Understanding the Exposome: What It Is and Why We Must Study It

The core mission driving the new Institute for Exposomic Research at the Icahn School of Medicine at Mount Sinai—the world's first institute devoted to the intensive study of the exposome, or the totality of environmental influences on human health—is to create ground-breaking research that catalogs the complex mix of nutritional, chemical, and social environments and how these shape our health.

“Our society has spent billions of dollars on finding the genetic cause for autism, asthma, obesity and learning disabilities, but we never found the smoking gun gene. That’s because it doesn’t exist,” says Robert Wright, MD, MPH, Professor and Ethel H. Wise Chair of the Department of Environmental Medicine and Public Health and Director of the Institute for Exposomic Research.

“Genes can’t work on 20- to 30-year time scales to explain increasing disease rates. Only environmental factors change in that amount of time. So if these increases are real, only environment can explain them,” he says. “Even for a disease like autism, for which increases in prevalence are controversial, the fact remains that no major genetic cause has been found, even though genetics has been the focus of research for 20 years. We have to re-think how we do research and accept that measuring the environment is a critical piece of the puzzle.”

The National Institutes of Health (NIH) recently launched several major projects to measure the role of the environment on child health using novel methods that rely on advances in laboratory and computational science. The first is the Children’s Health Exposure Analysis Resource, or CHEAR, which is creating a network of laboratories designated to develop new methods to measure exposure to chemicals. Funding for the sweeping project, led by Dr. Wright and Susan

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Teitelbaum, PhD, Research Professor at the Department of Environmental Medicine and Public Health, has been provided to Mount Sinai through $20 million in NIH grants.

Traditional environmental research has so far focused on a relatively small number of chemicals and addressed them one at a time. But almost nothing is known about health effects from the remaining hundreds of thousands of natural and man-made chemicals. To fit the puzzle pieces together, says Dr. Wright, we must embrace a large-scale, systematic approach to environmental science, known as exposomics.

Exposomics is a corollary of genomics, which changed the way genetics research was done by studying the totality of genetic variants instead of focusing on individual genes. In exposomics, huge numbers of exposures are screened at once. Then researchers discover which are the most important, and finally, they test the toxicity of the chemicals that rise to the top of the list. Using exposomics instead of hypothesis-testing methods will lead to breakthroughs in the next decade that would otherwise take hundreds of years, according to Dr. Wright.

“What exposomics represents is the idea that environment is as important as genetics... And unlike your genes, you can change your environment,” says Robert Wright, MD, PhD.

“‘There’s this enormous black box of chemicals that we don’t understand. We focus on such a small subset of chemicals that maybe we’ve actually been doing harm — because we miss the big picture. Whatever is driving the increase in childhood diseases is not these 50 chemicals we repeatedly study, since we have been successful by and large in reducing exposure to them,” says Dr. Wright. “We need to learn from genomics, which didn’t measure one genetic variant at a time. It strove to measure the whole genome. We know environment matters, so let’s prioritize measuring it on the grandest scale possible.”

With the new Institute for Exposomic Research, Mount Sinai, the largest recipient of CHEAR grants in the United States, is uniquely equipped to advance an ambitious environmental “big data” project. The Institute is anchored by Mount Sinai’s world-class data hub and groundbreaking environmental science laboratories, The Senator Frank Lautenberg Environmental Health Sciences Laboratory and the Physiological Assessment of Children’s Environmental Risk Laboratory (PACER). The Institute is dedicated to studying both the ‘internal’ and ‘external’ exposome, meaning discovering environmental biomarkers inside the human body and also measuring environment factors that can’t be assessed in blood, such as noise, climate change and green space. For example, Mount Sinai is leading multiple ongoing studies that mine satellite data in a new way that can map air pollution and temperature gradients to a finer pixilation than ever before achieved, going back nearly two decades, and linking that information to health outcomes.

