

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

**MEETING SUMMARY OF THE
NATIONAL ADVISORY ENVIRONMENTAL HEALTH SCIENCES COUNCIL**

September 13-14, 2022

The 167th meeting National Advisory Environmental Health Sciences Council convened virtually on September 13 and 14, 2022. The meeting began with a closed session that started at 10:45 a.m. and ended at 11:30 a.m. Open session convened at 11:45 a.m. and ended at 5:15 p.m., September 13 and opened at 10:00 a.m. and closed at 12:54 p.m. on September 14. Dr. Rick Woychik, Director, NIEHS, presided as chair.

Participating Council Members

Philip Bourne, PhD
Suzanne Fitzpatrick, PhD (*ex officio*)
Andrew Geller, PhD (*ex officio*)
Lynn Goldman, MD, MPH
J. Timothy Greenamyre, MD, PhD (*ad hoc*)
Irva Hertz-Picciotto, PhD
Andrij Holian, PhD
Darryl Hood, PhD (*ad hoc*)
Keri Hornbuckle, PhD (*ad hoc*)
Andrew Jorgensen, PhD (*ad hoc*)
Terrance Kavanagh, PhD
Gary Miller, PhD
Gohkan Mutlu, MD (*ad hoc*)
Trevor Penning, PhD
Marla Pérez-Lugo, PhD
Karen Vasquez, PhD

NIEHS Staff

Kathy Ahlmark
Sara Amolegbe
Trevor Archer, PhD
David Balshaw, PhD
Martha Barnes
Talin 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
Christie Drew, PhD
Beverly Duncan, PhD
Chris Duncan, PhD
Anika Dzierlenga, PhD
Lisa Edwards
Benny Encarnacion
Amanda Garton
Barbara Gittleman
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
Bonnie Joubert, PhD
Helena Kennedy
Alfonso Latoni, PhD
Cindy Lawler, PhD
Quentin Li, MD, PhD
Mbeja Lomotey, Dr.P.H.
Lindsey Martin, PhD
John Maruca
Jacqui Marzec
J. Patrick Mastin, PhD
J'Ingrid Mathis
Kimberly McAllister
Liz McNair
Carolina Medina
Parris Milly
Nathan Mitchiner
Rosemary Moody
Srikanth Nadadur, PhD
Sheila Newton, PhD
Liam O'Fallon
Nicole Popovich
Lingamanaidu Ravichandran, PhD
Scott Redman

Jim Remington
Chris Schnur
Carol Shreffler, PhD
Dan Shaughnessy, PhD
Varsha Shukla, PhD
Melissa Smarr, PhD
Spencer Smith
Claudia Thompson, PhD
Brittany Trottier
Fred Tyson, PhD
Leroy Worth, PhD
Rick Woychik, PhD
Demia Wright, MPH
Darryl Zeldin, MD
Alicia Ramsaran Zorn

Members of the Public Present

Kevin Elliott, PhD, Michigan State University
Jodie Fleming, PhD, CSR
Ernie Hood, Bridport Services, LLC
Jane Hoppin, ScD, North Carolina State University
Christopher Reh, PhD, ATSDR

CLOSED SESSION

This portion of the meeting was closed to the public in accordance with the determination that it concerned matters exempt from mandatory disclosures under Sections 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.

REVIEW OF APPLICATIONS

The session included a discussion of procedures and policies regarding voting and confidentiality of application materials, committee discussions and recommendations. Members absented themselves from the meeting during the discussion of, and voting on, applications from their own institutions or other applications in which there was a potential conflict of interest, real or apparent. Members were asked to sign a statement to this effect. The Council considered and recommended 389 applications requesting \$185,818,204 in total costs. For the record, it is noted that secondary applications were also considered en bloc.

The meeting was open to the public on September 13, 2022, from 11:45 a.m. to 5:15 p.m. and on September 14, 2022, from 10:00 a.m. to 1:00 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 September 13, 2022, from 10:45 a.m. to 11:30 a.m. for consideration of grant applications. Notice of the meeting was published in the *Federal Register*. Dr. Rick Woychik presided as Chair.

I. Call To Order and Opening Remarks, Review of Confidentiality and Conflict of Interest

NIEHS and NTP Director Rick Woychik, Ph.D., welcomed attendees and called the meeting to order. Acting Division of Extramural Research and Training (DERT) Director David Balshaw, Ph.D., asked Council members in the Zoom call to introduce themselves. Council member Jani Ingram, PhD, and *ex officio* Council members William Cibulas, PhD, and Lawrence Tabak, DDS, PhD, were unable to attend. Dr. Balshaw went over some of the logistics for the meeting.

II. Consideration of June 2022 Meeting Minutes

Approval of the June 2022 meeting minutes were 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 June 2022 Council meeting.

He began with budgetary matters. Dr. Woychik reported that although it took almost six months for Congress to pass a budget for the current fiscal year, in the end there was good news for the NIH. NIEHS received a 3.4% increase for its primary allocation, while Superfund received only a 1.23% increase. Overall, NIEHS received \$935 million. The hoped-for \$100 million increase to fund climate change and health research did not pass, but potential funding for activity does appear in the President's FY23 budget request. The new fiscal year starts October 1, 2022, but it is expected that there will be a continuing resolution through the end of the calendar year. The President's FY23 budget request for NIEHS totals \$932.1 million, while the House Mark totals \$878.8 million, and the Senate Mark totals \$918.3 million.

Dr. Woychik reported that President Biden is expected to appoint Dr. Renee Wegrzyn to lead ARPA-H, the Advanced Research Projects Agency for Health, a new initiative modeled on DARPA. Dr. Wegrzyn is a former DARPA official.

He announced that as of September 1, the NIEHS Division of the National Toxicology Program (DNTP) has been renamed as the NIEHS Division of Translational Toxicology (DTT). The name change is intended to more clearly describe the division's work. He also noted that Dr. Brian Berridge will step down as DTT Scientific Director in January 2023, after having served five years in the post. The process of recruiting and approving a new Acting and permanent Scientific Director will start in November 2022. The process of recruiting a new DERT Director continues, as top candidates were referred by the search committee in late August. Two referred candidates will deliver a seminar to NIEHS staff. Once a selection is made, the appointment approval process will begin at NIH and HHS.

Dr. Woychik discussed the recent 2022 Annual Meeting of the NIEHS Environmental Health Sciences Core Centers (EHSCC), which brought together 275 individuals, including more than 60 Community Engagement Core leaders from centers across the country. Former NIEHS Director Dr. Kenneth Olden was the keynote speaker. The meeting's theme was "A Path to Address Racism and Health Inequities." The 2023 NIEHS EHSCC Annual Meeting is scheduled for October 17-19 in Houston.

