

**DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
NATIONAL INSTITUTES OF HEALTH**

**NATIONAL ADVISORY COUNCIL FOR
BIOMEDICAL IMAGING AND BIOENGINEERING**

**Summary of Meeting¹
May 19, 2016**

The National Advisory Council for Biomedical Imaging and Bioengineering (NACBIB) was convened for its 41st meeting on May 19, 2016, at the Bolger Center in Potomac, Maryland. Dr. Roderic I. Pettigrew, Director of the National Institute of Biomedical Imaging and Bioengineering (NIBIB), presided as Council chairperson. In accordance with Public Law 92-463, the meeting was open to the public from 9:00 a.m. to 12:45 p.m. for review and discussion of program development, needs, and policy. The meeting was closed to the public from 1:50 p.m. to 2:53 p.m. for the consideration of grant applications.

Council members present:

Dr. Carol Espy-Wilson, University of Maryland, College Park, MD
Dr. Karen Hirschi, Yale University, New Haven, CT
Dr. Raphael Lee, University of Chicago, Chicago, IL
Dr. John H. Linehan, Northwestern University, Evanston, IL
Dr. Carolyn Meltzer, Emory University Hospital, Atlanta, GA
Dr. A. Gregory Sorensen, Imris Deerfield Imaging USA, Minnetonka, MN
Dr. Daniel Sullivan, Duke University Medical Center, Durham, NC
Dr. James Thrall, Massachusetts General Hospital, Harvard Medical School, Boston, MA
Dr. Bruce Tromberg, University of California, Irvine, CA
Dr. Sheldon Weinbaum, The City College of New York, New York, NY

Council Member Attending by Telephone:

Dr. Charles Mistretta, University of Wisconsin, Madison, Madison, WI

Council members absent:

Dr. Kristi Anseth, University of Colorado, Boulder, Boulder, CO

Ex officio members present:

Dr. Anne Plant, National Institute of Standards and Technology, Gaithersburg, MD
Dr. Sohi Rastegar, National Science Foundation, Arlington, VA

Ex officio members absent:

Ms. Sylvia Burwell, U.S. Department of Health and Human Services, Washington, DC
Dr. Francis Collins, National Institutes of Health, Bethesda, MD

Chairperson:

Dr. Roderic I. Pettigrew

¹ For the record, it is noted that members absent themselves from the meeting when the Council is discussing applications (a) from their respective institutions or (b) in which a conflict of interest may occur. This procedure only applies to applications that are discussed individually, not to "en bloc" actions.

Also present:

NIBIB staff present for portions of the meeting:

Ms. Holly Atherton	Dr. Steven Krosnick
Mr. Angelos Bacas	Dr. Richard Leapman
Dr. Richard Baird	Dr. Guoying Liu
Ms. Katie Ellis	Dr. Raymond MacDougall
Ms. Barbara Cantilena	Dr. Shadi Mamaghani
Mr. Christian Cartagena	Dr. Michael Marge
Dr. Michael Cheetham	Dr. Mark Martin
Dr. Richard Conroy	Mr. Rishi Mathura
Ms. Christine Cooper	Ms. Jessica Meade
Ms. Zoe Ann Copeland	Mr. Todd Merchak
Mr. Anuraj Dandgaval	Dr. Nicole Morgan
Ms. Monique Day	Mr. Larry Morton
Dr. Emilios Dimitriadis	Mr. Joe Mosimann
Mr. Anthony Dorion	Dr. George Patterson
Dr. Henry Eden	Dr. Grace Peng
Ms. Kate Egan	Ms. Ruthann Rand
Ms. Angela Eldridge	Dr. Edward Ramos
Dr. Zeynep Erim	Dr. David Rampulla
Mr. Jason Ford	Dr. Antonio Sastre
Mr. Anthony Fransella	Ms. Sarah Scharf
Dr. John Hayes	Dr. Behrouz Shabestari
Dr. Jill Heemskerck	Mr. Shaun Sims
Dr. Dennis Hlasta	Mr. Russell Songco
Ms. Alisha Hopkins	Dr. Manana Sukhareva
Mr. James Huff	Ms. Florence Turska
Dr. Rosemarie Hunziker	Ms. Keisha Whitaker-Duncan
Mr. Tom Izzard	Mr. Kwesi Wright
Ms. Stacy Jones	Dr. Li-Yin Xi
Dr. Krishna Kandarpa	Dr. Ruixia Zhou
Dr. Chris Kelley	Dr. Steven Zullo
Dr. Peter Kirschner	