As part of its CHEAR duties, the Institute will also provide lab services to the more than two dozen grantees of another NIH environmental medicine initiative known as Environmental Influences on Child Health Outcomes (ECHO). This initiative supports a large consortium of existing environmental cohorts on children’s health that will be looking for new insights into the environment’s role in children’s health trajectories. Through CHEAR, Mount Sinai will also help support ECHO’s goal of starting the nation’s largest longitudinal study on the effect of the exposome on children. ECHO plans to map individual environmental ecosystems affecting the health of 50,000 children from in utero to early adulthood. While ECHO is a new program, members at the Institute for Exposomic Research have already received two ECHO grants. These two grants were received in 2016 by Dr. Wright and Rosalind Wright, MD, MPH, the Institute’s Co-Director, who is also Horace W. Goldsmith Professor in Children’s Health Research and Dean of Translational Biomedical Research; and by Dr. Teitelbaum and Annemarie Stroustrup, MD, Associate Professor of Pediatrics, of Environmental Medicine and Public Health, and of Obstetrics, Gynecology and Reproductive Science.

The first major research conclusions from CHEAR and ECHO, seven-year initiatives, are expected to be published.
starting late next year, says Dr. Robert Wright, who is also the Director of The Senator Frank R. Lautenberg Environmental Health Sciences Laboratory. Researchers will not just be looking for harmful chemicals compounds but also for chemical groupings that play a buffering role and promote resilience.

“Exposomics is now at the same inflection point genomics was at 15 years ago. The next 15 years will see exposomic advances that match our recent genomic advances. There is a lot of work to be done still. Exposomics still has a lot of new technology and methods to develop, but you can see the energy and excitement in the field,” says Dr. Wright.

“What exposomics represents is the idea that environment is as important as genetics. In my opinion it is far more important. And unlike your genes, you can change your environment. The potential for intervention is much greater for exposomics than it is for genomics.”

Studying Environmental Influences on Child Health Outcomes (ECHO)

Mount Sinai Health System has positioned itself at the center of the largest national study ever established to evaluate environmental impacts on children’s health, known as the Environmental Influences on Child Health Outcomes (ECHO) study, which was launched last year by the National Institutes of Health (NIH).

The chief goal of ECHO is to determine the effect of a child’s early environment (including chemical exposures, nutrition, social stress, and physical stressors) on health, such as adverse birth outcomes, asthma, learning disabilities, autism, and childhood obesity. The ambitious program will harmonize data from dozens of existing studies across the United States to identify key environmental factors contributing to health and development in order to identify resiliency factors and develop preventive measures that may reduce the growing incidence of chronic disorders. The seven-year initiative is preparing to start tracking the impact of environmental factors on some 50,000 children from in utero to early adulthood. The Mount Sinai ECHO program, led by Rosalind Wright, MD, Dean for Translational Biomedical Research at the Icahn School of Medicine at Mount Sinai, is one of the largest ECHO programs in the country, following 4,500 children longitudinally.

“A large body of science tells us that the programming of chronic disease starts in the womb, even though many disorders don’t express themselves until decades later,” says Dr. Wright, who is Co-Director of the Institute for Exposomic Research. “We start to examine effects prenatally because we know that the roots are in pregnancy, where there also may be the greatest potential for prevention.”

ECHO represents a game-changing research model for environmental medicine called exposomics, which shifts the focus away from studying the effects of a single pollutant, such as lead, to the study of mixtures of multiple environmental exposures over time. Exposomics is a new science dedicated to studying the totality of environmental exposures across the lifespan. In order to advance our understanding of these effects, we need larger samples than currently exist, and then must follow them over a long period of time. ECHO is designed to achieve both these goals.

“Humans don't live in a vacuum where we are exposed to one thing at a time,” says Dr. Wright. “While we have a long way to go before we can comprehensively understand the impact of all environmental factors influencing our health across the lifespan, there has been amazing progress in this direction over the last five years. Taking advantage of advances in exciting technologies and computational science, we can already consider hundreds to thousands of environmental factors or chemicals at a time in our state-of-the-art laboratories at Mount Sinai. As we continue to leverage paradigm-shifting technologies and computational tools on the horizon, we are poised to make tremendous contributions to the field of exposomics.”

Computational advances and the development of new analytical methods by Mount Sinai researchers now allow...
scientists to go back in time to take measurements of environmental exposures. Many of the methods developed by researchers at the Institute for Exposomic Research will be leveraged in ECHO, enabling the program to combine and analyze massive amounts of data from multiple studies across the United States.

