

**DEPARTMENT OF HEALTH AND HUMAN SERVICES
NATIONAL INSTITUTES OF HEALTH
NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES**

**MINUTES OF THE ONE HUNDRED SIXTY-THIRD MEETING OF THE
NATIONAL ADVISORY ENVIRONMENTAL HEALTH SCIENCES COUNCIL**

June 1-2, 2021

The National Advisory Environmental Health Sciences Council convened the open session of its one hundred sixty-third regular meeting on June 1 and 2, 2021 as a Zoom virtual meeting. The closed session of the meeting was held earlier in the day June 1.

The meeting was open to the public on June 1, 2021 from 12:00 p.m. to 4:30 p.m. and on June 2, 2021 from 11:00 a.m. to 2:45 p.m. In accordance with the provisions set forth in Section 552b(c)(4) and 552b(c)(6), Title 5, U.S. Code and Section 10(d) of the Federal Advisory Committee Act, as amended (5 U.S.C. Appendix 2), the meeting was closed to the public on June 1, 2021 from 11:00 a.m. to 11:45 a.m. for consideration of grant applications. Notice of the meeting was published in the *Federal Register*. Dr. Rick Woychik presided as Chair.

Participating Council Members

William Cibulas, Jr., PhD (*ex officio*)
Suzanne Fitzpatrick, PhD (*ex officio*)
Andrew Geller, PhD (*ex officio*)
Lynn Goldman, MD, MPH
Irva Hertz-Picciotto, PhD
Terrance Kavanagh, PhD
Katrina Korfmacher, PhD
Edith Parker, DrPH
Trevor Penning, PhD
Marla Pérez-Lugo, PhD
Brad Racette, MD
Robyn Tanguay, PhD
Karen Vasquez, PhD
Jalonne White-Newsome, PhD
Robert Wright, MD, MPH

NIEHS Staff

Kathy Ahlmark
Janice Allen, PhD

Sara Amolegbe
David Balshaw, PhD
Martha Barnes
Linda Bass, PhD
Sharon Beard
L. Michelle Bennett, PhD
Brian Berridge, DVM, PhD
Abee Boyles, PhD
Danielle Carlin, PhD
Toccaro Chamberlain
Jennifer Collins
Gwen Collman, PhD
Yuxia Cui, PhD
Mary V. Diaz Santana, PhD
Christie Drew, PhD
Chris Duncan, PhD
Anika Dzierlenga
Lisa Edwards
Gary Ellison, PhD, MPH
Benny Encarnacion
Nidhi Gera, PhD
Kimberly Gray, PhD
Jenny Greer
Arshya Gurbani
Janet Hall, MD, MS
Astrid Haugen
Michelle Heacock, PhD
Heather Henry, PhD
Jon Hollander, PhD
Mike Humble, PhD
Patricia Jensen, PhD
Bonnie Joubert, PhD
Helena Kennedy
Heather Knox
Alfonso Latoni, PhD
Cindy Lawler, PhD
Chris Long
Lindsey Martin, PhD
John Maruca
Jacqui Marzec
J. Patrick Mastin, PhD
Kim McAllister
Liz McNair
Parris Milly
Nathan Mitchiner
Rosemary Moody

Srikanth Nadadur, PhD
Liam O'Fallon
Kristi Pettibone, PhD
Nicole Popovich
Alicia Ramsaran
Lingamanaidu Ravichandran, PhD
Scott Redman
Les Reinlib, PhD
Jim Remington
Carol Shreffler, PhD
Thad Schug, PhD
Dan Shaughnessy, PhD
Varsha Shukla, PhD
Melissa Smarr, PhD
Spencer Smith
Bill Suk, PhD, MPH
Laura Thomas, PhD
Claudia Thompson, PhD
Brittany Trottier
Steven Tuyishime, PhD
Fred Tyson, PhD
Mitch Williams
Leroy Worth, PhD
Rick Woychik, PhD
Demia Wright, MPH
Darryl Zeldin, MD

Members of the Public Present

Carol Blaisdell, MD, NIH
José Cordero, MD, MPH, University of Georgia (former Council member)
George Daston, PhD, Proctor & Gamble
Matthew Gillman, MD, NIH
Ernie Hood, Bridport Services, LLC
David Jett, PhD, NINDS
Walter Koroshetz, MD, NINDS
Susan Laessig, PhD, NIH
Erin Leutkemeier, PhD, NIH
Gary Miller, PhD, Columbia University
Andy Shih, PhD, Autism Speaks (former Council member)
Alex Tuttle, PhD, NINDS

I. Call To Order and Opening Remarks

NIEHS and NTP Director Rick Woychik, Ph.D., welcomed attendees and called the meeting to order. He asked Council members in the Zoom call to introduce themselves. Acting DERT Director Gary Ellison, Ph.D., went over some of the logistics for the meeting, including the conflict of interest statement.

II. Consideration of February 2021 Meeting Minutes

Approval of the February 2021 meeting minutes was moved and seconded, and Council voted to approve the minutes, with all in favor.

