture inherited risk (for instance, BRCA gene mutation), or lifestyle risk (such as smoking), but cannot account for individual risk factors, or dynamic changes: not all BRCA gene mutation carriers or smokers will develop cancer. We have recently identified epigenetic Women's cancer risk identification (WID) indices that can capture the risk for breast or ovarian cancers by quantifying markers on our DNA in easily-accessible surrogate samples. As part of the HEAP project, we are investigating how WID indices change over time in 160 individuals undergoing healthy lifestyle changes (smoking cessation/intermittent fasting), and whether they could be used to monitor individual cancer risk and the efficacy of preventive measures over time. In this talk, I will introduce this pilot project, that paves the way for personalised preventive medicine using epigenetics.

Frederik Trier Møller



Statens Serum Institut, Copenhagen, Denmark

Frederik Trier Møller, MD, PhD. Senior Registrar, is a project manager and innovator. Apart from his medical experience, he has established research and digital knowledge infrastructures and conducted epidemiologic studies using Danish registers. Through his work at Statens Serum Institut, he is involved in the Danish COVID-19 response. Frederik Trier Møller is leading the Consumer Cohort Work Package of HEAP, that aims to collect and analyse consumer purchase data's impact on health. He believes that analysis of the „consumer purchase data exposome", and health outcomes will lead to novel insights into our lifestyle's impact on health and disease, and provide a basis for future prevention

Presenting on "How your everyday purchases affect your health"

Consumer Purchase Data (CPD), from Loyalty programs and digital receipts, emerges as a promising source to assess the effect of consumer products on our health. A GDPR compliant, secure, encrypted web application developed by HEAP researchers allows researchers to collect consent to retrieve consumer data from three of the five largest retail chains in Denmark and link these data to health outcomes. Recruitment has commenced with 220 participants recruited by May 2022.Our health is already affected by the choices we make every day, and consumer data could, in time, enable us to answer questions such as how our purchases affect our health, paving the way for personalised prevention, and perhaps even loyalty programs could improve our health. During the talk, diet and consumer data, personal chemical cosmetics footprints, and some outbreak detective work are addressed.

Contact

If you have any questions, please contact

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For additional info, please go to the HEAP website

https://heap-exposome.eu

With your participation you grant us permission to publish images and video recordings made during the event.

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