

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

**MINUTES OF THE ONE HUNDRED FIFTY-FIFTH MEETING OF THE  
NATIONAL ADVISORY ENVIRONMENTAL HEALTH SCIENCES COUNCIL**

**September 11-12, 2018**

The National Advisory Environmental Health Sciences Council convened the open session of its one hundred fifty-fifth regular meeting on September 11, 2018 in the Rall Building, Rodbell Auditorium, National Institute of Environmental Health Sciences, Research Triangle Park, NC. The closed session of the meeting was held September 11, 2018.

The meeting was open to the public on September 11, 2018 from 10:30 a.m. to 4:15 p.m. and September 12, 2018 from 8:30 a.m. to 10:00 a.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 September 11, 2018 from 8:30 a.m. to 10:15 a.m. for consideration of grant applications. Notice of the meeting was published in the *Federal Register*. Dr. Linda Birnbaum presided as Chair.

**Participating Council Members**

Habibul Ahsan, MD  
Philip Brown, PhD (via WebEx, Tuesday 9/11/18 only)  
José Cordero, MD, MPH  
Irasema Coronado, PhD (Wednesday 9/12/18, via WebEx)  
Shuk-Mei Ho, PhD (Wednesday 9/12/18, via WebEx)  
Katrina Korfmacher, PhD  
Maureen Lichtveld, MD  
José Manautou, PhD  
Donna Mendrick, PhD (*ex officio*) (via WebEx, Tuesday 9/11/18 only)  
Edith Parker, DrPH (9/11/18 only)  
Brad Racette, MD  
Susan Schantz, PhD  
Andy Shih, PhD (9/11/18 only)  
Patrick Sung, DPhil  
Robert Tanguay, PhD (Wednesday 9/12/18, via WebEx)  
Deborah Winn, PhD (*ex officio*)  
Robert Wright, MD, MPH

## **NIEHS Staff**

Kathy Ahlmark  
Janice Allen, PhD  
Robin Arnette, PhD  
David Balshaw, PhD  
Martha Barnes  
Linda Bass, PhD  
Sharon Beard, MS  
Linda Birnbaum, PhD  
Mario Borgnia, PhD  
Tiffany Bowen  
Abee Boyles, PhD  
John Bucher, PhD  
Jed Bullock  
Danielle Carlin, PhD  
Trisha Castranio  
Kelly Chandler, PhD  
Jennifer Collins  
Gwen Collman, PhD  
Mike DeVito, PhD  
Darlene Dixon, DVM, PhD  
Christie Drew, PhD  
Chris Duncan, PhD  
Lisa Edwards  
Suzanne Fenton, PhD  
Symma Finn, PhD  
Christine Flowers  
Amanda Garton  
Kimberly Gray, PhD  
Astrid Haugen  
Michelle Heacock, PhD  
Heather Henry, PhD  
Jon Hollander, PhD  
Chip Hughes  
Michael Humble, PhD  
Bonnie Joubert, PhD  
Helena Kennedy  
Alfonso Latoni, PhD  
Cindy Lawler, PhD  
Ty Lawson  
Kelly Lenox  
Chris Long  
J. Patrick Mastin, PhD  
Steven McCaw  
Liz McNair  
Carolina Medina

Aubrey Miller, MD, MPH  
Sri Nadadur, PhD  
Sheila Newton, PhD  
Liam O'Fallon  
Kristi Pettibone, PhD  
Nicole Popovich  
Molly Puente, PhD  
Lingamanaidu Ravichandran, PhD  
Scott Redman  
Ericka Reid, PhD  
Elizabeth Rubin  
Carol Schreffler, PhD  
Thad Schug, PhD  
Sheena Scruggs, PhD  
Dan Shaughnessy, PhD  
Varsha Shukla, PhD  
William A. Suk, PhD, MPH  
Kimberly Thigpen Tart, JD, MPH  
Laura Thomas, PhD  
Claudia Thompson, PhD  
Brittany Trottier  
Steven Tuyishime, PhD  
Fred Tyson, PhD  
Christopher Weis, PhD  
Leroy Worth, PhD  
Rick Woychik, PhD  
Demia Wright, MPH  
Darryl Zeldin, MD