“For example, enhanced satellite models characterizing air pollution exposures can tell us how much air pollution a person endured at a specific U.S. location on a particular day going back to the year 2000, when satellites providing needed information were launched,” says Dr. Wright. In another significant development, Institute investigators have discovered that they can use teeth shed during childhood to examine what conditions were like for the child inside the womb and during infancy, and what those conditions may mean in terms of future health risk. Working with exposure scientists at the Institute, Mount Sinai autism researchers found that baby teeth are time-stamped with specific patterns of exposure to metals that can shape a child’s health, starting in utero.

But ECHO isn’t just about disease. Researchers are also looking for environmental factors that promote resilience to disease. For example, exercise or a diet high in antioxidants may offer protective effects from an environmental toxin found in drinking water. ECHO analyses will help identify a more optimal balance when it comes to the complex mixtures of environmental factors we are exposed to and how they affect our health. The Institute is already exploring how improving what we eat, how we deal with stress, and teaching better parenting skills can optimize healthy child development, even in the face of toxic chemical exposures or other pollutants, such as air pollution.

The Mount Sinai ECHO team has already played a key role in addressing challenges that arise when trying to combine many studies across a wide geographic area, serving as a model for the greater ECHO program. Last year, the team published its first ECHO-funded paper, after combining results from three air pollution studies that spanned North America, including an ongoing Mount Sinai sample of mothers and their infants. The paper reported that higher levels of air pollution breathed by mothers during pregnancy predicted lower birth weight in infants. Statisticians on the Mount Sinai team developed novel methods to combine these studies even though many parameters were substantially different across study sites. Data were merged in a way to enhance their quality and improve the impact of the findings. Importantly, these methods are now available to the larger ECHO community to facilitate future combined studies.

A second ECHO-funded study at Mount Sinai focuses more specifically on measuring effects of chemical exposures on brain development and behavior in infants who need the neonatal intensive care unit at birth. Mount Sinai has won two annual $9 million grants through ECHO, with an expected five-year extension anticipated in spring 2018, says Dr. Wright. In total, 35 cohorts nationwide currently operate under ECHO grants.

The NIH has also recently recognized Mount Sinai’s demonstrated excellence in medical technological innovation by designating Mount Sinai as a laboratory hub for another major NIH grant, the Children’s Health Exposure Analysis Resource (CHEAR). Biological samples from many of the 35 ECHO cohorts can be sent to Mount Sinai’s CHEAR lab hub for analyses of chemicals, metabolites, hormones, and other environmental factors. The two NIH studies are synergistic and illustrate the prominent role Mount Sinai plays in the new era of big data in environmental health.

“We will be able to answer bigger, more interesting questions because we’ve coupled CHEAR and ECHO,” Dr. Wright says. “We now have the tools and the numbers.”
Using Baby Teeth to Determine How Environmental Factors Increase Risk of Autism

Analysis of baby teeth can show that disruptions to metal metabolism start prenatally in children who are eventually diagnosed with autism spectrum disorder (ASD), according to a groundbreaking study led by researchers at The Senator Frank R. Lautenberg Environmental Health Sciences Laboratory and The Seaver Autism Center for Research and Treatment at Mount Sinai.

The research is now being extended to create a diagnostic approach that could potentially identify ASD as early as six months of age. Currently, most children are diagnosed with ASD after age four. The study, published in June 2017 in Nature Communications, could lead to earlier intervention for those with the disorder, which now affects an estimated 1 in 45 American children, according to the National Health Interview Survey, part of the U.S. Centers for Disease Control and Prevention. In the treatment of autism, early intervention is critical.

The genetic basis for autism has been intensively studied and is widely considered to be just one factor of what causes autism. But specific environmental factors and the stages of life when such exposures may have the biggest impact on the risk of developing autism are poorly understood.

The team, working within The Lautenberg Environmental Health Sciences Laboratory and the Physiological Assessment of Children’s Environmental Risk Laboratory (PACER) at Mount Sinai, developed a new method to reconstruct past metal exposures in teeth by using lasers that detect incremental markings, similar to growth rings on a tree to determine the tree’s growth history.