PFAS was an area of focus for the Council meeting. Dr. Woychik began the considerations by describing a November 2021 briefing on PFAS for Assistant Secretary for Health Admiral Rachel Levine, MD, to whom he reports in his role as NTP Director. He discussed the NASEM review of PFAS, which was conducted by an *ad hoc* committee of the NASEM. The report found evidence of association between PFAS exposure and:

- Decreased antibody response
- Dyslipidemia (abnormally high cholesterol)
- Decreased infant and fetal growth
- Increased risk of kidney cancer

The report calls for updates to CDC's clinical guidance.

Dr. Woychik outlined NIEHS Strategic Planning efforts for the new plan, which will cover 2024-2028.

He described the five emerging areas of scientific focus for NIEHS, which represent cross-cutting opportunities that contribute to implementation of the institute's Strategic Plan:

- Precision Environmental Health & the Exposome
- Computational Biology & Data Science
- Climate Change & Health
- Environmental Justice & Health Disparities
- Mechanistic & Translational Toxicology

Under Precision Environmental Health, he mentioned the International Common Disease Alliance (ICDA), which is addressing complex traits and involves huge cohorts, numbering in the tens of millions. He noted that the EHS community needs to engage with the ICDA to include environmental exposures and epigenetics into the efforts to phenotype the ICDA cohorts.

He discussed the July 28-29 workshop devoted to Integrating Climate Change and Environmental Data and Justice into the All of Us Research Program, which was sponsored by NIEHS and the All of Us Research Program. It brought together over 120 experts in environmental health, data privacy, biostatistics, climate change, epigenetics, genomics, and epidemiology. The program included three goals: a research agenda, data needs, and ancillary study design.

Over the summer, NIEHS held a series of five virtual workshops, “Accelerating Precision Environmental Health: Demonstrating the Value of the Exposome.” Over 400 colleagues joined some or all of the workshops, with 64 topics raised. The themes for the individual workshops were:

- July 22, 2022: Tools, Technologies, and Methodologies
- August 5, 2022: Biological Responses and Impact on Health and Disease
- August 12, 2022: Future of Clinical & Prevention Trials, Cohorts, and Epidemiology
- August 19, 2022: Social and Societal Impacts
- August 26, 2022: Data Infrastructure and Data Analytics

At a final virtual session August 31, 2022, 85 colleagues identified priorities.

September 14-16, 2022, saw an NIEHS Exposomics Summit, designed to collaboratively identify steps needed to enable exposomics research in support of Precision Environmental Health and Medicine. It addressed five major topic clusters that emerged from the Summer Exposomics Series:

- What to measure (when and why)?
- How to measure (methods)?
- Share and harmonize data (standards, ontologies...)
- Integrate, analyze, and interpret

- Translation and impact

Dr. Woychik addressed the third area of focus, climate change and health. He described the “All of NIH Initiative on Climate Change and Health,” which tasked NIH with taking a leading role in tackling the crisis. Seven Institute and Center Directors were tapped to lead the NIH response, including Dr. Woychik. The Executive Committee has re-energized the NIH Working Group, which is co-chaired by NIEHS and Fogarty International Center. The Working Group has formulated a framework for climate change and health research, with four core elements:

- Health effects research
- Health equity
- Intervention science
- Training & capacity building

The members of the Executive Committee provided funding with FY 2022 funds for projects from the seven NIH Initiative partners. Dr. Woychik detailed the four funded projects.

NIH has also initiated a new program called the 2022-2023 NIH Climate and Health Scholars Program, which will provide support to bring extramural scientists to work with NIH Climate Change and Health staff to share knowledge and help build capacity.

Dr. Woychik described the interest in climate change and health research within the NIH intramural programs. It includes a new competitive funding program, the Intramural Targeted Climate Change & Health (ITCCH) program, which will provide seed funding to stimulate research activities from NIH intramural investigators at multiple ICs.

He concluded his presentation by depicting links to several NIH resources on climate change and health. He then initiated Council strategic discussion on Exposomics, Precision Environmental Health, and Climate Change and Health.

Dr. Vasquez talked about the need to focus on mechanistic studies. Dr. Woychik said he agreed with her point, particularly as part of the vision for the DTT. Dr. Balshaw added that mechanistic studies would be one themes to be discussed at the Exposomics Summit.

Dr. Bourne commented regarding climate change and health, and asked what was happening internationally in terms of an opportunity to integrate with other global efforts. Dr. Woychik said it is well recognized that climate change is a global issue, and global strategies need to be developed. He cited a recent meeting with the Wellcome Trust as an example of conversations on a global scale. He acknowledged that it is a large,

complicated problem, and said he is working to bring a collaborative approach to it, according to a framework that will ensure accomplishment.

Dr. Penning noted that at the EHSCC Annual Meeting, the issue of developing an Intercenter Working Group on Climate Change and Health had arisen, which was subsequently unanimously endorsed by the core center directors. He said the next step would be to issue a survey to help identify needs and research gaps. Dr. Woychik said he was pleased to hear about the initiative and looks forward to supporting it. Dr. Penning added that moving forward with the new strategic plan, some emphasis needs to be put into place regarding identifying adverse outcome pathway constructs as a way to contribute to predictive toxicology, particularly incorporating machine learning and artificial intelligence. Dr. Woychik agreed, and added that to make machine learning and artificial intelligence capabilities possible, attention must be paid to the collection and annotation of data.

Regarding the Climate Change and Health Scholars Program, Dr. Kavanagh asked if it would be open to community members, students, or postdocs. Dr. Woychik said his understanding is that the program will be broad-based. Dr. Claudia Thompson added that it is not intended for graduate students and postdocs, but is designed for individuals who have a pedigree in climate change, because it involves working collaboratively with intramural scientists and others to bring climate change expertise to the NIH.

IV. NIEHS Strategic Plan 2024-2028: The Road Ahead

Dr. Sheila Newton, NIEHS planning officer and Deputy Director of the new NIEHS Office of Strategic Coordination, Planning, and Evaluation (SCOPE), briefed the Council on upcoming efforts to craft the next NIEHS Strategic Plan, which will cover the five years beginning in 2024. “It’s now time to begin the process of evaluating our goals and plans as an Institute to create a Strategic Plan to guide us through the next five years,” she said.