**Members of the Public Present**

Maureen Avakian, MDB, Inc.  
Megan Avakian, MDB, Inc.  
Lisa Chadwick, PhD, National Human Genome Research Institute  
Ernie Hood, Bridport Services, LLC  
Laura Krnavek, PhD, Army Research Office  
Michael Phillips, RTI  
Teresa Woodruff, PhD, Northwestern University

**I. Call To Order and Opening Remarks**

NIEHS/NTP Director and Council Chair Linda Birnbaum, Ph.D., welcomed attendees and called the meeting to order. She asked attendees in the room to introduce themselves. Following the introductions, NIEHS Division of Extramural Research and

Training (DERT) Director and Council Executive Secretary Dr. Gwen Collman reviewed meeting logistics, including votes to be taken through the Electronic Council Book.

Dr. Birnbaum recognized retiring Council members Dr. Philip Brown, Dr. Brenda Eskenazi, and Dr. Habib Ahsan. She presented Dr. Ahsan, the only retiring member present, with a certificate commemorating his service.

## **II. Review of Confidentiality and Conflict of Interest**

Designated Federal Official Dr. Collman reviewed the Conflict of Interest and Confidentiality procedures, which had been provided earlier to Council members in written form, and reviewed various other administrative matters.

## **III. Consideration of May 2018 Meeting Minutes**

Approval of the May 2018 meeting minutes was moved and seconded, and Council voted to approve the minutes, with all in favor. Dr. Collman noted the dates of the upcoming Council meetings for members to put on their calendars.

## **IV. Report of the Director, NIEHS**

Dr. Birnbaum briefed Council on Institute developments since the May 2018 Council meeting.

First, she noted that each Council member had received a copy of the new NIEHS 2018-2023 Strategic Plan, "Advancing Environmental Health Sciences, Improving Health." She called it "evolution, not revolution," as it built upon the foundation provided by the previous strategic plan.

She updated council on budget and appropriations. She went over the proposed budget numbers for FY2019 for both NIH and NIEHS, including the House bill and the Senate bill, which in recent years has been followed in appropriations. The Superfund budget has been flat for several years, but now may see a \$2.6 million increase (under the House bill). The annual \$10 million worker training pass-through from the Department of Energy remains, but the CDC-related Ebola response money has been discontinued. She said there was guarded optimism that the budget may actually be in place by September 30. If that does not happen, a relatively short-term Continuing Resolution would be anticipated.

She described authorization legislation impacting NIEHS. H.R. 5515, the National Defense Authorization Act for FY2019, became law in August, 2018, and funds extensive study of PFAS. H.R. 8, the FAA Reauthorization Act of 2018, is likely to

become law before the end of 2018, and would fund research on health effects of noise from aircraft flights.

Turning to science advances, Dr. Birnbaum briefly summarized several recent publications by NIEHS/NTP personnel or grantees. She began with a One NIEHS paper recently published in *Environmental Health Perspectives, Expanding the Concept of Translational Research: Making a Place for Environmental Health Sciences*, authored by several DERT and NTP employees. She highlighted two publications from DIR personnel, two from DNTP researchers, and four from DERT scientists.

Dr. Birnbaum updated the council on the reorganization of the National Academies of Science, Engineering, and Medicine, and described the long history of NIEHS engagement and support for the academies, including leadership of and involvement with several boards and committees related to environmental health. She particularly featured the Environmental Health Matters Initiative.

She summarized several recent awards and recognition given to NIEHS personnel and grantees, including NIH 2018 Director's Awards recipients.

#### **V. Concept Renewal for the NIEHS Worker Training Program**

Worker Training Program (WTP) Director Chip Hughes, along with his WTP colleagues Sharon Beard and Demia Wright, detailed the program's concept renewal proposal. The WTP has been training workers for hazardous materials and emergency response since 1987, and the program is subject to renewal every five years. It mainly uses the U45 Cooperative Agreement funding mechanism. The renewal concept recommends continuation of the U45, UH4, and R43/R44 grant programs, with an earliest anticipated start date for the renewed program of August 2020.