III. Report of the Director, NIEHS

Dr. Woychik briefed Council on Institute developments since the February 2021 Council meeting.

He began his report with an update on budgetary matters. Looking at the FY2022 President's budget request, he noted a proposed increase in funding for both NIH and NIEHS. The NIH request is \$52 billion, an increase of \$9 billion from the FY2021 level. A large percentage, \$6.5 billion, is for a new programmatic area called ARPA-H, Advanced Research Projects for Health, which is modeled on DARPA (the military's Defense Advanced Research Projects Agency). The new NIH agency would speed development of medical treatments, to fund innovative, transformational, breakthrough research. For NIEHS, the President is proposing a \$937.1 million budget, which is \$122.4 million above the FY2021 enacted level. The increase includes \$100 million to support research on the human health impacts of climate change. Congress still needs to weigh in on the budget requests.

Working from the three themes contained in the NIEHS 2018-2023 Strategic Plan, Dr. Woychik described several recent accomplishments and developments. He mentioned several science advances, publications from DIR, DNTP, DERT, and One NIEHS. He provided several examples of data to knowledge to action, including the impacts of Executive Orders on COVID-19 and climate change. He described the priorities for NIH-wide research on climate, environment, and health:

- Building the research workforce
- Developing state of the art data infrastructure
- Building healthy, resilient communities by supporting sustained research partnerships with disadvantaged communities
- Building rapid disaster research response capacity
- Supporting innovative discovery and solutions-based research

The third theme is Enhancing EHS through Stewardship and Support, and Dr. Woychik illustrated several recent examples.

He discussed the UNITE Committees, which are intended to help end structural racism at NIH.

- Committee U: To perform a broad, systematic self-evaluation to delineate elements that perpetuate structural racism and lead to a lack of diversity, equity, and inclusion within the NIH and the external scientific community.
- Committee N: To address long-standing health disparities and issues related to minority health inequities in the United States by ensuring NIH-wide transparency, accountability, and sustainability in marshaling resources for health disparity, minority health, and health equity research.
- Committee I: To change the NIH organizational culture and structure to promote diversity, equity, and inclusion throughout the NIH workforce.
- Committee T: To ensure transparency, accountability, and sustainability of all UNITE efforts amongst internal and external stakeholders. Coordinate NIH-wide efforts and communicate findings from other UNITE committees to internal and external stakeholders, and the public.
- Committee E: To perform a broad systematic evaluation of NIH extramural policies and processes to identify and change practices and structures that perpetuate a lack of inclusivity and diversity within the extramural research ecosystem.

He described several specific actions that will be taken to end structural racism at NIH. He also discussed the NAEHSC Diversity, Equity, and Inclusion Working Group, where Chair Council member Karen Vasquez is making progress recruiting members.

Dr. Woychik presented several instances of awards and recognitions received by NIEHS personnel and grantees. He concluded his presentation with a remembrance of Dr. Samuel Wilson, the Senior Investigator, former Deputy Director of NIEHS and NTP, and former Acting Director of NIEHS and NTP, who passed away in April 2021.

Dr. Ellison moderated a question and answer session following Dr. Woychik's remarks.

Dr. Wright asked about the possibility of public-private partnerships with organizations such as Google or Apple. Dr. Woychik replied that he is a strong supporter of public-private partnerships. He added that they can be structured in ways that can benefit the entire EHS community. He mentioned several NIEHS people who would be appropriate to contact with suggestions.

Dr. White-Newsome said she hoped that the EPA Environmental Justice screen will be part of the climate, environment, and health effort. Dr. Woychik said he advocates getting beyond siloes and working collaboratively together, and that he is committed to putting together the types of data repositories from which all can benefit. Dr. White-Newsome referred next to Dr. Woychik's slide on research partnerships in disadvantaged communities. She asked what the process would be like to determine priorities, and whether there would be external input to the process. Dr. Woychik said he is committed to listening to external stakeholders and community groups. He asked Dr. Collman to comment. She said that NIEHS is just at the beginning of developing a strategy, having engaged with more than 90 people across NIH. Part of the plan will be to request information to be able to better understand both academic needs and community needs as a series of programs is developed for a research and intervention agenda in the climate change and health effort.

Dr. Ellison referred to several comments about the section of Dr. Woychik's talk discussing NIEHS employees assisting with reuniting families at the U.S.-Mexico border. One asked about how the extramural community might be able to help out with the effort. Deputy Executive Officer Mitch Williams replied that the program is limited to Federal employees only.

IV. The Exposome: Integrating the Environment into Multiomic Research at NIH

Dr. Ellison introduced Dr. Gary Miller, Vice Dean for Research Strategy and Innovation and Professor of Environmental Health Sciences at the Mailman School of Public Health, Columbia University.

Dr. Miller described the exposome, a term coined by Christopher Wild in 2005. He shared several potential definitions, including "the cumulative measure of environmental influences and corresponding biological responses throughout the lifespan." He discussed the scientific developments related to the exposome in recent years, as well as developments in exposome education, dissemination, and training efforts.