She noted that there will be specific requirements for the next plan that did not exist in 2018 when the current, 2018-2023 plan was conceived. As a result of language in the 21st Century Cures Act, there is now a common template for all NIH strategic plans, which all ICs must utilize. The template determines the format for all NIH plans, but does not address content. It requires:

- Overview and Introduction
- Scientific Goals/Objectives/Priorities
- Approach to stewardship
- Description of the strategic planning process

Dr. Newton described how the current plan's three Strategic Themes (Advancing Environmental Health Sciences, Promoting Translation, and Enhancing Stewardship and Support) will continue to provide the Institute's organizational framework and will translate to the common template. The plan development process will be guided collaboratively by an internal Planning Group. The process was created to help NIEHS assess where the science has moved and where it is going, allowing the Institute to update its goals, create or revise goals to fill gaps, and adjust priorities as needed.

The Initial Input Phase will last from now until Spring, 2023, including publication of a Request for Information (RFI) for input on existing goals, a virtual Open Space Technology meeting tentatively scheduled for March 2023, and inclusion of other key inputs. The Analysis and Draft Phase will last from Spring 2023 to Fall 2023. Inputs will be analyzed, and first draft goals will be created. Once the Senior Leadership Committee has approved the draft, it will be discussed at the September 2023 Council meeting. The plan will then be updated and posted for public comment. Following the comment period, the plan will be further revised as necessary and again submitted for review by Senior Leadership and Council. The last stage is finalization, layout, preparation of rollout plans, and then publication and rollout. That is slated to happen as early in 2024 as possible.

Dr. Hertz-Picciotto asked how long the comment period would be following the RFI. Dr. Newton said that the length of the comment period has not yet been determined; it will depend on when the RFI is released.

Dr. Goldman asked how much thought people are giving to the role NIEHS is playing in education of the scientific workforce, particularly in light of the need to bring together the many siloes that exist in environmental health sciences, especially in terms of language. Dr. Newton agreed that this was an important issue, that the issue had been recognized in the last strategic plan as part of the first professional pipeline goal, and that as the science progresses, it becomes even more important. She also noted that in comparison with 2018, when the previous plan was released, the number of related disciplines in environmental health sciences is even larger. Dr. Goldman discussed the importance of including behavioral science in the strategic plan. Dr. Woychik agreed.

Dr. Penning asked which other ICs would be doing their strategic plans in the same time frame, and if so, whether there would be consideration of any inter-IC initiatives. Dr. Newton said that there are some other ICs involved in strategic planning at this time. She noted that NIEHS has the opportunity to review and provide high-level input to other institutes' strategic plans and has done so with every other plan that has come out since 2019. It is a best practice for the institutes to circulate and get input from sister ICs to see where areas of synergy and overlap could be recognized. Dr. Woychik noted the

importance of ongoing discussions with other ICs beyond periods of strategic planning, because the collaborative atmosphere should be continuous.

Dr. Bourne asked whether there is an opportunity to make the strategic plan innovative itself, to make it a living document. Dr. Newton noted that under Dr. Woychik's leadership, there has been considerable effort to make the strategic plans living documents. She cited several examples, such as DERT's implementation practices with the current strategic plan. Dr. Woychik agreed that the current strategic plan has been a living document, quite by design. He discussed the importance of the development of implementation tracking metrics, to allow evaluation of the success of the goals and expectations of the strategic plan. For example, during their review process, intramural investigators are required to describe how their work aligns with specific elements of the plan.

Dr. Bourne mentioned the influence of the strategic plan on extramural researchers. Dr. Woychik noted that every grant funded is coded with reference to the goals of the strategic plan. Dr. Newton said that when a new strategic plan rollout is planned, it always goes to the listserv that includes all of the grantees. If all of the institutional directors of research and development are not included, they should be, she observed. Dr. Balshaw noted anecdotally that there are calls from researchers who say they had seen something of interest in the strategic plan, so it is clear that the plan is a decision-making tool in the extramural community. Dr. Woychik noted that the process is almost as important as the outcome.

Dr. Vasquez discussed the importance of buy-in to the success of a strategic plan.

VI. Report of the Acting Director, DERT

Acting DERT Director Dr. David Balshaw briefed Council on DERT activities and accomplishments since the June 2022 Council meeting.

He provided staff updates, including new hires Alicia Graham in Grants Management and Dr. Lakeisha Wade in the Administrative Office and the pending departures of Rosemary Moody who received a promotion to move to NIDA, and Martha Barnes, and Dr. J. Patrick Mastin, who are retiring. Dr. Woychik added his congratulations to Dr. Balshaw on being named Acting DERT Director. He listed the meetings DERT had been part of since the last Council meeting and described upcoming DERT meetings.

Dr. Balshaw supplied an overview of DERT's PFAS funding and other activities. In FY2021 NIEHS invested more than \$21 million in PFAS research activities, including 9 new projects and a total of 42 projects. Funding was awarded to 29 institutions. Grantees have published 28 publications from FY21 projects, and 32 PFAS-related news items were shared from those projects. NIEHS PFAS investments increased from

\$10 million in 2016 to more than \$20 million in 2021. He described the variety of PFAS studies, including epidemiological studies and fundamental and mechanistic studies, as well as NIEHS Superfund Research Program studies looking at potential solutions for PFAS. He also discussed the potential data gaps related to PFAS.

Dr. Balshaw reviewed the Office of Science and Technology Policy (OSTP) Joint Subcommittee on Environment, Innovation, and Public Health (JEEP) and some of the important work emerging from that effort. The JEEP was established in May 2020 in response to the National Defense Authorization Act for FY2020. Its purpose is to promote federal cross-disciplinary research and development activities in environmental public health, in 3 priority areas, each of which is addressed by a Strategy Team:

- Contaminants of Emerging Concern (CECs)
- Per- and Polyfluoroalkyl Substances (PFAS)
- Sustainable Chemistry

OSTP has established a research initiative called the National Emerging Contaminant Research Initiative (NECRI), which organizes CECs research into five strategic goals designed to ensure access to clean and plentiful drinking water for every person in our nation.

- Goal 1: Decrease the time from drinking water CEC identification to risk mitigation
- Goal 2: Promote technological innovation in tools to discover, track, understand, and mitigate drinking water CECs
- Goal 3: Develop and deploy tools and approaches for drinking water CEC decision making
- Goal 4: Coordinate transdisciplinary drinking water CEC research activities among Federal and non-Federal partners
- Goal 5: Foster transparency and public trust when communicating about drinking water CECs

Dr. Vasquez asked Dr. Balshaw to elaborate on the initiative to recognize female faculty members as being in an underrepresented group. Dr. Balshaw said it was for supplements to existing research grants to add support for junior level faculty – essentially a bridge to independence. Dr. Vasquez noted that it was often difficult for female faculty members to obtain their first R01, and suggested that a program for that would be useful. Dr. Balshaw said that the mechanism he had described was available through the existing diversity supplement program. Dr. Vasquez reiterated that that first step is often the most difficult for female researchers.