Mr. Hughes provided background information about the WTP, including successes and accomplishments through the years. The primary WTP program has three primary program cores and components:

- Hazardous Materials Worker Health and Safety Training (U45)
  - Hazardous Waste Worker Training Program (\$20M)
  - HazMat Disaster Preparedness Training Program (\$3.5M)
  - Environmental Career Worker Training Program (\$2.5M)
- NIEHS/Department of Energy Nuclear Worker Training (UH4)
- SBIR E-Learning for HazMat (R43/R44)

The core Hazardous Waste Worker Training Program is to include training on new and emerging health threats, such as occupational exposure to opioids. The Environmental Career Worker Training Program is to expand to cover a wider geographic area of

training sites, with expanded partnerships with local, state, tribal, and regional governmental organizations. The HazMat Disaster Preparedness Training Program will continue to create materials and deliver training to prepare works responding to local HazMat events and disasters, with an emphasis on site-specific hazards. The NIEHS/Department of Energy (DOE) collaboration will continue with all aspects of existing training, with ongoing collaboration between NIEHS, DOE, and contractors, encouraging training on safety culture and expanding training for fenceline communities and tribal nations. The program is funded by an annual transfer of \$10 million under an interagency agreement with DOE. The SBIR E-Learning program has a yearly FOA that focuses on development of e-learning health and safety methods from a variety of delivery methods, facilitating the use of Advanced Training Technologies. The program has \$683,000 available for awards.

Dr. Lichtveld, the first Council reviewer, called the WTP “one of NIEHS’s signature programs, well-known on the practice frontline.” She said the program is very responsive in its connection with the community and the opportunity to provide flexibility in the definition of whom a worker is. The research/practice interface becomes increasingly important, she noted. She observed that there is an opportunity to increase the program’s usefulness and impact, and recommended making that aspect explicit in the next set of FOAs. She felt that across the programs, there is a need for more scholarly and better evaluation. She recommended three levels of evaluation – learner performance, at the employer/employee level, and at the program level. She said that one of the greatest opportunities with the new announcement is a more deliberate promotion of cross-fertilization. She suggested consideration of a hands-on workshop to bring the three programs and SBIR together. She agreed with the cooperative agreement approach. She noted instances of the word “encouraged,” and recommended changing some of them to “required,” specifically, passages on environmental literacy and emerging technologies. She recommended that the Environmental Career program connect with community colleges. Regarding the disaster preparedness program, she urged recognition that responders are also victims. She asked whether there is flexibility within the HazMat training program to devote more resources to inclusion of fence communities in the training.

Dr. Brown, the second Council reviewer, said the WTP is a wonderful program, and that it is astounding how many people have been reached and how many directions have been taken. He felt that the logic for the cooperative agreement is solid. He agreed that environmental health literacy is important, and recommended that general education materials be developed for clinicians, nurses, and other clinical care professionals. He suggested connecting with people who work in the water supply industry, with attention to both regulated and unregulated contaminants, particularly PFAS. He said it would be great to have outreach to the NIEHS-funded centers. In

terms of the DOE program, he wondered if it would be possible for them to collect health data, particularly at the Hanford facility. He recommended incorporating health data in firefighter training. Regarding the SBIR, he pointed out the Native American and cultural concerns at the DOE site, and he wondered if that could be added to broaden training programs. He noted that it would be good to involve some of the green building groups. For the career program, he said it should be standard to collaborate in that type of training. He approved of the economic impact analysis activity.

Dr. Parker was the third Council reviewer. She praised the program's ability to adapt to changing topics, changing populations, and changing situations. She noted its alignment with the new NIEHS Strategic Plan. She said there was a real opportunity for greater dissemination, which perhaps could be required for contractors. She felt that it might be good for some of the training materials to include reference to research. She recommended looking more at impact, strengthening the health impact data. Overall, she was very supportive of the program.

Dr. Winn said the program is amazing, with impressive accomplishments, and that she wished it were more broadly known across the NIH. She felt there would be ways to leverage some of the expertise across NIH to benefit the program, perhaps including some of the interest groups.

Mr. Hughes said that had been the experience with the Opioid Task Force for NIH. He said it was one example of how the WTP can deepen its continuing engagement with the research enterprise, such as the partnership with the DR2 program. He noted that breaking down institutional barriers between researchers and communities and workers is a large challenge, and that there is an opportunity to impact the situation. He said that the connection between research and practice is "clearly a place where our program lives," and acknowledged that Council is recommending that the program be more explicit about that kind of collaboration.

Dr. Collman called for and received a motion and second to approve the concept. Council members voted electronically, and the motion passed.