Baby teeth are “a gift from nature—biological hard drives,” says Manish Arora, PhD, BDS, MPH, the study’s lead author and Director of Exposure Biology at the Lautenberg Laboratory and Edith J. Baerwald Professor of Environmental Medicine and Public Health at the Icahn School of Medicine at Mount Sinai. His team took about 150 measurements from microscopic layers of shed teeth. During fetal and childhood development, a new tooth layer is formed every week or so, leaving an imprint of the micro chemical composition from each unique layer, which provides a chronological record of exposure.

“Now, for the first time, we can consider a cluster of environmental factors that increase risk of ASD,” says Avraham Reichenberg, PhD, Professor of Psychiatry, and Environmental Medicine and Public Health, an author of the study. “Your physician can calculate your risk for having a heart attack in the next five years, but in psychiatry, we do not have such tools.”

Compared with the teeth of their unaffected siblings, teeth of children with ASD had less of the essential nutrients manganese and zinc and more of the toxin lead in utero during the second and third trimesters, as well as during the first three months after birth, the study found. Dr. Arora’s research on metal profiles in teeth, an exemplary study forming part of the Transdisciplinary Center on Health Effects of Early Environmental Exposures at the Icahn School of Medicine, suggests that the prenatal and postnatal periods act as critical windows of exposure when it comes to metals linked to autism.

Mount Sinai researchers, in collaboration with the Karolinska Institute in Sweden, collected teeth from 76 children who were identical or fraternal twins in the United States and in Sweden. Twin pairs included normally developing children and pairs of twins—identical and fraternal—in which one child had autism and the other did not. Identical twins’ genes are the same, but fetal partitioning in the womb can affect metal uptake.

Additional studies are needed to determine whether the discrepancies in the amount of metals are due to simple differences in how much a fetus or child is exposed to these metals, or because of abnormal metabolism of manganese, zinc, and lead.

Upcoming research will focus on assembling a larger sample size to replicate the findings and creating an algorithm to predict ASD risk based on a metals analysis of baby teeth. Dr. Arora and Dr. Reichenberg also plan to test whether newborn hair samples could be an equally reliable way to determine ASD risk.

“We’re not too far away from a point where we can collect babies’ hair soon after birth, or within six months, and identify which children are at a higher risk of autism based on a biochemical test,” says Dr. Arora, who heads the Center for Innovation at the Institute for Exposomic Research. “We can then intervene earlier.”
About The Institute for Exposomic Research

The mission of The Institute for Exposomic Research is to understand how early environmental exposures affect health, disease, and development later in life and to translate findings into new strategies for prevention and treatment. Our approach to exposomics is holistic, encompassing the chemical, nutritional, and social environments and the interrelationships among them.

The Institute for Exposomic Research at the Icahn School of Medicine at Mount Sinai, established in 2017, focuses unique resources, talented scientists, and clinicians and supports collaborations across departments and institutes at Mount Sinai, including: Environmental Medicine and Public Health, Genetics, Genomics, Psychiatry, Pediatrics, and Informatics.

Although an emerging consensus suggests that prevalent complex diseases in humans develop as a result of multiple biologically unique gene–gene, gene–environment, and environment–environment interactions, this conceptual framework is still limited. In fact, the development of disease in humans is far more complex and is not even a three dimensional issue (i.e. involving interactions) but a four dimensional issue (i.e. changes in interaction-related risk over time).

Chronic illnesses—neurodevelopmental/degenerative disorders, asthma, cardiovascular disease, cancer, obesity, and diabetes—are the principal causes of disability and death in the US. The incidence and prevalence of these diseases are increasing and growing evidence indicates that environmental exposures in early life are important causes.

We work both on the external exposome and the internal exposome. We use traditional lab based methods as well as non-traditional methods that employ computer science, geospatial modeling, public data mining, and the use of smartphone-based apps. The growth of systems biology has illustrated the importance of considering multiple risk factors simultaneously and measuring the biological pathways they affect, as well as the limitations of solely taking reductionist approaches to science in a rapidly changing world.