Dr. Hertz-Picciotto asked whether epidemiology is considered a biological science. Dr. Balshaw said that it is, and that any of the programs eligible for the diversity supplements would be eligible. Dr. Woychik agreed that epidemiology is in fact a biological science.

Dr. Miller asked what NECRI could become that NIEHS-funded scientists could contribute to. Dr. Balshaw cited the example of the Elk River spill as the type of issue that NIEHS-funded scientists could become involved with under NECRI. Dr. Miller pointed out that that example was reactive. He said he was having difficulty envisioning how NIEHS-funded scientists could participate in the broader research infrastructure. Dr. Balshaw said it was not yet clear whether it would be an NHANES-type surveillance program or a HHEAR-type research program, although he anticipated that it may be both models.

Regarding PFAS, Dr. Kavanagh asked about the potential for international collaborations. Dr. Berridge said there is engagement with overseas partners. Dr. Woychik asked whether some of the PFAS species removed from the market in the United States are still in use in other countries. Dr. Goldman said that there are some still on the market, and that it is a difficult issue on a global basis. Dr. Woychik noted that there are still PFAS in consumer products in the United States as well and acknowledge that this is a global issue.

VII. NIEHS Worker Training Program Infectious Disease and Pandemic Prevention Training: Then, Now, and Future

Sharon Beard, Director/Branch Chief of the NIEHS Worker Training Program (WTP) shared the program's activities around infectious diseases to date and plans for the future.

She related background information about the WTP, which provides health and safety training for thousands of workers who may be involved in handling hazardous materials or responding to emergency releases of hazardous materials. WTP has trained more than 4 million workers since its inception and reaches approximately 160,000 workers annually.

WTP supports the development and implementation of training programs to prevent occupational exposure to infectious agents that cause diseases like COVID-19 and Ebola. The Ebola Biosafety and Infectious Disease Response Worker Training Program began in 2016 and ran through 2019. Training was delivered in 36 states and one territory, with a wide variety of occupational sectors trained by grantees. Ms. Beard described several specific programs that conducted more than 4,800 courses for large national emergency response partners such as American Medical Response and Air

Methods Corporation, and training for flight attendants by Communication Workers of America via the United Steelworkers Consortium.

WTP has also built capacity during the COVID-19 pandemic by quickly filling knowledge gaps with effective training. For example, in spring 2020, WTP conducted a workshop on protection for infectious disease responders during the pandemic, which was attended by 260 participants. The WTP COVID-19 Safety Training Initiative was designed to increase health and safety awareness for responders and workers who faced potential exposure to the virus. It created a virtual training platform for affected workers and built a cadre of virtual safety trainers and advisors to deliver remote training. WTP has developed a variety of COVID-19 training tools, including a General Awareness Training Tool and an Essential and Returning Workers Training Tool. In addition to the training tools, fact sheets and checklists that aid in planning exposure control for diverse workers were added as more was learned about COVID-19 transmission. The Virtual Safety Training Platform has been used to train thousands of workers in management, construction, first responders, healthcare, military, science, and others.

The WTP COVID-19 Webinar Series has held twenty webinars. The latest was August 31, 2022: “WTP Reflects on COVID-19 Response, Plans Ahead for Future Infectious Disease Threats.”

Ms. Beard described the activities funded by supplemental funds in 2020-2022, which allowed grantees to deliver training specific to COVID-19 health and safety. WTP supplemental funding accounted for 40 awards totaling \$9 million. She provided details about several of the specific programs funded by the NOSIs, including several WTP COVID-19 Recovery Centers. Recently, WTP released funds for a second year of Recovery Centers and a second round of Recovery Center grants. One of the supplements was awarded to the Prevention, Preparedness and Response (P2R) Consortium at the University of Texas Health Science Center that delivered training to a variety of workers on topics such as decontamination and reuse of N95 filtering facepiece respirators and other respiratory equipment and improving airflow in labs and critical workspaces.

The entire WTP team as well as other DERT staff and contractors were invaluable to support this training initiative. For more information on our COVID-19 training efforts go to <https://tools.niehs.nih.gov/wetp/covid19worker/index.cfm>.

WTP will continue to use an all-hazards approach and build capacity, to be ready to pivot as outbreak events emerge.

Dr. Hertz-Picciotto complimented Ms. Beard on the accomplishments by WTP during the COVID-19 pandemic, particularly in the workplace.

Regarding the vaccine training Ms. Beard had mentioned, Dr. Kavanagh asked whether WTP had tracked employer acceptance, and whether it varied by sector. Ms. Beard said that some of the evaluations by the grantees looked at employer buy-in, and efforts to educate workers on the effectiveness of vaccines was one of the most effective programs conducted by the recovery centers for workers engaged in high-impact industries. She said that it might be possible to mine the evaluations that individual grantees had done to extract information in that area.

VIII. Concept: Data and Metadata Standards Efforts to Promote Development and Adoption of a Harmonized Environmental Health Language

Dr. Chris Duncan from the Genes, Environment, and Health Branch briefed the Council on a new concept to advance community-driven standards development efforts in key gap areas of the environmental health language. The purpose of the proposed initiative is to support resource-focused projects to enable EHS domain and/or subdomain communities to openly develop, extend, adapt, or refine data and metadata standards and associated tools to implement standards. The projects are intended to support activities at any point in the data standards lifecycle.

Dr. Duncan discussed the importance of open standards for data and metadata, and the reasons that harmonized language is a persistent challenge for EHS. He mentioned that there is a collective recognition that the lack of harmonized language approaches for describing environmental health data, findings, and knowledge has been a barrier for research and policy decisions. He provided a timeline for NIEHS efforts around harmonized language over the past several years, including the 2021 establishment of The Environmental Health Language Collaborative (EHLC), an effort to coordinate an ongoing community discussion around advancing integrative environmental health research by promoting access, use, and harmonization of data through interoperable terminologies and best practices.

He delineated the ongoing challenges in the field:

- Gaps in standard terminologies, vocabularies, ontologies, and related schema
- Data curation and harmonization efforts are challenging and time-consuming
- Standards development work is often done by “volunteer” effort
- Standards gaps lead to challenges for researchers/practitioners in:
 - Describing and comparing findings
 - Organizing and representing data
 - Finding and integrating data for analysis
 - Linking data in knowledge graphs
 - Addressing large-scale, complex EHS research questions

The concept is designed to provide catalytic support through research resources for a diverse array of EHS-focused standards development activities, utilizing NIH mechanisms for Research Resources.