Members of the public present for portions of the meeting:

Dr. Eric Betzig, Janelia Farm Research Campus, Ashburn, VA
Ms. Erin Cadwalader, Lewis-Burke Associates, Washington, DC
Ms. Renee Cruea, Academy of Radiology Research, Washington, DC
Ms. Paris Day, Baltimore Design School, Baltimore, MD
Dr. Anthony Demsey, Contractor, Waxhaw, NC
Ms. Monika Dickens, Baltimore Design School, Baltimore, MD
Dr. Craig J. Goergen, Purdue University, Indiana
Ms. Blair Hall, Baltimore Design School, Baltimore, MD
Ms. Briana Kelley, Baltimore Design School, Baltimore, MD
Ms. Makeia Kelly, Baltimore Design School, Baltimore, MD
Ms. Miyona Thompson Payne, Baltimore Design School, Baltimore, MD
Mr. Michael Peters, American College of Radiology, Washington, DC
Ms. Anissa Reynolds, Baltimore Design School, Baltimore, MD
Mr. Steven Rose, Bolger Center, Potomac, MD
Ms. Maria Spencer, Academy of Radiology Research, Washington, DC
Ms. Teresa Spriggs, Baltimore Design School, Baltimore, MD
Ms. Trinaya Spriggs, Baltimore Design School, Baltimore, MD
Ms. Angel Wheeler, Baltimore Design School, Baltimore, MD

I. Call to Order: Dr. David T. George

Dr. David T. George called to order the 41st meeting of the National Advisory Council for Biomedical Imaging and Bioengineering. He reminded attendees that the morning session of the meeting was open to the public and welcomed attendees.

II. Director's Remarks: Dr. Roderic I. Pettigrew

A. Welcome

Dr. Pettigrew opened the meeting by remembering Larry Clarke, Ph.D., from the National Cancer Institute, and Lee Rosen, Ph.D., from the NIH Center for Scientific Review, who have recently passed, noting they would be missed by the imaging community. He also welcomed STEM/STEAM students visiting from the Baltimore Design School.

B. NIBIB Transitions, Awards, and New Staff

Dr. Pettigrew announced recent staff departures, including Dr. Jessica Tucker who transitioned to a position in the NIH Office of Science Policy, and Dr. Michael Dellarco, who retired but will continue as a part-time contractor in the Division of Discovery Science and Technology.

Jordan J. Green, Ph.D., an NIBIB grantee, was acknowledged for his Presidential Early Career Award for Scientists and Engineers (PECASE).

Dr. Pettigrew introduced four new staff members to NIBIB: **Jason M. Ford**, Executive Officer, Office of Administrative Management; **David Rampulla, Ph.D.**, Program Director, Division of Discovery Science and Technology; **Emily Conlan**, Scientific Program Analyst, Division of Interdisciplinary Training; and **Stacy L. Jones-Straehle**, Scientific Program Analyst, Division of Applied Science and Technology.

C. NIH/NIBIB Budget

The FY16 budget includes a 5% increase for NIBIB (of this, 1.1% is designated for the BRAIN initiative). The NIBIB 2016 R01 payline will be at the 12th percentile.

D. NIH Activities

Zika Response: There have been recent increases in reported cases of Zika, particularly in Brazil. NIBIB is participating on an initiative to support Zika research via the R21 mechanism.