Meet the Directors

Robert O. Wright, MD, MPH, Director of The Institute for Exposomic Research, is a pediatrician, epigeneticist, and environmental epidemiologist at the Icahn School of Medicine at Mount Sinai. He is the Ethel H. Wise Chair of the Department of Environmental Medicine and Public Health, and is the Founder and Director of the Senator Frank R. Lautenberg Health Sciences Laboratory.

Rosalind J. Wright, MD, MPH, Co-Director of The Institute for Exposomic Research, is a pediatrician, pulmonologist, critical care physician, and international leader in life course epidemiology at the Icahn School of Medicine at Mount Sinai. She is the Dean for Translational Biomedical Research, holds the Horace W. Goldsmith Professorship in Children’s Health Research, and is Professor of Pediatrics at Kravis Children’s Hospital.
Save the Date

New York City Exposome Symposium

Join us for the New York City Exposome Symposium, hosted by the Department of Environmental Medicine and Public Health at the Icahn School of Medicine at Mount Sinai. This symposium is designed to be an introduction to exposomics, the study of how the complex mix of nutritional, chemical, and social environments shape human health throughout the lifespan. Learn about the use of old and new methods in the field and an illustration of the challenges. This symposium will be of interest both to researchers new to the field and to those who are already practicing exposomics.

The Institute for Exposomic Research
Collaborating Centers and Institutes

Transdisciplinary Center on Health Effects of Early Environmental Exposures (TCEEE)
Children’s Health Exposure Analysis Resource (CHEAR)
Environmental Influences on Child Health Outcomes (ECHO)
The Children’s Environmental Health Center (CEHC)
The Pediatric Environmental Health Clinic (PEHC)

Partnering Laboratories

The Senator Frank Lautenberg Environmental Health Sciences Laboratory
Physical Assessment of Children’s Environmental Risk Laboratory (PACER)
Global warming researchers at The Institute for Exposomic Research at the Icahn School of Medicine at Mount Sinai are mining NASA satellite imagery to reconstruct temperatures from years ago in an effort to limit the potential harm that an increase in extreme weather could cause to public health.

At the forefront of the cutting-edge research is Allan Just, PhD, an environmental epidemiologist and Assistant Professor in the Department of Environmental Medicine and Public Health at the Icahn School of Medicine. He is able to reconstruct outdoor temperatures at a resolution of one kilometer by one kilometer going back to the year 2000.

“Climate change is already happening, and some of the impacts are unavoidable,” says Dr. Just. “It is part of our responsibility as public health practitioners to figure out how we can better understand the health impacts and adapt.”

Research has already established that heat waves cause death through physiologic stress and dehydration, and that cold weather also triggers stress. But Dr. Just is among the first researchers in the world to undertake studies that take a nuanced, individualized look at the link between weather and health. By merging New York state hospitalization data from 2000-2016 with hour-by-hour temperature conditions at patient home addresses prior to hospitalization, he and two collaborators—Itai Kloog at Ben-Gurion University of the Negev in Israel and Marianthi-Anna Kioumourtzoglou at Columbia University—expect to create an individualized portrait for more than two million heart attack patients, and to study the dynamics of temperature variability and health effects.

“People have looked at the range of temperatures over a day and adverse health outcomes. But one of our goals is to look at the relationship between the temperature where you live, how that fluctuates within a day during extreme weather events, and how that drives cardiovascular disease risk. We wanted to take something that's prevalent and common,” says Dr. Just.

Prior to satellite modeling, temperature studies relied on weather station data, which tended to be available in limited areas in cities, measuring, for example, only neighborhoods close to an airport. Dr. Just’s methodology opens the door to answering more specific, complex questions about weather effects.

“Now we can do studies that include suburban and rural populations, as well as more nuanced studies about urban areas,” says Dr. Just. “We know that in urban areas, there’s a ‘heat island effect’ because of the spectral qualities of asphalt and other materials. Now we can reconstruct that and start to ask questions about links to health.”

Dr. Just is also interested in discovering whether a heat wave came on suddenly or slowly, and if that difference was reflected in local health outcomes. Ultimately, Dr. Just hopes his research can be used to offer early warnings to the people most susceptible to extreme weather and get them help.