Anticipated activities and outcomes include:

- Open standards for data and metadata
 - Developing, extending, adapting, or refining data and metadata standards in key gap areas of the environmental health language
- Tools for standards implementation
 - Developing, extending, adapting, or refining software tools to implement data and metadata standards for the EHS community
- Collaborator, contributor, and user community engagement
 - Engaging relevant persons, groups, and organizations throughout the data standards lifecycle

Dr. Duncan requested Council input on:

- Program structure
- Focus for individual resource projects
- Adoption and use
- Coordination with other domains and agencies

Dr. Bourne was the first Council discussant. He said that the program is an essential part of what the Institute proposes to do in the future, and addresses a compelling need. He emphasized two points. He noted that the initiative would take a huge amount of effort, but the payoffs would also be huge. He felt that the domain experts would need to engage in the effort to define the elements of the standards; otherwise, adoption would be very slow. He agreed with the emphasis on the role of resource leads as major participants, as they understand the data better than anyone. He emphasized the importance of NIEHS coordination, using the power of the dollar to facilitate how the standards come together. He said it would be advisable to be more dictatorial about what standards are to be used in funding calls; this would accelerate the process of getting the standards in place and getting them adopted. He noted that it is a complex undertaking, and that community engagement is perhaps the most critical element.

Dr. Goldman was the second Council discussant. She said the effort is extremely important and very difficult. She noted how much time had already been invested, but there is urgency for getting it done, especially with the new requirements on investigators. The more data provided publicly without standards, the less useful it will be, she observed, and over time that will become increasingly problematic. "Our community has been slow to harmonize," she said, and felt that there must be

incentives. She said the effort needs to be inclusive and brokered in a way so that everyone feels it is fair. She urged that the libraries not be overlooked, particularly the National Library of Medicine, and noted the importance of educating journal editors about standards. She wondered if the effort would be considered an international issue, or just a national issue, and felt that there should be a global common language.

Dr. Duncan agreed that there is a sense of momentum at present. He appreciated the suggestion about collaborating with the National Library of Medicine. He said that the issue is certainly international in nature, and cited several examples.

Dr. Vasquez asked how the standards to be developed would relate to those required by certain other entities such as many journals and some other institutions. Regarding metadata, she expressed concern about who sets the standards for what is accurate. Dr. Duncan said that the first option is always to reuse existing standards and ontologies. The emphasis is on inclusivity. Regarding quality standards, it comes down to the individual domains and fields.

Dr. Miller expressed frustration that it is taking so long to make progress in the area. He noted that journals have much control, but are also in a very competitive landscape. He cited the example of Environmental Health Perspectives (EHP), which has full autonomy. He said NIEHS, through EHP, should set the standard by picking an ontology for the journal and requiring its use, thereby setting a standard. He observed that going into the All of Us program without a solid ontology for environmental health would be a disaster. He said the effort should move ahead quickly, and NIEHS is in a position to lead it. Dr. Duncan agreed with Dr. Miller's points, and said he would discuss them with colleagues at EHP to see what could be done. Dr. Woychik indicated that EHP has editorial independence from the Institute, and it would be inappropriate for us to push this but that the community, or members of Council, could share this perspective with the Editor in Chief.

Dr. Hertz-Picciotto applauded the effort, and noted that the project will never end, but should be thought of as a process as new methodologies and terminologies come along.

Dr. Balshaw called for a vote on the proposed concept. Dr. Bourne moved acceptance; Dr. Miller seconded. The Council voted to accept the proposal.

Dr. Woychik added a comment that although EHP is the NIEHS journal, the agreement is that the editor-in-chief and editorial staff have editorial independence, so NIEHS personnel cannot dictate the journal's practices or policies. However, he said that Dr. Archer will bring the discussion points up with the editor-in-chief.

IX. Concept: Superfund Hazardous Substances and Basic Research and Training Program (SRP) Continuation of Multi-Project Center Grants

On behalf of the SRP team, Dr. Michelle Heacock presented the concept proposing to continue the P42 program structure and function.

She provided background information about the SRP's mandates, strategic plan, evolution, and history, as well as its current funding mechanisms, including the P42 Multi-Project Centers. She noted that SRP has supported more than 2,500 trainees, and has awarded grants to more than 1,300 researchers, who have published more than 11,000 research publications and patented 200 inventions. SRP-funded remediation and site monitoring tools are estimated to have saved more than \$100 million compared to traditional approaches.

P42 Centers consist of interdisciplinary research teams with expertise in biomedical science as well as environmental science and engineering to advance knowledge using innovative and integrative approaches. Centers are expected to facilitate transfer of research finding through coordinated data management and analysis, engage communities with prevention/intervention strategies, share findings with broader audiences, and train the future generation of scientists.

Since the Centers were first funded in 1987, the SRP has continued to evolve, both structurally and scientifically, introducing key components that are now required and in place to help enhance the impact of the science emerging from the program. These components include a Community Engagement Core (CEC), Research Translation (RT) activities, a Research Experience and Training Coordination Core (RETCC), and most recently a Data Management and Analysis Core (DMAC). In addition to these required cores, each center consists of at least two biomedical research (BMR) and two environmental science and engineering projects (ESE). In the last iteration of this RFA, Centers were limited to 11 components and could request a budget of up to \$1.75M/year direct costs for 5 years.

Moving forward, the Centers program is designed to:

- Advance collaborations
- Continue to value Community in the research enterprise
- Promote cross-disciplinary training
- Encourage diversity
- Enhance data management and sharing strategies
- Embrace a Systems Approach

Dr. Penning was the first Council discussant. He praised the program and said what makes it really unique and outstanding is the marriage of environmental science with

environmental health science, particularly the engineering and remediation components, which impact the research translation component within the field. “The concept of having two nonbiomedical and two biomedical projects linked together by a theme is very persuasive and compelling,” he observed. He said that the idea of being able to do environmental engineering, exposure reduction, remediation and mitigation are all very unique to the program. The biomedical components provide a way to mitigate health effects at the individual level. He endorsed the idea that the program is not Superfund site-specific. He cautioned against becoming unbalanced in the portfolio. He said he liked the systems approach. He noticed that the program’s level of funding had leveled off coincident with the addition of cores. Thus, he felt that the funding needs to increase. He noted that the Research Translation Core is an important element, and perhaps it should not be diluted as part of the Admin Core, where it is currently placed. He commented on the Community Engagement Core, which should include elements that go beyond remediation, with post-remediation plans. He recommended inclusion of entrepreneurship training as part of the Training Core. Finally, he said that the Data Management Core is essential.