He provided several examples of research regarding the exposome, and delineated national and international efforts. Looking forward, he recommended a two-pronged approach:

- First, we optimize methods for measuring as many chemicals/molecules as possible in biobanked samples. Increased throughput and reliability, decreased cost.
- Second, we collect geospatial-related data that can be tied to a person's location (where they live, where they work, movements throughout the day).

He suggested approaching the issue as “the pragmatic exposome,” setting aside the view of the exposome as the totality of exposures and focusing on the practical. The pragmatic exposome, he said, will use the cutting-edge high-resolution mass spectrometry on biobanked samples from existing, ongoing studies, leverage geospatial data at the individual and population data, and help restore balance to the gene x environment equation.

Dr. Wright asked Dr. Miller what he thinks should be done at a foundational level, such as an exposome atlas. Dr. Miller said he would love to have a reference exposome, which would include data collected from a very large, very diverse population. It would help establish a range and narrow the focus of the efforts. Dr. Wright observed that that type of initiative is being conducted by NHANES. Dr. Miller agreed and noted that it will take an institute-level collaboration to gather the required number of samples.

Dr. Kavanagh referred to the concept of precision environmental health. He noted that you could take some of the exposomics analyses to make predictions about interventions. He asked when such efforts could be called a success. Dr. Miller said it would be a tall order to achieve that level of success. He alluded to pharmacogenomics and added that the exposome is actually more influential than the genome. The thinking is to be able to predict the best treatment in an individual based on their exposomic profile. It requires “big numbers” to be able to make those types of predictions, which can happen once the larger projects have been completed.

Dr. Goldman said she has long been frustrated by the relative lack of interest and lack of investment in the U.S. in this area. She felt that research needs to go beyond sequencing. She noted that NHANES samples were not created to be representative of the exposome, that NHANES is extremely underfunded and does not have environmental health as its core mission. She said she hopes that Dr. Miller’s efforts with the European community and others can help stimulate interest at NIH in a much bigger effort related to the exposome. She endorsed Dr. Miller’s definition of the exposome, in terms of defining it very broadly. She agreed that psychosocial factors will affect how people respond to environmental and pharmacological agents.

Dr. Vasquez noted that in her field of cancer research, single cell work is prevalent. She asked how that field could be tied together with the large exposomic studies being proposed by Dr. Miller. He replied that the answer is working at both a macro and a micro level, such as using mass spectrometry to look at both the direct tumor environment and at the plasma.

Dr. Geller asked Dr. Miller to address how exposomics might speak to the regulatory side. Dr. Miller said it is a complex systems problem, requiring a network science

approach. He noted that it will be important to recruit the next generation of EHS scientists who will understand network science.

V. The Neural Exposome

National Institute of Neurological Disorders and Stroke (NINDS) Director Dr. Walter Koroshetz described a concept called the neural exposome, which seeks to characterize how the brain functions in the body.

He provided an overview of NINDS and its mission to seek fundamental knowledge about the brain and nervous system and to use that knowledge to reduce the burden of neurological disease.

He detailed the neural exposome, how the brain senses the environment and how the environment influences nervous system health from early development through aging. The various interfaces between the nervous system and the blood are one example, along with the direct interfaces between the nervous system and the environment. Dr. Koroshetz cited several examples from Parkinson's Disease and Alzheimer's Disease.

He discussed the BRAIN Initiative: Brain Research through Advancing Innovative Neurotechnology's, which has been in progress since 2014. It is a partnership between five federal agencies and private foundations, with the mission to revolutionize our understanding of the human brain by accelerating development and application of innovative technologies. He provided several examples of innovations stemming from the BRAIN Initiative.

He indicated that NINDS has made some initial investments in neural exposome research, and is anxious for collaborations moving forward, particularly with NIEHS. He described the need for interdisciplinary, well-integrated team science in the area.

In summary, Dr. Koroshetz noted:

- NINDS mission is to reduce the burden of neurological disease.
- The Neural Exposome is an important factor in complex disease etiologies.
- NINDS had begun to incorporate research on the Neural Exposome into its portfolio.
- Advances will require more collaboration with NIEHS and other ICs.
- Opportunities exist in leveraging existing human and basic research programs at NIH.

Dr. Wright asked what kind of work is being done around the neural exposome in children, as well as early life environment and later life disease. Dr. Koroshetz said that much of the current effort is in longitudinal study of babies. He noted that it is important

to have good data and longer-term follow-up. Dr. Wright cited interesting work being done in teeth.

Dr. Gary Miller asked Dr. Koroshetz how far you must drill down in looking at susceptibility to Parkinson's and other neurodegenerative disorders. He wondered whether systems-level information is enough to help understand vulnerability without the need for single cell work. Dr. Koroshetz said that many of the neurological disorders have a pathology, so the need is to nail down how the drivers give rise to the known pathologies, although that can be quite difficult. He cited examples where strong epidemiological evidence was not borne out in clinical trials.