Dr. Just has also used the satellite data to recreate air pollution conditions at the same resolution as weather, one kilometer by one kilometer. Other past research has focused on obesity, children’s growth, metabolic disorders, fetal early growth, respiratory health, and airway inflammation.

Studies increasingly show a host of negative health effects from air pollution that include not just toxicity to the lungs but also negative neurodevelopmental outcomes such as cognitive decline and Alzheimer’s disease. A PhD student working with Dr. Just has submitted a paper using Dr. Just’s data that links air pollution in Mexico City to the number of residents who die on a given day from a heart attack or stroke.

Dr. Just plans to start work on a study that uses large population registries in the continental United States to combine temperature variability, air pollution, roadway congestion, and ‘greenness’—or the presence of green spaces and trees, which help absorb some of the harmful toxins in air pollution—and merge them with birth outcomes.

Dr. Just’s methodology offers a unique competitive advantage compared with other environment researchers who are also using satellite data to reconstruct temperature and air pollution histories, because of his access to laboratories that The Institute for Exposomic Research is built upon. The Senator Frank Lautenberg Environmental Health Sciences Laboratory and the Physiological Assessment of Children’s Environmental Risk Laboratory (PACER) provide crucial tools that Dr. Just and his colleagues are leveraging, including new machine learning approaches that enable the capturing of measurement variation in time and space. Dr. Just also has a close collaboration with the NASA scientists who generate the measurements from space that become inputs to his models in Mexico, the United States, and elsewhere.

“We're just getting started,” says Dr. Just. “We have several years of publications demonstrating these models can work. Now we're getting into more careful characterizations and starting to measure more specific components of weather that may affect public health. We are now determining whether those components of weather now influenced by climate change are drivers of risk. That's going to enable a lot of cool epidemiological work and ultimately influence public health.”
**NIEHS K99 Grant Awardees**

Four distinguished postdoctoral fellows in the Department of Environmental Medicine and Public Health at the Icahn School of Medicine at Mount Sinai have won career transition grants from the National Institutes of Health (NIH).

In September 2017, the National Institute of Environmental Health Sciences, through the NIH, awarded four of its prestigious K99/R00 awards to postdoctoral researchers at the Icahn School of Medicine at Mount Sinai. The objective of the “NIH Pathway to Independence Award” is to help outstanding researchers complete needed training in order to help them transition to an independent tenure-track or equivalent faculty position.

**Dr. Christine Austin, PhD,** won a career development grant from the Eunice Kennedy Shriver National Institute of Child Health and Human Development within the NIH. She is studying how breast milk and infant formula affect children’s lifelong health trajectories. By identifying a biomarker in baby teeth, she expects to be able to objectively quantify the dose and composition of breast milk and infant formula, and their duration of exposure. Infant and childhood diets are major determinants of lifelong health trajectories, but these diets are difficult to study because it is difficult to recreate accurate breastfeeding histories. Dietary markers circulating in the blood are incorporated in teeth as they grow. Dr. Austin seeks to spatially map biomarkers in naturally shed teeth against the daily growth lines that form in teeth, much like rings in a tree, to reconstruct a timeline of these dietary markers. By measuring multiple elements and applying novel statistical methods that consider mixtures and temporal data, she expects to identify a suite of elements that can reconstruct the dose of breast milk or infant formula throughout infancy at a weekly resolution. The biomarker will then be used to investigate the association of breast milk dose with neurodevelopment. “This work could only be done at the Icahn School of Medicine, where I have access to a state-of-the-art laboratory to undertake the tooth analysis, an established cohort where teeth and all other required measures are already collected, and leading experts in mixtures and temporal analysis as well as tooth development and histology,” says Dr. Austin.