Dr. Kavanagh said he was very impressed with the program, which occupies a unique place in NIEHS, as one of the few places where funding can be secured to conduct ecosystems research and restoration ecology, as well as associated remediation technologies to be applied in a translational fashion. The opportunity for students and post-docs to acquire exposure to multidisciplinary training is also important, as is the program’s emphasis on risk assessment. He commended the program for its excellent communication tools. Regarding the flat funding mentioned by Dr. Penning, he wondered if it could be addressed by involving some of the other core centers, perhaps by adding P30 supplements, although this may be a problem with mingling of funds. He said he was curious about the climate change aspects of the program, at the intersection of climate change with public health, environmental health, and the health of the environment. He concluded by expressing his support for the program.

Dr. Balshaw called for a vote on the proposed concept. Dr. Goldman moved acceptance; Dr. Penning seconded the motion. The Council voted in favor of approving the concept.

X. Overview of Guidance on PFAS Exposure, Testing, and Clinical Follow-ups

Dr. Christopher Reh, Associate Director of the Agency for Toxic Substances and Disease Registry (ATSDR) briefed the Council on the many activities at ATSDR associated with PFAS, which he called “a major initiative for the agency and our sister agency, the National Center for Environmental Health (NCEH).” He provided background information about ATSDR (“a small but mighty agency”) and its key

strategies. He noted that the science on PFAS is changing every month, and summarized much of the known characteristics of PFAS and its sources in the environment. He described the health effects of PFAS and noted that some (but not all) studies in humans with PFAS exposure have shown that certain PFAS may affect many systems in the body. Thousands of PFAS and PFAS precursors have been identified, and as legacy PFAS are phased out, replacement species are being developed.

Dr. Reh went over federal PFAS activities from 1999 through 2015, including CDC's NHANES, which was the first study to document widespread exposure to PFAS in the U.S. Since 2002, PFAS have been measured in blood samples collected in the NHANES effort.

He described ATSDR's PFAS site work in more than 30 communities across the nation. The National Defense Authorization Act authorized PFAS activities from 2018 – 2022:

- Multi-Site Health Study
 - Expands science on the relationship between PFAS exposure and health outcomes
 - Helps people better understand their risk for health effects
- Exposure Assessments
 - Assess PFAS exposure in communities near current or former military installations
 - Compare PFAS levels in blood and urine from each community to levels in the general population
 - Identify and assess environmental factors that affect exposure
- Pease Study
 - Expands science on the relationship between PFAS exposure and health outcomes
 - Evaluates study procedures and methods to improve the design of multi-site health study

Dr. Reh listed the 10 communities across the country where exposure assessments are being conducted. He provided more details about the Pease Study, which is being conducted in Portsmouth, NH. For the Multi-Site Health Study, CDC and ATSDR have established cooperative agreements with seven partners across the nation to study how drinking water that contains PFAS may harm health.

He described the National Academies report, which was released in July 2022, and provides advice regarding PFAS testing and how test results should inform clinical care. NCEH/ATSDR is currently examining the findings in the report, and will update guidance for clinicians advising patients with concerns about PFAS exposure. Dr. Reh went over the high-level findings included in the report.

He discussed the ATSDR Toxicological Profile for PFAS, and Minimal Risk Levels (MRLs), which can be converted into drinking water concentrations for adults and children called Environmental Media Evaluation Guides (EMEGs). He referred to several tools and resources available online from ATSDR.

He mentioned two ATSDR publications on PFAS mixtures that will soon be released.

Dr. Greenamyre asked about neurologic outcomes, which did not appear to be assessed in the NASEM report. Dr. Reh said that was correct. He said there are neurologic outcomes in the Pease Study and the Multi-Site Study. Dr. Greenamyre suggested that it would be useful to also look at late-onset neurodegenerative diseases. Dr. Reh said that in terms of PFAS 2.0, that is on the list. He noted that ATSDR has the ALS biorepository, which provides a resource for some of that work.

Dr. Pérez-Lugo asked Dr. Reh to expand on the public engagement dimension of the enterprise, and if within the products ATSDR has produced there are products directed toward specific community needs, instead of just the researchers. Dr. Reh replied that most of ATSDR's work is designed around engaging with people in specific communities. He said there is a new section within ATSDR to emphasize community engagement.

Dr. Penning noted that he had put a connection in the chat to a publication that just came out of his center describing a method of discovering health effects by "reverse epidemiology" (PMCID: PMC8357930). It used electronic health records (EHRs) to measure PFAS health effects in individuals located near a Pennsylvania military base. His group was able to conduct the study as part of a large health system, and he suggested it could be another way to capture the health effects of PFAS. Dr. Reh replied that ATSDR is still "spinning up" its ability to look at EHRs, as it is somewhat more cumbersome to do so at the federal level. There is a pilot study underway at NCEH to determine how to conduct reverse epidemiology using EHRs.

Dr. Hood asked Dr. Reh whether ATSDR is aware that, based on litigation related to PFAS compounds, it has been shown that the primary source of exposure in communities of color is coming from landfills. Dr. Reh said he was aware, but had not had time to include ATSDR's Environmental Justice Index in his presentation. The index was just released. He noted that the agency has had a drinking water focus, but is conducting an analysis currently looking at contamination from hazardous waste sites, which should be released in 2023.

Dr. Holian asked Dr. Reh what in his view would be the critical next steps. Dr. Reh replied that it will be important to get a better handle on what total exposure looks like, beyond just drinking water, understanding how the many exposure pathways contribute to overall exposure. Also, understanding the role of mixtures in producing health effects.

He said that doing the right cancer studies would be important. He also cited an interest in the mother-developing-fetus-child continuum.

XI. PFAS in DTT: Designing a Next-Generation Research Strategy

Dr. Brian Berridge, the Scientific Director of the Division of Translational Toxicology (DTT), briefed the Council on DTT plans for developing a next-generation PFAS research strategy.

He provided an overview of the DTT organizational mission as context for the division's PFAS work, including the division's goals. He summarized the history of DTT PFAS health effects research, which have encompassed animal toxicity studies, literature-based health hazard assessments, and laboratory-based bioactivity screening and investigative studies.