NIH-Bill and Melinda Gates Foundation (BMGF) Working Group on Point of Care Diagnostics met in April to discuss collaborations to bring diagnostic tests to low-resource settings. The group focused on goals such as identifying predictive proteins and biomarkers for preeclampsia and neonatal sepsis, lowering costs and increasing sensitivity of tests for HIV and tuberculosis, and developing a test for malaria that does not require drawing blood.

Multi-IC Initiatives: In 2017, NIBIB will lead two new requests for applications for the **BRAIN Initiative**: (1) next generation tools and technologies to image the human brain and (2) innovative early stage ideas for the next generation human brain imaging tools and technologies. NIBIB has partnered with NICHD for the **Human Placenta Project**. Now in its third year, fifteen of the nineteen grants awarded have been for imaging projects. The **P41 annual meeting** was held in April and NIBIB presented the policy requiring applications with a new focus after fifteen years of project funding.

E. NIBIB Activities

DEBUT (Design by Biomedical Undergraduate Teams): NIBIB's partnership with VentureWell offers \$65,000 in prizes for excellence in biomedical design and innovation to undergraduate biomedical engineering students. The competition closes at the end of May.

Engineering Clinician-Scientist supplement program: A partnership with the National Center for Advancing Translational Sciences (NCATS) CTSA program was proposed in which teams of engineers supported by NIBIB and CTSA clinician-scientists would be funded for two-year projects that translate engineering approaches to the clinic.

Meyerhoff scholars: The Meyerhoff Scholars Program supports and trains minority students in STEM fields. Meyerhoff Scholars graduating from the University of Maryland, Baltimore County (supported in part by NIBIB and NIDA) go on to pursue MD or PhD degrees at a significantly higher rate than similar students attending other universities.

NIH Take Your Child to Work Day: The annual event proved to be a success with over three hundred children playing the NIBIB game app "Want to be a Bioengineer?".

Congressional Communication: In February, NIBIB showcased Infrared Imaging and Tomography to students from DC and Baltimore schools as part of the White House's National Week at the Labs. In March, twenty-eight congressional staff members visited NIBIB to see technology demonstrations from five grantees and to tour an intramural lab. In April, NIBIB participated in the Coalition for Imaging and Biomedical Research (CIBR) 2016 Medical Technology Showcase on Capitol Hill, allowing congressional representatives to hear personal stories of the positive difference imaging makes in patients' lives.

F. News and Science Highlights

ISMRM meeting: The International Society for Magnetic Resonance in Medicine meeting was held in early May in Singapore and featured the NIBIB New Horizons Lecture by Dr. Kawin Setsompop on accelerated imaging.

Neurovascular regeneration: NIBIB-funded researchers at Yale are working to develop transplantable neurovascular regenerative units (complete with neural stem cells and blood vessels) in an effort to promote recovery following stroke.

Stem cell transplantation: A team of NIBIB-funded scientists from Rutgers and Stanford are working to create three-dimensional scaffolds to transplant neural stem cells in the brain. Their system increased survival in the mouse brain and the ability to make functional networks in hippocampal slices.

Glioblastoma imaging biomarkers: Recent work by NIBIB-funded researchers shows that magnetic resonance imaging (MRI) can identify characteristics of glioblastomas that predict clinical outcome.

Musical MRIs: A new technique called magnetic resonance fingerprinting can turn the sounds of an MRI scanner into musical tones and improve patient comfort.

III. Precision Medicine Initiative: Dr. Edward Ramos

Dr. Edward Ramos presented the President's Precision Medicine Initiative (PMI) Cohort Program, which will be the largest longitudinal study ever conducted in the US. The program is being rolled out rapidly with pilot awards issued this summer and an expected enrollment of 79,000 people by the end of 2016. It will take a transformational approach, viewing participants as partners in the research process, emphasizing representation across diverse economic and education levels, races, ethnicities, and communities, and

efficiently sharing data between researchers and participants.