Dr. Hertz-Picciotto said she had spent the last 20 years working on autism and environmental factors. She said that one of the interesting developments in the field has been increased understanding of the role of maternal immune activation in neurodevelopmental disorders. She felt that NIEHS has been "extremely supportive" in a field where funding has been challenging, but there are many potential opportunities for a linkage between NIEHS and NINDS. Regarding the immune function, he noted that it has become clear in recent years that microglial cells are involved in the innate immune system in the brain. Brain pattern development has some genetic component, but much of it is based on interactions between the different cell types, he observed. He noted that the immune system seems to be of considerable importance in autism. Dr. Hertz-Picciotto said that the environmental component in inflammation currently has much evidence, as well as epigenetics.

Dr. Penning said he was pleased that Dr. Koroshetz and Dr. Woychik were able to come up with good ideas about how to move the field forward. He raised the issue of air pollution exposure through the olfactory bulb and how it may relate to neurodegenerative disease. Dr. Koroshetz noted that drug companies are increasingly looking at the nose for drug delivery. The olfactory system is recognized as an entry zone to the brain for any kind of toxin and is implicated in Parkinson's and Alzheimer's. He said there is good evidence that air pollution influences risk of dementia on a population level. Dr. Penning agreed that it is all part of the neural inflammation story.

Noting the preponderance of autism in boys versus girls, he wondered if imprinted genes might be part of the answer. Dr. Koroshetz said it was his understanding that the immune response in the brain triggered a genetic load that would cause autism in boys is not present in girls. Although the underlying principles are unknown, he added that in research in stroke, multiple sclerosis and other disorders, there is a dramatic difference in immune response in women versus men.

VI. Council Discussion

NIEHS Acting Chief Innovation Officer Dr .L. Michelle Bennett moderated the Council's discussion, the purpose of which is to explore and initiate conversations with the EHS community on the exposome and how the power of environmental exposure research can be shared more effectively and convincingly. She listed several questions for discussion by the Council.

Dr. Kavanagh wished to consider the role of study sections in funding unconventional cross-disciplinary research. He wondered if the institutes have in mind RFAs with Special Emphasis Panels that might bridge the funding gap. Dr. Koroshetz said his philosophy is to try not to be "top-down" as much as possible and to rely on people to submit grants. It is also important to identify gap areas, where a top-down approach may be necessary. He felt that the best thing is for the science to drive the research. Dr. Woychik said that the desire is to achieve more cross-disciplinary, collaborative research. If the current mechanisms do not allow that, then the IC directors need to identify other efforts, keeping focused on the type of science that is needed.

Dr. Penning returned to the concept of tools versus research. He noted that not all of the sophisticated tools are available to all institutions. He alluded to HHEAR, the Human Health Exposure Analysis Resource, and wondered whether such a structure might be appropriate in terms of exposome research. He noted that the price tag for such research is often quite high and wondered whether such research could be achieved using cheaper methods, such as using biosensors and GIS information to capture individual exposures. He felt that it would be important to start comparing different approaches to capturing exposomic data to help improve public health.

Dr. Hertz-Picciotto said that much work is already being done with biosensors and personal monitoring that is making links between corresponding biological responses and the exposome. She described an example at UC Davis using a breath sampler. She noted that one of the challenges associated with the wildfires in the West is characterizing the exposures people are experiencing. It requires longitudinal, real time measurements that are spatially referenced, while being able to link them to biological markers and health outcomes. "The technology is here, and obviously needs much more development to make everything scalable and cheap enough," she added.

Dr. Kavanagh asked Dr. Miller to comment on integrating the metabolomics technology with single cell transcriptomics or epigenomics. Dr. Miller said his thinking has been more along the lines of simple models such as *C. elegans*. He added that technologically, it is feasible to consider use of human samples, but it is not something he has attempted yet.

Dr. Wright observed that much foundational work remains to be done in exposomics, particularly in bioinformatics. Dr. Woychik agreed and said that what is needed by the

broad-based biomedical community is to come up with a plan for the field and a framework, a vision for what needs to be collected. With that, there may be an opportunity to go to the Common Fund for the necessary support. Dr. Koroshetz agreed and observed that the right answers will emerge as the field progresses. He said it has not been a rational, logical procession, but more a process of serendipity. He noted that in terms of the exposome, at some level it will be necessary to define what part of it to pursue. For the neurological diseases, there will be a need to look for large effect sizes in smaller groups of people. Dr. Woychik added that there may be epigenetic signatures relevant to different types of exposures. Dr. Koroshetz said it would be possible to work backwards from patients, looking to see whether certain environmental exposures might drive such signatures.

Dr. White-Newsome said she had been working with communities dealing with flooding, and the health effects related to mold. She expressed concern about cumulative health effects. She wondered if there could be a tool developed that could help with everyday disasters such as flooding, and whether the exposome concept could be used to help define levels of exposure where people can return to their homes. Dr. Miller said that it will be necessary to determine a reference exposome. Having that information, it will be possible to look for deviations. He said a discovery-focused, untargeted approach would be necessary. "One of the challenges is that if you're looking under the streetlamp, you're not looking at the exposome. You have to be looking for the unknowns," he observed.