## **VI. EVATAR: Next Generation *Ex Vivo* Environmental Toxicant Testing Device**

Dr. Teresa Woodruff, the Thomas J. Watkins Professor of Obstetrics and Gynecology at Northwestern University, briefed the Council on EVATAR, a biology and microfluidic technology system for *ex vivo* modeling of human biology.

She described the NIEHS-funded project as exciting and dynamic. The premise is that reproductive hormones impact every tissue of the body, but Petri dishes do not reflect that biology. The promise of EVATAR is that it represents endocrinology in a dish, with

five organs of the female reproductive system represented in chip form, with microdynamic fluid flow across the multi-organ system, mimicking the *in vivo* environment. The potential represented by the system is to enable a new kind of biology, allowing advanced models of health and disease, covering genes, epigenetics, environment, drug interactions, obesity, age, and sex. It will also facilitate personalized approaches based on individual biologies.

The model disease being studied with EVATAR is polycystic ovary syndrome (PCOS), a common female hormonal condition affecting reproduction. Dr. Woodruff provided details about the pioneering work being conducted with EVATAR. The ability to study *ex vivo* organs as systems rather than individual tissues or cells is enabling technology to contribute to improved biology, personalized medicine, and earlier discovery of environmental health hazards.

Dr. Birnbaum suggested that endometriosis might be an appropriate disease to study next with the system. Dr. Woodruff noted that the plan had been to study prostate cancer, but that modeling the male reproductive system was proving more challenging than the female system had been.

Dr. Ho asked if the system could be used to model Alzheimer's or other neurodegenerative diseases. Dr. Woodruff answered that the intent is to provide researchers with the system by the end of the year, anticipating that as a result there will be "biology before microfluidics, and biology after." She said that the hope is that researchers will determine ways to use the system to improve modeling of neurodegenerative and other diseases. She noted that it would not replace animals or human biology, but would be one additional system to enable faster and better human clinical research.

Dr. Manautou asked if there had been consideration of incorporating metabolomics analysis. Dr. Woodruff said that had not yet been done, although some steroid metabolomics had been conducted. She agreed that much would be learned by looking at how the various organs interact.

## **VII. Environmental Influences on Aging Concept**

Dr. Symma Finn and Dr. Michelle Heacock presented the concept on Environmental Influences on Aging: Effects of Extreme Weather and Disaster Events on Aging Populations and Aging Processes. The program is a trans-NIH effort led by NIEHS that is being planned in parallel with a complementary FOA that would explore fundamental processes of aging in the context of disasters and extreme weather and was recently approved by National Institute on Aging leadership. The FOAs are intended as an overall exploration of both the processes and population effects of extreme weather and disaster events, and will be linked by common endpoints and cross-fertilization among



basic and social scientists, epidemiologists, and risk communicators in annual meetings that bring together the investigators from both programs.

The impetus for the initiative began with a trans-federal workshop called Extreme Events, Environmental Health and the Elderly, which was held in June, 2017. The workshop led to the establishment of two related trans-NIH FOA planning teams, who developed the programs being proposed. NIEHS is leading the development of a fundamental Population Studies FOA that focuses on aging populations.

Dr. Finn and Dr. Heacock presented several points for justification and considerations related to the proposed program, including the fact that the elderly comprise the fastest-growing segment of the U.S. population, and that aging is the largest risk factor for most chronic diseases. There are research gaps related to aging processes and aging health disparities that require attention. Overall, aging increases susceptibility to harmful effects of environmental exposure, and in turn those harmful effects may accelerate aging.

Research topics for the Population-based FOA include:

- The impacts of disasters on chronic health conditions
- Aging in place and the stress of displacement
- Health services delivery and supporting infrastructure
- Sensory deficits and their influence on perception, cognition, and behavior
- Health promotion and resilience
- Analysis of mixtures
- Circadian rhythm changes over the course of aging
- Biopsychosocial mechanisms of exposure and aging

Many of the topics will be of interest to multiple NIH ICs, so it is anticipated that funding will be provided from several NIH sources. An R01 mechanism is proposed, with a 2-year announcement. The expectation is to fund between 5 and 8 grants per year, with an expected FOA release date of January 2019. As a PAR, the Center for Scientific Review would conduct the review.