**Dr. Maria Rosa, DrPH,** is studying the link between in utero and early-life exposure to ambient air pollution and stress, and children’s respiratory health. One of her main goals is to identify potential critical windows of susceptibility during development to these environmental factors, as well as the joint effects of air pollution and stress, in order to pinpoint vulnerable individuals and help prevent respiratory illnesses in childhood. As part of her research, Dr. Rosa plans to take an interdisciplinary approach to advance her field, by integrating existing studies on stress, air pollution, and molecular epidemiology. Dr. Rosa aims to identify biomarkers of early biological effects of exposures to stress and air pollution that might elucidate the mechanisms through which these exposures lead to subsequent disease. Scientific research has already linked ambient air pollution and stress to asthma and lung development. But few studies have focused on the role of exposure timing starting in utero and incorporating biomarkers of these pro-oxidant exposures. Dr. Rosa plans to use data from an existing Mexico City-based study, Programming Research in Obesity, Growth, Environment and Social Stressors (PROGRESS), led by Robert Wright, MD, MPH, Ethel H. Wise Professor and Chair of the Department of Environmental Medicine and Public Health and Director of the Institute for Exposomic Research. “Mount Sinai has provided me solid mentorship and resources, including vast grant writing experience, that have been crucial to my becoming an independent researcher. I’ve taken the lead on respiratory health in a world-class study, PROGRESS, which is unique in Latin America in terms of longitudinal birth cohorts,” says Dr. Rosa.
Dr. Jeanette Stingone, PhD, MPH, is an environmental epidemiologist whose goal is to leverage advanced data science techniques to address the critical research question of how prenatal and early-life exposure to air toxins can affect children’s cognitive health. Her grant focuses on developing analytic approaches that rely on advanced biostatistics to supplement epidemiologic methods to uncover associations between air pollution and neurodevelopment. With guidance from multidisciplinary advisors, she is applying “big data” algorithms to administrative records for more than 200,000 children born and/or living in New York City from 1994 to 1998 to investigate the relationship between prenatal exposure to multiple air toxics and academic outcomes in third grade. Epidemiologic studies have shown that prenatal and early-life exposures to ambient air pollutants are associated with multiple measures of cognitive health in infants and young children. But traditional studies have mostly investigated pollutants individually, failing to consider the impact from multiple exposures and the combined impacts of multiple pollutants. Dr. Stingone is ultimately looking to reveal combinations of air pollutants that represent the “bad actors” within high-dimensional exposure data in order to improve risk assessment and identify targets for intervention. Dr. Stingone has a strong interest in environmental justice. She is working to help inform affected communities, government regulators, and other stakeholders to help them understand the research results. “The Icahn School of Medicine provides an institutional environment that is uniquely suited for my research because of its success and strong leadership in the fields of children’s environmental health and big data analytics. Access to experienced mentors, computational resources, and a supportive training environment within the Department have prepared me well to be an independent investigator and conduct novel research on the pediatric health effects of air pollution,” says Dr. Stingone.

Dr. Allison Sanders, PhD, is an environmental epidemiologist studying the link between children’s exposures to toxic metals in utero and the development of kidney problems, such as high blood pressure, later in childhood. Current research has established that the trajectory for later-life hypertension is identifiable as early as age seven. In November 2017, Dr. Sanders presented preliminary findings at the American Society of Nephrology that found that prenatal lead exposure was associated with higher blood pressure at age four, and that children born prematurely may be more susceptible. The study was based in Mexico, where women can be exposed to lead through ingestion or inhalation via lead-glazed pottery, leaded gasoline, or pipes for drinking water, as well as some cosmetics or home remedies. She is working with the National Institute of Public Health in Mexico to address the long-term public health challenge of characterizing the adverse effects of childhood lead exposure and sharing the findings with the public in accessible ways. Dr. Sanders is also engaged in ongoing toxicological research in conjunction with the Pittsburgh Center for Kidney Research that aims to uncover the mechanisms by which lead may cause renal dysfunction. Dr. Sanders is studying the effects of metals in kidney cells and organoids—miniaturized organs, grown from stem cells—supported by a grant from the Burroughs Wellcome Fund, a private, independent biomedical research foundation. “Mount Sinai has enabled me to create a unique research niche in pediatric environmental nephrotoxicology,” she says. Dr. Sanders cites access to cutting-edge molecular epidemiology tools and internationally recognized collaborators, as well as strong joint support from the Department of Pediatrics and the Department of Environmental Medicine and Public Health, as key contributors to her success.
New Members

Two new faculty members joined the Department of Environmental Medicine and Public Health at the Icahn School of Medicine at Mount Sinai in the fall of 2017.