Dr. Bennett explained that Dr. Miller was expressing the need for a common definition of the exposome across the community in general. Dr. Miller said the need is for an NIH biomedical definition because it is an NIH conversation. Dr. Bennett asked about Dr. Miller's thoughts about All of Us using a reference genome and what the exposome equivalent may look like. Dr. Miller said he is on the All of Us advisory board and described his ideas for gathering environmental information in the All of Us context.

Dr. Parker brought up the role of social science and the social determinants of health, such as the direct impact of racism and chronic stressors and how they might affect biological processes. Dr. Miller said he does not work in the social space, but that chronic stress and allostatic load probably result in a molecular signature. With the right independent variables, it would be possible to see the effects on systems that are involved in responding to stress. Dr. Koroshetz added that systems neuroscience efforts are looking at those types of issues.

Dr. Vasquez asked when exposome research should be integrated into research studies and using what funding mechanisms. Dr. Woychik reiterated that the effort on exposomics should start with a framework, a definition of the exposome and an idea of the types of data desired. A thoughtful approach is needed because "we can't collect

everything all at once.” Once that process is started, new types of data to be collected can be added. Dr. Vasquez said that from the NIEHS perspective, the thinking is about what to collect, but asked if there is thinking about how to use what is being collected, particularly in terms of financing. Dr. Koroshetz cited his IC’s experience with Parkinson’s, and the process of collecting data and following up with analysis. Dr. Woychik said the framework will help determine “what it is we want to do.” Once the framework is in place, questions about funding arise. He noted that the exposome is more complicated than the genome. He said that it will be important to be intersecting with the genetics and genomics communities, since there may be genetic contributions to individual responses to exposures. He felt that approaching the Common Fund for initial funding may be a way to approach the project. He added that it will be important to be thoughtful about how to integrate geospatial data. Dr. Koroshetz reinforced his interest in the interface of the nervous system and the environment and his belief that this is an area for the two to come together.

Dr. David Balshaw mentioned that true value comes not from individual projects, but combined ones that link lab to phenotypic data. When the HHEAR and CHEAR programs were established, data sharing and data re-use were central to the thinking. Secondary analysis and mining of the data were important.

Dr. Bennett summarized the discussion to that point.

- There is a dire need for an NIH definition for the exposome.
- Upon reaching a definition, it will be important to establish a framework to approach the exposome in a smart, sustainable way.
- Smaller, cheaper, better tools are needed to bring down costs.
- There is a need for a central, HHEAR-like resource.
- Managing the flood of data will be a challenge.
- There is potential to access the Common Fund.
- In such a transdisciplinary arena, there is an opportunity to bring together people from multiple disciplines to work on the exposome.

Dr. Woychik asked the Council to discuss the next step in the process. Would a workshop be the best follow-up? He asked Dr. Miller to comment. Dr. Miller stated, “I think it’s time for our Asilomar. We need to get the right people in a room, locked in, to walk out with a plan.” He said it should be a focused, NIH-wide plan that should be tied to achievable goals. Dr. Koroshetz recommended working backwards from deliverables. Dr. Woychik agreed, noting that it would be important to arrive at a good definition of deliverables that integrate the environment into studying the etiology of human disease.

Dr. Hertz-Picciotto felt that if NIEHS puts out the right kind of mechanisms, the experts will come, in the highly collaborative field.

Dr. Janet Hall cited large-scale programs that have worked in an interdisciplinary way successfully, such as the BRAIN Initiative and the Cancer Moonshot, and said that a program on that level will be needed to tackle the exposome.

Dr. Wright noted that environment plays a role in every disease, and therefore every institute needs to invest in exposomics.

VII. DERT Director's Report

Acting DERT Director Dr. Gary Ellison briefed the Council on DERT activities since the February Council meeting.

He mentioned the hiring of Dr. Quentin Li to be a Scientific Review Officer in the Scientific Review Branch, beginning June 7, 2021.

He described several DERT meetings that had taken place between February and June, and upcoming DERT meetings through September.

He discussed two events that took place in April in recognition of Autism Awareness Month: a mini-symposium and a research presentation.

Dr. Ellison described the DERT Environmental Health Disparities (EHD) and Environmental Justice (EJ) portfolio. He defined the terms and noted that the focus of EJ action is on the translation of EHD research into practice to address inequities. He provided details about the ongoing NIEHS commitment to EHD research and EJ. The EHD/EJ portfolio is broken down into five grant type categories: Environmental Health Disparities (114 grants funded), Environmental Justice (122 grants), Minority Health (82 grants), Rural (38 grants), and American Indian/Alaska Native (43 grants). Grants can fit in one or more categories. NIEHS also currently co-funds three Centers of Excellence on EHD Research with NIMHD. There were 235 EHD/EJ grants funded from 2011-2020. Dr. Ellison described several case studies as examples of research in the EHD/EJ portfolio.