Dr. Lichtveld, the first Council reviewer, said that the concept was long overdue. She applauded the fact that it is transdisciplinary in nature. She recommended that “aging” be better defined in the FOA proposal. She approved that the concept took the aging population out of the “special population” category. She said that the effort could be done right from the start, without letting programmatic implementation hamper cross-fertilization. She asked that that be made more explicit in both FOAs. She said there is an opportunity to operationalize two sets of domains: first, the broader definition of the environment, incorporating the physical, biological and social aspects. Second are what she termed the capitals – financial, cultural, natural, built, and social. She recommended

including chronic, slow-moving shocks and stressors such as neighborhood and violence. She added that it would also be important to look at infectious diseases. Regarding cumulative exposures, she suggested inclusion of both chemical and non-chemical stressors, as well as the pathophysiology underlying psychosocial aspects. She recommended reconsideration of naming one of the areas "risk communication" as being too limiting. She also wondered how community engagement would be integrated. In terms of the research topics, she noted the rise of sexually transmitted diseases in the aging population. She recommended thinking about adaptation readiness when considering aging in place. She said it would be important to distinguish between the supporting health system infrastructure and the supporting infrastructure itself, such as transportation. She recommended that immune function be called out in the population-based initiative as well as the fundamental initiative. Repair function should also be included in the population-based setting.

Dr. Korfmacher, the second Council reviewer, described the FOAs as "a perfect storm," and clearly an important area for NIEHS research. She noted that the idea of user-informed research appears to be embedded in the concept, especially in the section on dissemination and implementation of risk communication strategies, and agreed with the idea of broadening that approach. She said it seems to focus on communication with individuals, with individuals as the target user, but disasters and extreme weather events are actually system phenomena, and are more and larger than has been seen previously. So the impacts on systems are a central concern, as well as how individuals interact with the systems. Thus, the relevant audiences include community groups, organizations, agencies, and institutions at the local level that are affected by the perfect storms. She felt that that should be made more explicit in the FOA, discussing risk communication with decision makers, utility companies, major employers, universities as citizens, and agencies such as local health departments, transportation agencies, infrastructure, housing, and education, as well as interest groups such as AARP or community action agencies. She said that communication is just one part of the translation of findings into dissemination and implementation, and that it would also be important to include economic policy and systems dynamics analysis in the scope of the research. She encouraged inclusion of comparative community-based studies. She suggested including the groups she had mentioned in the grantee conferences to help clarify what information is needed and how it can best be shared. She noted that the concept is complex, and suggested inclusion of a well-developed example in the FOA, such as wildfire. She said that research on the connections between extreme weather and aging populations and disparities is essential to inform development and funding of effective systems for both prevention and response, and that this FOA will give NIEHS a key role in developing that research.

Dr. Sung was the third Council reviewer. He felt that the proposal was not focused enough. He said the impression was that it was much broader. He cautioned about the potential for overlap in terms of the scientific areas being pursued. He felt that it was a great idea to encourage the people who do population work to conduct epidemiologic studies, and to talk to those who do more basic research. On paper, that interaction is a good idea, he noted, but could be difficult in practice. Dr. Finn noted that the impetus for the proposed joint meetings was the good experience at the elders workshop, seeing the discussions between the basic scientists, the risk communicators, the social scientists, and the policy makers.

Dr. Brown noted that the proposal generates other ideas from the reviewers. He recommended inclusion of new phenomena related to aging, such as aging in place programs and co-housing.

Dr. Cordero said that the program is a unique opportunity to connect the social determinants of health with biological health. The culture of health and the importance of transportation are other critical elements. Food insecurity is also an important consideration.

Dr. Schantz asked Dr. Finn to elaborate on how the double FOA model was developed, and whether it may make it difficult to integrate the two elements. Dr. Finn replied that the developers began as a combined team, and it was discovered that there was so much complexity on both sides, it was getting unwieldy, particular in terms of how grants could be reviewed under one program with such distinct grants. Leadership at NIEHS encouraged a divide and conquer approach, taking advantage of the common interests, particularly with NIA. She said there is confidence that the proposed structure is best. Dr. Collman noted that all ICs will have the opportunity to fund grants under the proposal.

Dr. Manautou asked why nutrition was not among the research topics delineated. He felt that it should have been at the forefront. Dr. Finn agreed and pledged to call out nutrition as the final document is prepared.

