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NEXUS
NETWORK FOR EXPOSOMICS IN THE US

May Newsletter

Visit the NEXUS website and our social media for exposome news, blog post, events, publications, and much more!

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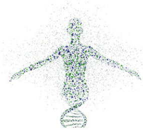
This month, we are pleased to report three foundational publications in the field of exposomics!

1. “Integrating exposomics into biomedicine”

Published in Science by The Banbury Exposomics Consortium



Read the Science Perspective

The Banbury Exposomics Consortium, published a foundational perspective in *Science* titled *“Integrating exposomics into biomedicine.”* Many of the NEXUS team members were apart of consortium including Dr. Gary Miller, Dr. Chirag Patel, Dr. Arcot Rajasekar, Dr. Fenna Sillé, Dr. Sophie Thuault-Restituito, Dr. Krystal Pollitt, and Dr. Thomas Metz. This paper offers the biomedical field a unified and operational definition of the “exposome” and the field of “exposomics”, addressing a knowledge gap as the field has long lacked a clear, succinct definition since the exposome was first introduced by Dr. Christopher Wild in 2005.

In December of 2023, 23 interdisciplinary scientists convened at the Banbury Center of Cold Spring Harbor Laboratory in an effort to advance the field of exposomics and to further the understanding of the environmental contributors to human disease and health, ultimately forming the Banbury Exposomics Consortium. This Banbury Conference fostered meaningful scientific exchanges and creative collaboration among a diverse team of professionals. This led to a successful meeting and the publication in *Science* that defines the Exposome and Exposomics as the following:

> **“… the exposome is posited as an integrated compilation of all physical, chemical, biological, and (psycho) social influences that impact biology. The field of exposomics thus examines the comprehensive and cumulative effects of these factors by integrating data from interdisciplinary methodologies and data streams to drive discovery.”**

Columbia University Mailman School of Public Health highlights this perspective in the article “Can Technology Revolutionize Health Science? The Promise of Exposomics”

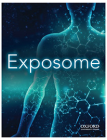
The Banbury Exposomics Consortium at Cold Spring Harbor Laboratory in December 2023.

Photo Citation C/Burkin/CSHL

Learn more about the Banbury Exposomics Consortium

2. “The exposome at twenty: a personal account”

Published in Exposome by Christopher Paul Wild, PhD.



Read the Exposome Publication

On the twentieth anniversary of introducing the term “*exposome”*, Dr. Christopher Wild reflects on the history of exposomics in a personal account. In this paper, Dr. Wild discusses his journey in developing the field, the need for exposomics as a complement to the human genome, along with his vision for future directions of the field.

As Peng Gao, PhD, Harvard University (and a Banbury Consortium member) stated on social media after reading it. “Rarely does a scientific article feel this romantic, courageous, and visionary. It’s not just a history, it’s a call to purpose.”

3. “Human exposome research: Potential, limitations and public policy implications”

Commissioned by the European Parliament’s Panel for the Future of Science and Technology (STOA)

After several years of exciting research in exposomics in the European Union, The European Parliament commissioned a report about the future of the field. From the report, “This report examines the emerging field of exposomics, which studies the cumulative impact of environmental exposures on human health. It highlights the limitations of established environmental health research and advocates a more comprehensive approach…it emphasizes the need for improved exposure assessments, integration of data, international collaboration, and sustainable data infrastructure. The report discusses the potential of artificial intelligence in advancing exposomics, and addresses ethical considerations for the field… It highlights the opportunity to create a large-scale European Human Exposome Initiative to position the EU as a global innovation leader.”

“This study was written by Roel Vermeulen of Utrecht University and University Medical Center Utrecht (UMCU) and included input for several global investigtors. Caspar Safarlou (UMCU) assisted in the writing of the report and provided critical reflections on all parts of the report. George Downward (UMC Utrecht), Gerard Hoek (Utrecht University), Gary Miller (Columbia University), Susan Peters (Utrecht University), Jelle Vlaanderen (Utrecht University), and Martine Vrijheid (ISGlobal) contributed to the writing of the seven application domains. Maurice Sanciaume and Francois Busquet (Altertox) contributed to the EU policy connection.”

Read the Publication

Spotlight

Chirag Patel, PhD

Harvard Medical School

Dr. Patel is an Associate Professor of Biomedical Informatics at Harvard Medical School and is a leading expert in the field of exposomics. He is a NEXUS MPI and co-leads the NEXUS Data Science Hub alongside Marina Sirota, PhD, University of California, San Francisco. The Data Science Hub is focused on developing digital infrastructure to support the next generation of precision environmental health. Dr. Patel trained in biomedical informatics at Stanford University. He also leads R01 applications from NIEHS, NIDDK, and NIA that focus on executing exposure-wide and genome-wide investigations in cardiovascular disease, diabetes, dementia and aging.