Dr. Berridge described how the DTT pipeline of capabilities, the Translational Toxicology Pipeline, applies to PFAS problems. He listed the variety of challenges to developing a next-generation PFAS research strategy:

- Hundreds–thousands of test articles
- Lots of stakeholders with lots of different (but complementary) needs
- Lots of players in the field
- Competing portfolio priorities – e.g., other important public health needs we could be working on
- Matching technical and intellectual capabilities to need
- Defining actionable products that can be delivered in a timely way

He discussed the background behind the collaboration among the National Academies, the CDC, ATSDR, and NIEHS:

- Review of current human evidence of PFAS of CDC's National report on Human Exposure to Environmental Chemicals
- To guide decision-making for PFAS testing in a patient's blood or urine
- To determine PFAS concentrations that could inform clinical care of exposed patients
- Recommend appropriate patient follow-up and care specific to PFAS-associated health endpoints

The committee found sufficient evidence of an association between PFAS exposure and four specific diseases and health outcomes. It found limited or suggestive evidence of an association with several other diseases and health outcomes. It also observed a variety of gaps in the evidence. Dr. Berridge described the research opportunities those

findings presented. He reported the considerations for developing a PFAS research strategy:

- We know we're exposed to PFAS, and they have health effects; we know what many of those health effects are.
- There is a lot of existing PFAS data.
- Is there enough existing data to make the decisions we need to make?
- Should we do anything?
- If so, what could/should we do that best fits our capabilities and place in the PFAS research enterprise that:
 - Addresses a discrete and definable problem
 - Would produce an actionable product
 - Could be delivered in a time that would make a difference.

In summary, Dr. Berridge noted that:

- DTT has and continues to be active in PFAS research.
- Our technical and intellectual capabilities position us to add value in the area of hazard assessments to inform human public health decision-making.
- It would be easy enough for us to continue to conduct research in this area, produce data, and publish reports/papers, but does it add value?
- Our resources are not limitless.
- If we do this, we're not doing something else.
- Where do we put our efforts for best effect in a timeframe that helps our public stakeholders?

XII. Investigating PFAS Health Effects in a Highly Exposed Population: GenX Exposure Study in North Carolina

Dr. Jane Hoppin, Professor of Biological Sciences at North Carolina State University and Director of the Center for Human Health and the Environment, reported to the Council on the GenX Exposure Study in North Carolina. The study started in 2017 in response to community concerns about potential GenX exposures in the drinking water in the Cape Fear River Basin, the largest watershed in North Carolina, which supplies approximately 1.5 million people with drinking water. GenX, a type of PFAS, was discharged into the river from a chemical plant upstream of Wilmington, NC for many years. The company responsible, Chemours, announced in late June 2017 that it had ceased the discharge. The study was designed to respond to community concerns, such as:

- Am I exposed?
- Is the chemical in my body?

- What are the health effects?

The challenges from the outset were:

- What chemicals to look for
- No analytical standards
- No half-life information
- Little or no toxicology data
- No comparison populations

Dr. Hoppin provided background information about GenX, which was used to make Teflon and is also a byproduct of fluorochemical manufacturing. Fluoroethers produced as manufacturing byproducts were discharged into the river. Wilmington and Fayetteville, NC, were the most affected communities.

Dr. Hoppin described the design of the study, which enrolled 344 Wilmington residents 6 years of age and older. It involved collection of blood and drinking water samples, which were analyzed for GenX and other PFAS, along with clinical analyses. Report back was incorporated, and there was substantial community engagement. GenX was not detected in anyone's samples, but 7 PFAS were detected in almost everyone's blood, including 3 long chain fluoroethers. Blood concentrations of the fluoroethers decreased after 6 months. Dr. Hoppin presented several other findings from the study. Ultimately:

- New PFAS was found in the blood of all Wilmington residents, 5-11 months after discharge to the river stopped.
- Residents had elevated levels of all legacy PFAS
- ~25% of PFAS in blood was related to the new chemicals
- The levels of all new chemicals could not be measured and quantified, so that is likely an underestimate.

The study will transition from an exposure study to a health study. It will grow to 1200 participants throughout the Cape Fear Basin. It will be a five-year project.

XIII. PFAS: Ethical and Social Issues

Former Council member and Michigan State University Professor Dr. Kevin Elliott briefed the Council on the ethical and social issues surrounding PFAS, as addressed in the 2022 NASEM report, *Guidance on PFAS Exposure, Testing, and Clinical Follow-up*. Dr. Elliott was on the committee that prepared the report.

He started by discussing the principles for decision making as presented in the report. The principles incorporated Proportionality, Justice, Autonomy, Feasibility, and

Adaptability. Dr. Elliott presented quotes from the report illustrating several of the principles.

He discussed the community engagement elements addressed in the report, including messages from some of the town halls that had been held. He described PFAS-REACH and report-back initiatives as examples of community engagement.

Looking at some other issues related to the report, he mentioned studies that discussed the definition and categorization of PFAS. He described some of the obstacles to progress in PFAS research, including legal and surveillance-related obstacles. He discussed the need for better education on occupational and environmental medicine.

XIV. Council Discussion

Dr. L. Michelle Bennett, Senior Advisor for Strategic Initiatives in the Office of the Director, led a Council discussion session, which focused on these questions:

- Of the challenges you heard about today (e.g., the need for better exposure surveillance, the lack of chemical standards, the fragmentation of information among government agencies), which are the most pressing and what approaches are the most promising for addressing them?
- What scientific investments today will have the most return tomorrow in helping our public stakeholders?
 - Community-engaged projects? Better PFAS classification schemes? Understanding and addressing environmental injustices? Exposure characterization for newly identified chemicals? Something else?
- How can we improve exposure reconstruction, recognizing that we don't know the full extent of PFAS exposure in the US?
- In what ways can toxicology and computational biology help bridge the gaps being observed in epidemiological studies?
- What role, if any, does NIEHS/NIH have in better educating clinicians about environmental and occupational health?

Dr. Goldman agreed with Dr. Elliott that there is a lack of preparation by clinicians to be able to address issues like PFAS. She observed that it is true that medical education provides very little knowledge or preparation for environmental or occupational health practice. There was more focus historically by NIEHS, ATSDR, NIOSH, and other agencies on attempting to provide more education. Even loading EHS into medical school curricula, most practitioners graduated years ago. She said it is an ethical problem that most people cannot get their individual situation evaluated by a physician, and added that it is also an ethical problem that there is not a standardized, reliable clinical test to use. She felt that one cannot get reliable analytics by going to individual laboratories. More capacity is needed, to be implemented in a way that includes

validation, whether it is CLIA or state processes. She said it is a terrible situation in terms of the lack of an infrastructure in clinical medicine to deal with EHS. As a former regulator, she felt that it is immoral for there to be continued production of PFAS compounds, as they are not critical in their uses.