Dr. Wright noted that in the aging population, chronic diseases are unlikely to be treated and cured, but will be mitigated. He said that his associates who are geriatricians say that most of their work is related to function, and urged that it be given more prominent place in the FOAs. Dr. Finn said it was a topic of great interest to NIEHS and the other ICs.

Dr. Racette said there were many great ideas in the concept, but was concerned that there is a need to explore environmental influences on neurodegeneration. He said that the idea that extreme weather would have a significant impact on neurodegeneration is

premature, and could potentially detract from the important research that needs to be done.

Dr. Parker said there was a need to clarify risk communication, because it currently looks “very narrow and very individual-focused.”

Dr. Collman called for a motion and second, which were made. Council then voted electronically to approve the concept.

### **VIII. Expanding the Toolkit of Structural Biology with Molecular Microscopy**

DIR Scientific Director Dr. Darryl Zeldin introduced the scientific presentation by Dr. Mario Borgnia, Director of the Cryo-electron Microscopy Core.

Dr. Borgnia provided the Council with background information about cryo-electron microscopy (cryo-EM), which is rapidly becoming a necessity in structural biology on a par with X-ray diffraction methods and nuclear magnetic resonance.

Duke University, NIEHS, and the University of North Carolina at Chapel Hill are collaborating in the formation of the Molecular Microscopy Consortium (MMC), where each institution will be equipped with a cryo-EM instrument. This mission of the MMC is to enable the use of single particle cryo-EM and other tools in molecular microscopy by research groups at the partner institutions. NIEHS led the effort by establishing the first of the three facilities, with the cryo-EM Core at NIEHS established in June, 2017. More recently, the Krios instrument has been installed and is operational at Duke. The UNC instrument is in the process of installation and should be operational in 2019.

The next level of the MMC is to develop methods to extend collaborations and training to the biochemistry groups and cell biology groups at the partner institutions. There is also a goal to create a regional center to allow access to the instruments by groups from other institutions such as East Carolina University and North Carolina State University.

### **IX. Report of the Director, Division of Extramural Research and Training**

DER Director Dr. Gwen Collman updated the Council on recent developments in the division.

She welcomed new DERT employee Dr. Varsha Shukla, a Scientific Review Officer who will be responsible for the scientific peer review of research project grant applications, proposals for R&D contracts, the Loan Repayment Program, and SBIRs that span the overall programmatic mission and goals of the NIEHS.

Dr. Collman briefed the Council on the NIH Loan Repayment Program (LRP), a set of programs designed to recruit and retain promising young investigators into biomedical

or biobehavioral research careers. The LRP will repay a portion of a researcher's qualified educational debt in return for commitment to NIH mission-relevant research. Of five extramural LRPs, NIEHS participates in two: the Clinical Research LRP and the Pediatric Research LRP. Dr. Collman provided details about those programs, and described the other LRP in which NIEHS does not participate. She discussed eligibility requirements and application procedures. She detailed NIEHS LRP funding, which totaled \$848,000 in FY18, as well as trends in applications and awards FY09 – FY18. She also related several success stories, where young investigators have been substantially helped in their careers by the LRP.

Dr. Collman provided details about the workshop held at NIEHS in August, *Developing a Data Science Competent EHS Workforce*. She also profiled several upcoming DERT-sponsored meetings and workshops to be held through the end of 2018.

Dr. Collman went over the FY18 Keystone Science Lecture Seminars, describing the speakers and topics for the monthly series.

Dr. Manautou asked Dr. Collman about the demographics related to the LRP, as to which level the awardees are at. Dr. Collman replied that they are required to be at the doctoral level. There is no one particular scientific domain that is more or less successful, she observed, with a good spread across the portfolio areas.

Dr. Racette noted that young MDs typically have a great amount of debt. He saw that all but one of the examples Dr. Collman had shown were PhDs, and asked whether there was less of an MD workforce applying, expressing concern about losing physician-scientists due to the debt burden. Dr. Collman said there were MD applicants. Astrid Haugen said she did not have the statistics on hand, but there are MDs who are funded. Dr. Collman said she would pull the information together and share it. She noted that having a high amount of debt may preclude the utility of the program to some individuals. However, it is possible to apply and receive funds multiple times, but there is a considerable amount of work involved.

Dr. Birnbaum commented on the decreasing number of MD/PhDs going into research, which is a topic of concern at NIH.