Currently, At Harvard Medical School, Dr. Patel leads a translational exposomics informatics group, mentors the next generation of data scientists, and teaches an introductory AI course that brings computation to real-world biomedical problems. Historically, the Chirag Patel group pioneered computational approaches to develop exposome-wide association studies (ExWAS), a ‘search engine’ for finding and confirming links between exposures and phenotypes. Today, Dr. Patel's team applies these methods to large surveys, electronic health records, biobanks, and global studies to pinpoint why conditions like dementia, diabetes, and cancer affect some communities more than others. Chirag Patel Group considers the exposome as an entity that impacts clinically relevant biological function through the integration of 'omics and interventional studies, and applies meta-science methods to boost exposomics' reliability and secure its lasting impact.

Fun Fact! Prior to starting his PhD in bioinformatics at Stanford, Chirag was a software engineer at Applied Biosystems, whose DNA sequencing technologies were critical in the Human Genome Project.

NEXUS Collaboration Feature

SMARTER

Sensors and Metadata for Analytics and Research in Exposure Health

SMARTER Tools for Exposure Health Research

SENSORS AND METADATA FOR ANALYTICS AND RESEARCH IN EXPOSURE HEALTH
SMARTER

This month, NEXUS is proud to spotlight the SMARTER Project (Sensors and Metadata for Analytics and Research in Exposure Health). In a special feature for the NEXUS blog, the SMARTER team shares insights about the project's aims, current work, importance, and ways to connect.

Understanding how environmental exposures impact human health is among the most pressing challenges in environmental health research. Our daily exposures to air pollutants, chemical agents, physical stressors, and more can substantially influence disease risk, health outcomes, and quality of life. Yet, integrating and making sense of complex environmental data remains a critical barrier to progress.

Enter SMARTER (Sensors and Metadata for Analytics and Research in Exposure Health) project, a new effort at the University of Utah aimed at revolutionizing how environmental exposure data is managed, shared, and reused. Funded by the National Institute of Environmental Health Sciences (NIEHS), SMARTER builds on the University of Utah's previous innovations in exposure health informatics, including the Exposure Health Informatics Ecosystem (EHIE), and addresses foundational challenges that limit the reproducibility and impact of environmental health research.

Read the SMARTER feature

NEXUS
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Upcoming Events

Exposome Moonshot Forum

May 12-15, 2025
Washington, D.C

EXPOSOME MOONSHOT FORUM

A multi-stakeholder forum plotting the future of the Human Exposome. The inaugural Exposome Moonshot Forum aims to gather these diverse stakeholders to collaboratively translate the exposome from concept to utility.

Learn more

The Exposome Boot Camp: Measuring Exposures on an Omic Scale

July 17-18, 2025
New York, New York

COLUMBIA | MAILMAN SCHOOL OF PUBLIC HEALTH
The Exposome Boot Camp

A two-day intensive boot camp of seminars and hands-on analytical sessions to provide an overview of concepts, techniques, and data analysis methods used in studies of the exposome. Led by a team of expert scientists in the rapidly growing field of exposomics, the boot camp will integrate seminar lectures with hands-on computer lab sessions to put concepts into practice. Emphasis will be given to leveraging existing resources from ongoing studies and initiating new investigations. The afternoon lab sessions will provide an opportunity to work hands-on with real data. Participants will learn and practice data handling, cleaning, and basic analysis of exposomics data.

2025 Instructors

Training Director: Gary Miller, PhD, Columbia University Mailman School of Public Health
Rima Habre, ScD, USC Keck School of Medicine
Dean Jones, PhD, Emory University School of Medicine
Vrinda Kalia, PhD, Columbia University Mailman School of Public Health
Yunjia Lai, PhD, Columbia University Mailman School of Public Health
Shuzhao Li, PhD, The Jackson Laboratory
Chirag Patel, PhD, Harvard Medical School
Krystal Pollitt, PhD, Yale School of Public Health
Randolph Singh, PhD, Columbia University Mailman School of Public Health
Douglas Walker, PhD, Emory University Rollins School of Public Health

Learn more

NEXUS Community Events

Lipidomics Task Group of the Metabolomics Society Meeting

METABOLOMICS
SOCIETY

June 2, 2025

17:00 UTC (1:00pm EST)

Virtual

Zoom Link

The Lipidomics task group of the Metabolomics Society will hold its next meeting on June 2nd, and is an open event. The theme of the meeting is “Studying the chemical exposome and its impact on lipid metabolism – analytical and biological considerations” During the meeting, NEXUS Chembio Hub co-leads Tom Metz, PhD, Pacific Northwest National Laboratory, and Krystal Pollitt, PhD, Yale University, will be presenting and providing an introduction of NEXUS.