Dr. Ellison focused on climate change as an EJ issue and presented a preliminary view of climate change topics within the DERT portfolio. The active portfolio is broad, with more than 100 active grants in Fiscal Years 2018-2020. The most common research topics are weather related and those dealing with asthma, allergies, and airway health. The portfolio also includes research on vulnerable communities, water- and vector-borne exposures, and health-related effects. He also highlighted the Oceans and Human Health Centers program, which is a long-standing partnership between NIEHS

and the National Science Foundation. The focus of the current program is to determine how climate change affects oceans and great lakes, and resulting exposures, toxicities, and human health.

He provided details on DERT activities related to Diversity, Equity, and Inclusion and efforts to create a more diverse EHS workforce:

- The EHD/EJ portfolio
- Diversity supplements
- EHS extramural community engagement
- The Council Working Group

Dr. Wright said he had noticed that NHLBI has an RFA out for T32s that promote diversity in training and asked if NIEHS has considered a similar type of training grant. Dr. Ellison replied that NIEHS is discussing such a program as efforts in diversity, equity, and inclusion are being considered.

Dr. Kavanagh asked about inclusion of P30s in diversity supplements. Dr. Mastin said that although no diversity supplements have been awarded to P30 programs, he was not aware of any exclusion. He pledged to look into the matter. [Note: Dr. Mastin checked the NIH Diversity Supplement Funding Opportunity Announcement, and it listed P30s as being eligible for diversity supplements.]

Dr. Vasquez asked whether it would be desired to have more grants, or larger grants, and wondered about the right balance between the two. She cited the ONES program as an example. Dr. Ellison said that it was an important question. He noted that portfolio analysis would help with that type of critical decision-making.

Dr. White-Newsome asked Dr. Ellison if there were any research topics that he felt should be covered more or are missing from the DERT portfolio. She also asked if there is any mechanism in the grant programs that pushes the optimization of data in terms of health disparities. In response to her first question, Dr. Ellison cited the example of the exposome as an area that needs more attention. He asked Dr. White-Newsome what areas she might think are not adequately funded. He also mentioned climate change refugees and mental health as another area needing more focus. Responding to her second question, he mentioned the Research to Action initiative, citing specifically a study involving the use of fruits and vegetables in populations exposed to PCBs. He added that NIEHS has a community engagement core as a requirement for all centers. Dr. Korfmacher said there is an opportunity to assess the Research to Action program. She said that the next step would be interpretation. Responding to Dr. Ellison's summary of the many EHD/EJ programs, she asked what had been accomplished with that funding and how those topics can be evaluated. Referring to Dr. Ellison's slide on

community engagement, she noted that the bullet points included mainly addressed workforce development issues.

Dr. Mastin asked whether the new funding addressing climate change would include EJ. Dr. Woychik said that the Biden administration focus on climate change is within a framework of EJ.

VIII. Early Physical and Chemical Influences on Child Health Outcomes – the ECHO Program

Dr. Woychik introduced Dr. Matthew Gillman, who joined the NIH in 2016 as the inaugural Director of the Environmental Influences on Child Health Outcomes, the ECHO Program.

Dr. Gillman described ECHO and the ECHO-wide Cohort, a nationwide research program that brings together 72 ongoing maternal-child cohort studies into one large cohort of more than 50,000 children and their families. Data from these diverse populations allows ECHO investigators and the wider community of scientists to address research questions about the effects of a broad range of early environmental exposures on child health and development from birth through adolescence, questions that no single cohort, or even a few, can answer alone. He provided details about the program's first five years of progress, including the ECHO-wide Cohort Data Platform with data from more than 90,000 participants, and more than 650 publications.

To illustrate the program's scientific accomplishments, he discussed its research activities related to phthalates, particularly measurements of prenatal phthalate exposure and maternal prenatal stress. He described research on prenatal PFAS and child obesity and metabolism, as well as geospatial approaches to elucidate air pollution and airways outcomes. He cited the contributions from the CHEAR and HHEAR programs.

ECHO cohort researchers are investigating the influences of exposure to air pollution, the built and natural environments, and multiple chemicals during pregnancy and early childhood on ECHO's five pediatric outcome areas:

- Pre-, peri-, and post-natal outcomes
- Upper and lower airway
- Obesity
- Neurodevelopment
- Positive health

The ECHO-wide Cohort is yielding a valuable nationwide data resource for evaluating influences of chemical mixtures, interactions of pollutants with social and behavioral factors, critical periods vs. cumulative exposures, and health disparities. ECHO researchers are addressing effects of ubiquitous, well-characterized, low detection, and emerging chemicals, as well as pursuing untargeted analyses to identify novel chemicals of concern. Through ECHO's Opportunities and Infrastructure Fund, junior researchers are innovating exposure assessment and modeling methods. ECHO's diversity supplements support pre- and post-docs who are examining several aspects of chemicals exposures, and ECHO COVID-19 supplement awardees are addressing how rapid changes in exposures with the pandemic affect child health outcomes.

Dr. Wright asked whether ECHO is at a point of being able to create a representative subcohort that could be used for case-cohort or case-control analyses. Dr. Gillman said that "the ECHO floor is open for analysis proposals to use that kind of approach."