Dr. Wright asked whether the amount of debt a candidate has is part of the decision making process. Astrid Haugen replied that that is not a consideration, and that the decision is based on scores. Dr. Collman added that NIH does not want to make decisions based on debt load, but instead on identifying the candidates with the most potential to be successful researchers.

Dr. Lichtveld asked how it is decided which program funds a particular applicant. Dr. Collman said a candidate can ask to be in particular program, but can be referred to another if it may be more appropriate.

Dr. Manautou asked how the decision was made for NIEHS to participate in the two LRP programs. Dr. Collman said Congress had made that determination in the legislation.

#### **X. NIEHS PFAS Research Coordination**

Dr. Christopher Weis, a senior advisor in the Office of the Director, briefed the Council on NIEHS research activities related to per- and polyfluoroalkyl substances (PFAS), which have become an increasing cause of public health concerns.

He provided background information about the substances, which number more than 5,000 chemicals. There are currently 44 projects in the NIEHS PFOS/PFOA/PFC grant portfolio, totaling \$8.8 million. Twenty-nine are epidemiologic/human studies; 10 are animal or basic studies; and 5 are environmental system studies. Dr. Weis described specific time-sensitive awards on PFAS, and several human cohort PFAS studies now in progress. He also delineated PFAS analyses within the CHEAR program. He reported on a project related to PFAS and child cognition, and a study under the Nurses' Health Study on PFAS and the risk of Type 2 diabetes in women. He provided several examples of Superfund Research Program PFAS-related research initiatives.

Dr. Weis also described ongoing National Toxicology Program studies, including 28-day toxicity studies comparing 7 PFAS, and a PFOA two-year study, with a draft NTP Technical Report anticipated in early 2019. NTP also has the Responsive Evaluation and Assessment of Chemical Toxicity, or REACT PFAS Project, which is screening 110 representative PFAS.

He described the authorization legislation that has now become law, mandating studies of PFAS contamination of drinking water, as well as pertinent congressional hearings.

Dr. Ahsan asked whether the compounds could be measured in urine, or only in blood. Dr. Weis said that historically they are measured in serum, but going forward it will be important to be able to measure them also in whole blood and urine. Dr. Birnbaum noted that the short chain compounds tend to be rapidly cleared and found in urine. She said she had suggested to EPA that total organic fluorides should be looked at.

Dr. Wright commented that there are very few organic chemicals for which whole blood is an ideal specimen. Dr. Weis said that the chemicals are extremely unusual, and that for reasons that have not been worked out, they do bioaccumulate, but they remain in blood. He added that human biomonitoring will be necessary, although that is

complicated and expensive. Dr. Birnbaum noted that CDC used to monitor for 11 PFAS, but now have expanded to 16, and only recently began to look in urine as well as serum.

Dr. Balshaw said that CHEAR has looked at pooled samples of serum, plasma, and urine, using untargeted methods. Dr. Birnbaum described the study looking at the presence of PFAS in food-contact paper products, where the investigators could only identify approximately 20% of the materials. She noted that due to the nature of the bonds involved, the compounds will be very persistent in the environment. Dr. Weis said that is particularly important in metropolitan areas where water is being re-used. He noted that understanding the water supply and water cycle is extremely important, but it is not the only source of exposure to PFAS. Clothing, carpets, and furniture also sources of exposure to the compounds.

Dr. Cordero asked whether the US Geological Survey is testing for PFAS. Dr. Weis said that they are in many cities, as interest is expanding across the nation. He noted that it is expensive to conduct untargeted analysis. He said that what is needed is a full understanding, particularly in metropolitan areas, of source water, polished water, infrastructure delivery systems, and what comes out of the tap. That is not yet understood at present.

## **XI. Adjournment**

Dr. Collman thanked everyone for their great presentations, and thanked the staff for their hard work at the end of the fiscal year. Dr. Birnbaum thanked everyone for two great days, and said she would look forward to seeing everyone again in February.

The meeting was adjourned at 10:00 a.m., September 12, 2018.

CERTIFICATION:

\_\_\_\_\_  
/s/  
Linda S. Birnbaum, PhD, DABT, ATS  
Chairperson  
National Advisory Environmental  
Health Sciences Council

\_\_\_\_\_  
/s/  
Gwen W. Collman, PhD  
Executive Secretary  
National Advisory Environmental  
Health Sciences Council

Attachment:  
Council Roster