Learn more

The 4th Latin American Congress of Clinical-Laboratory Toxicology (ToxiLatin 2025)

TOXI
LATIN
2025
EXPOSOME:
CHALLENGES BEYOND UTOPIA
JUNE 24 - 27
PORTO ALEGRE - BRAZIL
UFRGS

June 24-27, 2025

Porto Alegre, Brazil

The 4th Latin American Congress of Clinical-Laboratory Toxicology (ToxiLatin 2025) is and is an initiative by the Latin American Association of Environmental, Experimental and Nanomaterials Toxicology (ASTOXILATIN). The theme of this meeting is “Exposome: Challenges Byoond Utopia”, and aims to “ discuss the challenges of studying the exposome at the environmental, occupational and experimental levels. In this context, primary health care emerges as the first care for individuals chronically exposed to toxic agents.”

Learn more

ISES & ISEE Joint Annual Meeting

August 17-20, 2025

Atlanta, Georgia

The annual joint meeting between International Society of Exposure Science and International Society for Environmental Epidemiology is taking place in Atlanta, Georgia this August. The theme of the meeting is “Global Environmental Health Equity across the Lifespan” and NEXUS Collaborator Douglas Walker, PhD, Emory University and NEXUS Chem bio co-lead Krystal Pollitt, PhD, Yale School of Public Health will both be hosting a workshops.

Registration is **Open!** The Early Bird registration deadline is **May 14, 2025.**

Half Day Workshop:

WS09: Wristbands 101: Harnessing Wearable Tech for Personalised Environmental Exposure Assessment

Full Day Workshops:

WS02: High-resolution mass spectrometry workflows to study the exposome

NEXUS-Related Talks:

"Community Wide Perspectives, Methodologies, and Applications in Exposomics: Results from the Network for Exposomics in the U.S. (NEXUS) Center for Exposome Research Coordination Survey"

Learn more

NEXUS in the Scientific Community

Dr. Chirag Patel presents at the Naomi Berrie Diabetes Center at Columbia University Irving Medical Center

Dr. Chirag Patel, Vidhu Thaker, MD, Columbia University Medical Center and Gary Miller, PhD, Columbia University Mailman School of Public Health

April 10, 2025

New York, New York

NEXUS MPI Chirag Patel, PhD, Harvard Medical School, presented at the Naomi Berrie Diabetes Center Conference at Columbia University Irving Medical School, and was hosted by Vidhu Thaker, MD, Columbia University Medical Center. His talk, titled "Studying the Multi-Modal Exposome & Cardiometabolic Phenotypes at Biobank Scale & Introduction to NEXUS: Network of Exposomics in the US," introduced NEXUS and highlighted his research on exposomics in diabetes and obesity.

In the era of precision medicine the exposome is gaining traction as a critical counterpart to genetic research. This talk highlighted the integration of genome, exposome, and phenome data at large biobank scales to better understand complex diseases like diabetes, whose primary risk factor, obesity, has causes that are under debate. While genetic factors explain significant variability in disease risk, environmental exposures (like diet, physical activity, pollutants, and socioeconomic status) substantially influence cardiometabolic outcomes and can be quantified systematically through Exposome-wide association studies (ExWAS). For example, how to shine light on obesity, or insulin resistance, or beta-cell function? Or what nutrients to eat? Or is it energy balance? Exposomics, the hypothesis could shine light on the debate.

Current hypotheses in diabetes management emphasize personalized risk assessment, incorporating both genetic (polygenic risk scores) and environmental (poly-exposure risk scores, or PXS) factors. The talk showed how combining these scores with clinical data can enhance diabetes prediction and potentially improve clinical decisions. However, despite the potential, exposome-related factors alone typically account for a small portion of disease variability, underscoring the complexity of diabetes and the need for integrative models. Future precision medicine efforts might focus on further refining these models through multi-modal approaches, including proteomics and metabolomics, to identify more precise biological mechanisms linking lifestyle exposures to diabetes risk and in interventional programs.

He had the honor of meeting a key figure in obesity genetics, Dr. Rudy Liebel.

6th Annual Canadian Metabolomics Conference

April 24 – 25, 2025

Montreal, Quebec

The 6th Annual Canadian Metabolomics Conference (CanMetCon) was held on April 24–25, 2025 in Montreal, Quebec. The theme of this year's conference was "Clinical Metabolomics" and fostered discussions and networking between researchers, industry experts, and professionals on the most recent trends, research, and innovative developments in metabolomics. NEXUS ChemBio Analytical Sciences Hub co-lead, Tom Metz, PhD, Pacific Northwest National Laboratory (PNNL), presented at the conference, during the "Computational Metabolomics and Machine Learning" session.