Dr. Penning asked Dr. Gillman whether the ECHO program would consider new cohorts, such as a cohort for the phthalate study of children who have been in a NICU and exposed to the various types of tubing. Dr. Gillman replied there is a mini-consortium of NICU babies which form several cohorts within ECHO. Dr. Penning asked if ECHO ever considers new cohorts. Dr. Gillman said that in this cycle of ECHO (a 7-year cycle starting in 2016), all cohorts have been awarded, and they are all pre-existing and ongoing.

Dr. Korfmacher noted that in her conversations with ECHO researchers, they often lacked information about matters such as housing and location, which would allow conclusions about environmental exposures and the exposome. She asked how ECHO would deal with that issue. She asked whether ECHO was pushing out standards that would guide collection of environmental exposures and social determinants data. Dr. Gillman cited the geospatial approaches he had mentioned, and on the individual exposure level, the ECHO-wide Cohort Protocol, which contains elements about environmental exposures, including housing. Regarding Dr. Korfmacher's point about influencing what goes into EMRs, he said ECHO has not yet tackled that issue.

Dr. Kavanagh asked about public-private partnerships in the context of geospatial information, with companies using high-resolution satellite imaging that could yield data on exposures. Dr. Gillman said that ECHO has not yet pursued public-private partnerships, but indicated interested in what types of data might be available. Dr. Kavanagh suggested that companies such as planet.com already have relationships with government agencies, and that it would be interesting to see companies like that incorporated into the program.

Dr. Goldman noted that the ECHO cohort is a completely new way of doing a cohort study, in terms of bringing together existing cohorts, supporting them, coordinating them, and creating scientific collaborations among them. She said it is an exciting model, and it was not necessarily obvious at the outset that it would work. She observed that “it has gone magnificently well.” She suggested that over time, the model could be extended to support new cohorts. She agreed that there are other cohorts developing tools for assessing elements like housing that have not yet been used in ECHO and could be useful for ECHO cohorts. She felt that the collaborative efforts in ECHO have worked better than most would have expected. Dr. Gillman replied that ECHO is working across NIH in harmonizing data systems and outlets. He agreed that moving forward ECHO will have the opportunity to innovate and bring in new elements and topics to remain on the cutting edge of environmental science.

IX. The Noradrenergic System and Environmental Health Science

Dr. Patricia Jensen from the DIR Developmental Neurobiology Group briefed the Council on recent scientific work centered on the noradrenergic system.

Brainstem noradrenergic neurons comprise a small population of cells that project to virtually all areas of the central nervous system. Through the release of norepinephrine, these neurons modulate functions as diverse as attention, emotion, appetite, memory, and response to stress. Norepinephrine signaling is disrupted in a spectrum of neurodegenerative and neurodevelopmental disorders and following exposure to a number of environmental toxicants and stressors. It has been observed that subpopulations of noradrenergic neurons are differentially vulnerable to disease-related cell death and environmental insult. Dr. Jensen and her colleagues suspect that the key to understanding noradrenergic system dysfunction will not be found by focusing on the system as a whole, but will only be understood by uncovering the developmental and genetic factors that define unique functional subtypes of noradrenergic neurons.

The long-term goal of the group’s research is to understand the mechanistic relationship between perturbation of distinct noradrenergic neuron subtypes during development and increased susceptibility to emotional and cognitive deficits in adulthood. They use the mouse as a model system to:

1. Define subtypes of noradrenergic neurons base on differences in developmental gene expression.
2. Determine their circuitry and function in the adult brain.
3. Perturb their function during development to uncover critical windows of susceptibility and the long-term effect of these perturbations on adult behavior.

Results from these studies promise insight into the basic biological mechanisms underlying noradrenergic neuron subtype function and their differential response to disease and environmental insult.

Dr. Vasquez asked Dr. Jensen about the diet-induced obesity studies that she plans, and whether they will be based on sugar or total calories. Dr. Jensen said that Dr. Natale Sciolino from her group is taking the study with her to her new posting at the University of Connecticut and is definitely interested in looking at the differences.

Dr. Zeldin asked Dr. Jensen to comment on the importance of long-term support from the intramural program, which makes high-risk, high-reward research possible. Dr. Jensen said that the types of studies she conducts would not be possible in an academic setting. She added that the tools she has developed in her lab are now being used by several other researchers. Dr. Vasquez said that the issue speaks to the status of an R21 grant. Dr. Jensen said she makes her mouse lines, viral vectors, and plasmids available to others through the Jackson Laboratory in order to help the extramural community. She discussed the importance of bringing together people from different disciplines to work as a team to answer some of the big scientific questions. She described cross-divisional efforts with NTP. Dr. Ellison asked how she plans to bring the different groups together. Dr. Jensen provided more details about working with NTP, working as a team to mentor a postdoc for training on both the neuroscience side and the toxicology side. She said she has two new postdocs joining the project.

Dr. Kavanagh asked if there is intention to look at single-cell transcriptomics or epigenetic modulation. Dr. Jensen said there is definitely intent to use those tools.

X. DEI Working Group Update

Dr. Vasquez updated the Council on the Council Working Group (WG) on Anti-Racism, Diversity, Inclusion, and Equity, which she chairs. The WG has held two meetings thus far.