Elena Colicino, PhD brings extensive training in environmental epidemiology and epigenetics to her role as Assistant Professor of Biostatistics. Since joining the Department in September 2017, Dr. Colicino has been working on the development of new statistical methodologies capable of analyzing mixtures of environmental exposures across large data sets and assessing their effects on health risk throughout the life course. Her goal is to overcome limitations of current models, which often test just one environmental exposure at a time and are incapable of determining combined effects of these exposures.

“I feel extremely privileged to collaboratively work at The Institute for Exposomic Research, the world’s first institute to focus on exposomics at large and to facilitate the study of multiple environmental exposures and their effects on health risk and disease development,” says Dr. Colicino, who holds a PhD in statistics from Bocconi University in Milan. “Our efforts will lead to successful strategies for better understanding the underlying causes of diseases and aid in the development of disease prevention and treatment.”

Megan Niedzwiecki, PhD is an environmental epidemiologist with research interests in metabolomics, the nutritional modulation of environmental exposures, and the health effects of metal exposures. She graduated with a PhD in Environmental Health Sciences from Columbia University in 2014, where she studied the influence of one-carbon metabolism, a B-vitamin-dependent pathway, on susceptibility to arsenic toxicity in Bangladesh. She completed postdoctoral fellowships with the Department in 2015, where she developed imaging tools to study metal mixtures in the placenta, and with the HERCULES Exposome Research Center at Emory University in 2017, where she gained expertise in the analysis of high-resolution untargeted metabolomics data. Currently, her work focuses on the integration of metabolomics with other approaches to better understand the human exposome, a concept encompassing complex environmental exposures and biological responses throughout the life course. She is interested in understanding why certain individuals are adversely affected by environmental exposures while other people are not. Another goal is to identify new metabolomic biomarkers to help predict disease.

“One thing that I wanted to focus on the exposome concept in my research. Mount Sinai seemed like a perfect fit. I wanted to start my career in a place that embraced the exposome concept because it’s a new field and Mount Sinai is at the forefront of this research. Most researchers here have already been thinking about the exposome before it was formalized into a field of study,” says Dr. Niedzwiecki.

Learn more about our new clinic: The Pediatric Environmental Health Clinic (PEHC)

The Pediatric Environmental Health Clinic’s mission is to improve the lives of children by providing outpatient medical care to patients to reduce harmful environmental exposures. Our physicians specialize in environmental pediatrics, and address a range of issues including environmental asthma triggers, lead, mold, and pesticide exposure. The clinical team will also focus on providing guidance and support to reduce environmental exposures and connecting families to community resources. Our clinic will be offering telemedicine consultations to make it easy for our physicians to work with families to identify and address home environmental hazards in real-time using video communication technology.
Faculty Members

Leadership
Robert O. Wright, MD, MPH; Director
Rosalind J. Wright, MD, MPH; Co-Director

Department of Environmental Medicine and Public Health
Chitra Amarasiriwardena, PhD
Syam S. Andra, PhD
Manish Arora, BDS, MPH, PhD, FICD
Michael Aschner, PhD
Christine Austin, PhD
Ghalib Bello, PhD
Jia Chen, ScD
Luz Claudio, PhD
Elena Colicino, PhD
Paul Curtin, PhD
Sarah Evans, PhD, MPH
Maida P. Galvez, MD, MPH
Chris Gennings, PhD
Homero Harari, ScD, MSc
Megan K. Horton, PhD, MPH
Hsiao-Hsien Leon Hsu, ScD
Allan Just, PhD
Itai Kloog, PhD
Philip J. Landrigan, MD, MSc
Ruth Loos, PhD
Robert Luccini, MD
Megan Niedzwiecki, PhD
Lauren Petrick, PhD
Maria Rosa, DrPH
Allison Sanders, PhD
Perry E. Sheffield, MD, MPH
Lauren Petrick, PhD
Shanna H. Swan, PhD
Susan Teitelbaum, PhD
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