Dr. Tom Metz presenting at CanMetCon

Dr. Metz's talk, titled *Integrating Multiple Spectrometries and Computational Predictions of Molecular Properties for Reference-Free Identification*, described recent PNNL-developed capabilities for prediction of experimental observables such as ultra-high precision molecular collision cross sections (CCS), fragmentation spectra, and infrared ion spectra; and new high-resolution, multi-dimensional experimental capabilities, such as Structures for Lossless Ion Manipulations (SLIM) coupled with Orbitrap mass spectrometry (MS), and SLIM coupled with cryogenic infrared ion spectroscopy and time-of-flight MS. He highlighted how these capabilities were recently demonstrated in a use-case of fentanyls. For a chemical space of ~2 billion potential fentanyl analogs, the integrated capabilities provided 2 candidate structures on average per detected fentanyl analog in a blinded challenge sample and identified the correct fentanyl structure in 90% of cases. This use-case provides line of sight for broad utility of reference-free compound identification in metabolomics, exposomics, and related studies.

The American Association for Cancer Research (AACR) 2025 Annual Meeting

April 25- 30, 2025
Chicago, Illinois

The American Association for Cancer Research (AACR) 2025 Annual Meeting was held this year in Chicago, Illinois, drawing together leaders in cancer research from around the world. Spanning six days, the conference featured over 6,000 research abstracts and 250 presentations, highlighting advancements in cancer research. Among the participants was NEXUS collaborator Randolph Singh, PhD, Columbia University Mailman School of Public Health. Dr. Singh presented during the session titled "Interwoven Risks of Exposures and Environments: Mapping the Future of Cancer Prevention," alongside Melissa Davis, PhD, Morehouse School of Medicine, and Tsion Minas, PhD, Johns Hopkins Medicine.

This session explored the intersection of cancer and the human exposome, with presenters sharing the latest developments in prevention science, multi-omic approaches, geospatial analytics, and epidemiological modeling to better understand the complex web of environmental exposures driving cancer disparities.

Dr. Singh's presentation "Leveraging high resolution mass spectrometry based exposomics for decoding the role of chemical exposures in cancer" discusses his work as a collaborator of SAMBAI (Social, Ancestry, Molecular and Biological Analysis of Inequalities). SAMBAI is led by Dr. Melissa Davis and was a 2024 Cancer Grand Challenge awardee. SAMBAI brings together a multidisciplinary team of researchers and institutions across the United States, United Kingdom, and Africa in an effort to "decode the factors that cause and influence disparate cancer outcomes in underserved populations of African descent." NEXUS MPI Gary Miller, PhD, Columbia University Mailman School of Public Health, leads the SAMBAI "Work Package 2" to conduct exposomics analysis using high-resolution mass spectrometry to collect data on thousands of exogenous and endogenous molecules to identify risk factors relevant to these populations.

Exposomics in Focus at PNNL Predictive Phenomics Conference

April 29- May 1, 2025
Richland, Washington

Pacific Northwest National Laboratory (PNNL) hosted the inaugural Predictive Phenomics Conference in April 2025, convening researchers from academia, industry, and national labs to explore how omics, AI, and environmental data can be integrated to predict phenotype. Exposome plays an essential role in predicting phenomes, and several presentations highlighted its growing importance in the predictive phenomics landscape.

Read more

EXACT-PLAN Conference at the Benaroya Research Institute

April 30, 2025
Seattle, Washington

This month, NEXUS MPI and Data Sciences Hub co-lead Chirag Patel, PhD, Harvard Medical School, participated in the EXACT-PLAN Summit. This event was hosted by the Benaroya Research Institute, which has a mission to " advance the science to predict, prevent, reverse and cure diseases of the immune system." Dr. Patel's presentation "Data Science Approaches to Deconvolve Exposome–Phenotype Relationships and Next-Generation Networks for Exposomics in the U.S. (NEXUS)," highlighted how exposomics can enhance understanding of the immune–disease axis.

Read more

We want to feature your exposome-related events on the NEXUS website and social media!

Survey form

Fellowship Opportunity

The International Human Exposome Network (IHEN) is offering 15 fellowships for exposome and health researchers.
The application deadline is **May 15, 2025**

Learn more

Feature Podcasts

As the NEXUS Podcast is being constructed, please enjoy these recent podcasts that feature NEXUS Collaborator Douglas Walker, PhD, Emory University.

Babbage from The Economist

Material world: should you worry about microplastics

HEALTH WANTED

NPR Health Wanted

The Exposome

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National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)
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More information can be found on NIH RePORTER.

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