Dr. Hertz-Picciotto addressed the issue of clinician dismissiveness. She blamed the medical education for the ongoing ignorance, with environmental and occupational health only at the margins. She asked about the relative contribution of consumer products like non-stick pans versus the role of drinking water. She asked for more information about the long half-lives of the legacy compounds. Regarding the Superfund Research Program, she asked if there is currently research on medical interventions for people to reduce or eliminate their longer-lived PFAS body burdens.

Dr. Hoppin described an ongoing study in Bladen County, the poorest county in North Carolina, which presents the issue of how to communicate effectively with the community. She said her group had done a lot of work on PFAS half-lives. Most are 2-7 years, but since exposure has been relatively constant for such a long period of time, the body burdens still persist. Her group has been working to model the half-lives, so as to be able to make inferences about the future. She said that relative contribution presents an interesting challenge, because in the area where her research is being conducted, exposure was mainly in the water. "If you are in a highly exposed area, relative contributions of other things are less important," she noted.

Dr. Elliott added that he was curious about how to provide incentives for broadly based medical education, which is a long-standing issue. He said that some people in the profession have speculated that it needs to be addressed in the field's board exams.

Dr. Miller felt that the field needs to get better at measuring PFAS levels. In clinical care, CLIA-certified tests must be performed, which are not trivial items. There should be a plan to get LabCorp and Quest to offer a CLIA-certified PFAS test. There needs to be a strategy for getting more environmental chemical tests CLIA-certified, he said.

Dr. Reh said that issues such as CLIA tests and who pays for them are health equity issues. He noted that insurance companies are not paying for them, and they are not cheap, even when they can be ordered. Most physicians are completely ignorant of the issue or how to address it. He said that when ATSDR completes a field study and provides results, they recommend taking the report to doctors. They conduct physician education around PFAS in the affected communities, but it is a struggle, because they do not have a ready knowledge base from their education. He suggested that it might be helpful to ensure that physicians get continuing education credits. He said that they consider themselves lucky to get 50% of the physician community in a particular area. They rely on community action panels, with people on the ground in affected areas, to

reach out to the doctors. He said it is “a huge health equity issue that is going to take a combined effort.” He noted that the points of departure for developing health standards for PFAS continue to go down, which makes the issue more difficult. He is optimistic that remediation technologies will continue to progress, in order to be able to help people who have contaminated drinking water. However, “what we think of today as minor exposures may not necessarily be as minor as we once thought.”

Dr. Woychik noted that PFAS is a highly complex problem being addressed by several different organizations. He asked Dr. Reh wondered if they are tripping over each other or centrally organizing. He also asked Dr. Reh his thoughts about the role of the NTP. Dr. Reh said ATSDR works closely with the NTP, with constant communication. He agreed that it is a challenge to coordinate efforts, even as a Federal family. He cited several organizations involved, and noted that even the VA and DOD are involved. He agreed that “we are tripping over each other,” despite past efforts at coordination and consolidation. He said, “We talk at each other, not with each other,” with everyone trying to get their piece of the pie and promote their programs. There would be more power in working together to look at PFAS 2.0 than pursuing it individually. Dr. Woychik agreed that there must be a better job of coordination among Federal agencies. He said that as Director of the NTP, he will step in to ensure that NTP is more proactive.

Dr. Hood observed that the issue of PFAS compounds is “a snowball going downhill” right now, and even more important is their interaction with disinfection-related byproducts produced by water treatment facilities. When those compounds are mixed with a municipal drinking water supply, it is “a formula for disaster.” He hoped that the social and ethical issues connected with PFAS can be addressed in short order.

Dr. Penning addressed three points. First, he reinforced the previous comments about the lack of medical education in environmental health and occupational health. He suggested that NIOSH and NIEHS work together on new training programs, and that NIEHS take a leadership role in influencing the American Association of Medical Colleges (AAMC) to recognize the need for education in this area, with a longer-term goal to advance the ability to take effective individual exposure histories. Those histories becoming part of the electronic health record would be “an enormous inroad into the exposomics initiative that NIEHS and other ICs want to implement.” Second, he felt that there are challenges when it comes to exposomics, such as the large and growing number of PFAS chemicals. Third, the issue of health equity is another challenge, with measurement of the exposome creating inequities in access and costs.

Dr. Hall said that in terms of medical education, the specialty needs a re-branding. She suggested that perhaps the “occupational” should be removed from the specialty. She added that there are ways to leverage the roles of professional societies by working in the clinical environment to do things like change diagnostic codes or adding clinical

testing. She said there is “definitely a lot that can be done,” including by AAMC and other boards. There is a way forward, although it will not happen quickly.

Dr. Elliott expressed appreciation for the ideas about medical education. He amplified the point about health equity when it comes to PFAS testing, which is not cheap.

Dr. Reh said he had worked on both sides of the fence in occupational and environmental health, and he found that partnering with NIOSH had been very valuable, as they speak the same language when it comes to PFAS work.

Dr. Woychik commented about his efforts to increase consciousness of environmental health among his fellow NIH IC directors. He said that the leadership in the institutes must be aware of the importance of environmental exposures, which can then trickle into the rest of the biomedical research enterprise.

Dr. Greenamyre said the specialized training programs being discussed were great, but training in the field needs to be much more broad-based and earlier, starting in medical school, although there is competition for space in the medical curriculum.

Regarding equity issues, Dr. Hoppin said her group is aware that everyone in the Cape Fear River basin is at high risk of being highly exposed. Better predictive models are needed.

Dr. Berridge said a more proactive problem definition phase is needed in the area. There are many research plans being developed, but there is a need to address existing gaps, with improved prioritization.

Dr. Goldman mentioned that the issue would be a perfect one to put the mission of the NTP to the test. With the many different types of exposures, there is a need for a government-wide approach to coordinate efforts effectively, given the magnitude of the problem.

Dr. Elliott said that with so many chemicals in the class, there is considerable uncertainty, so there is a need to group them effectively to aid decision making.

Dr. Bennett concluded the discussion, thanking the participants.

Dr. Balshaw added his thanks to all of the Council members.

XV. Adjournment

Dr. Woychik thanked Dr. Balshaw, and thanked everyone who had been involved in preparing for the meeting, including Nathan Mitchiner and his colleagues, Liz McNair, and Dr. Pat Mastin.

Dr. Balshaw thanked Rosemary Moody and everyone in DERT.