Current membership consists of Dr. Vasquez, former Council members Dr. José Cordero and Dr. Andy Shih, current Council member Dr. Edith Parker, Dr. George Daston from Procter & Gamble, and NIEHS representatives Mary Diaz Santana, Fred Tyson, Nicole Popovich, Gary Ellison, and Pat Mastin. Five nominations are currently under review, bringing total membership to 12-15.

Dr. Vasquez noted that the group has established four subgroups to address issues of racism, diversity, equity, and inclusion in the following areas:

1. Workforce (hiring, retention, diversity of workforce, etc.)
2. Funding (extra- and intramural, new initiatives, etc.)

3. Trainees (mentoring areas of study, make up of study sections, T32s, R01 diversity supplements, etc.)
4. Community engagement (who is the research benefitting, etc.)

Dr. Korfmacher commented about the community engagement subgroup. She felt that it should be part of the first three subgroups as well. Dr. Vasquez explained that although community engagement is certainly part of all of the groups, the intention was to break down the groupings based on the expertise available on the committee. She added that two of the five nominees being considered were recruited for their community engagement skills.

Dr. Hertz-Picciotto suggested that a fifth subgroup devoted to culture change would be appropriate, as a way to tackle hidden assumptions. Dr. Vasquez agreed that changing the culture is key but pointed out that it would be difficult to address as a WG subgroup, because it fits all of the subgroups.

Dr. Penning wanted to ensure that groups working on the issues both within NIEHS and at NIH are working together. He endorsed the idea of “spheres of influence” as a method of addressing the topic. Dr. Vasquez said that she is bridging with other groups. Dr. Mastin added that the WG intends to interface with several other groups working on the issues, such as the NIH UNITE committees.

Dr. Cordero agreed with the concept that all of the WG’s recommendations are likely to address some form of culture change, as an overarching issue.

Dr. Daston said that three of the four areas are 100% under NIEHS control, but the community engagement goes beyond NIEHS. He asked how far it can be pushed with other agencies. Dr. Woychik said it is part of collaboration, which is one of his leadership values. He cited climate change as an example to the collaborative approach. He noted that it should extend beyond NIH to include agencies such as EPA and DOD. “One of the key things we need to do is provide the reward mechanisms that encourage this type of collaborative activity,” he added. He said that he will be dedicating a lot of his energy to ensuring that such collaborations happen. He noted that DEI is a multi-faceted issue. He said it is abundantly clear that there has been structural racism at NIH, which needs to be fixed. He said he is looking to the WG for specific recommendations.

Dr. Cordero noted that all NIH ICs have similar committees, presenting an opportunity for collaboration on issues such as new ways to review proposals. Dr. Woychik pointed out that every IC will hire a Diversity Officer reporting to the Director. He will ask that person to ensure that proceedings at NIEHS are well-coordinated with those at the other ICs.

Dr. Wright suggested that there should be an evaluation first to identify the problems that need to be addressed. Some of the issues will be intransigent. Dr. Mastin agreed about the need for data and felt that the nature of that need is an issue the WG should work on. Dr. Wright mentioned the possibility that there may be a need to bring in a consultant to help with those issues, adding a voice from outside the system. Dr. Woychik asked Dr. Collman to comment. She discussed her activities in the area in her capacity as Acting Deputy Director of NIEHS. There is an advisory committee to the Director of NIH, as well as the Office of Scientific Workforce in the Office of the Director. Those organizations have worked on DEI issues at the larger biomedical level, and their reports are available to the WG. That would help to delineate the data needs to be determined by the WG. The concept of a consultant has been discussed but may be pursued. She cited a suggestion in the chat forum that focus groups be held and agreed that it might be a good idea.

Dr. Ellison commented on the data collection issue. He said that there is a need to broaden how data is thought about. He agreed that focus groups and listening sessions may be good ways to gather qualitative data. He also mentioned that it will be important for everyone in the WG to be on the same page in term of what is meant by racism. He said that it may be a contribution that could be made by a consultant.

Dr. Shih pointed out that everyone in the meeting is successful in the system, and that the value of the WG may be to help those have been less successful. Dr. Woychik agreed and added that there may be opportunities for those who have been successful to be mentoring others who have not. Dr. Parker said that it may require digging deeper and seeing if there is something about the system that needs to change, beyond mentoring. Dr. Woychik suggested that both elements could be pursued.

Ms. Popovich said she was honored to be a member of the WG. Dr. Tyson said he has noticed that study sections are being populated differently than he had ever seen, with more African American scientists serving on study section panels. He felt that it was a positive step.

Dr. Woychik asked Dr. Vasquez to comment on how the WG feels about the UNITE committees. She said the WG has not discussed that effort yet, as the group is still being assembled. She said that although there is a desire to work with others, the WG wishes to maintain its independence, establishing its own ideas and then seeing how they fit in with ideas generated elsewhere.

Dr. Ellison said he had found the discussion stimulating and thanked the members of the WG.

XI. Adjournment