The first phase will focus on engaging the initial participants and obtaining standard information and data. Phase II, beginning in 2017, will expand the participants to one million, establish on-going research, and include data from genetics, smartphones, and structured electronic health records. Phase III will continue from 2020 onward and will maintain engagement with the participants while expanding and upgrading the core data. In collaboration with six electronic health records vendors, NIH has launched an application called “Sync for Science” that allows participants to voluntarily share their data with PMI researchers.

Discussion

Discussion focused on how imaging data might be included in PMI, along with the challenges of large image archives and quality control for images coming from many different sources. The use of personal health and fitness monitors as a potential resource was discussed, particularly as new non-commercial monitors are currently in development. Cooperation between electronic health records organizations will need to be accomplished. Dr. Ramos mentioned that the Sync for Science application is already emphasizing interoperability. Finally, it was pointed out that people unfamiliar with PMI assume the focus is entirely on genetics. It will be important to make it clear that PMI goes beyond genetics to capture and analyze a wide range of influences on human health, including environmental exposures and behavior.

IV. Task Force Implementation - R21 Management Plan: Dr. Jill Heemskerk

Dr. Jill Heemskerk spoke about changes to the NIBIB R21 funding program proposed in response to recommendations from the NACBIB Task Force on Efficient Spending. Since 2008, the number of R21 applications has doubled and the large increase in applications has driven the payline down. As discussed at previous Council meetings, the Task Force considered extensive data analyses of the NIBIB R21 portfolio. Based on metrics of productivity such as publications, patents, and citations, NIBIB R21s as a whole outperform R01s. New and early stage investigators in the STEM fields make productive use of the R21 mechanism, and early stage investigators who receive an R21 grant have nearly two-fold higher success in getting an R01 than those who did not have an R21. While recognizing the particular value of R21 grants for new and early stage investigators, the Task Force noted that the rapid increase in the number of R21 applications is driven largely by established investigators. Further, the R21 funding success rate of established investigators is substantially higher than the success rate of new and early stage investigators.

To maintain the size of the R21 program at the current level, NIBIB has capped the budget for R21s and uncoupled R21s from the R01 payline. In addition, two R21 funding pathways are proposed. NIBIB plans to establish the Trailblazer R21 Award for new and early stage investigators, with an additional year of funding and increased budget, providing \$400,000 over three years. Consistent with the R21 goal of supporting new research projects, applications for the Trailblazer Award will not require preliminary data. Projects representing new directions for established investigators will be funded through the existing NIH parent R21 and Exploratory/Developmental Bioengineering Research Grants (EBRG) initiatives. Meritorious applications received under these FOAs will be selected for funding according to the exploratory, developmental, and high-risk/high-reward goals of the R21 mechanism.

Announcements detailing these plans will be announced in the NIH Guide in August of this year, with the first application receipt deadline in October and the first applications coming to Council in May 2017.

Discussion

The council members expressed support and were excited about this new direction. A question arose about whether established investigators who had received an R21 tended to apply for another R21. Dr. Heemskerk said they typically go on to apply for R01s. There was also discussion about whether the intent to fund

projects distinct from small R01s would result in a reduced number of applications. Another question was whether eligibility for the Trailblazer Award required that all PIs must be new or early stage investigators and Dr. Heemskerk confirmed that an entire multi-PI team must be new and/or early stage investigators to qualify. Success rates for new and early stage investigators were also discussed. Dr. Heemskerk said that the goal was to increase their success rate to be comparable to that of established investigators. Finally, discussion focused on whether other institutes are adopting a similar approach. Dr. Pettigrew mentioned that NIBIB is out in front with this strategy.

V. Imaging Life at High Spatiotemporal Resolution: Dr. Eric Betzig

Dr. Eric Betzig presented super-resolution imaging technologies to visualize, for the first time, molecular dynamics in living cells and whole embryos. A major drawback of imaging with high spatial resolution is phototoxicity, which severely limits the ability to image living cells. Dr. Betzig has developed two variations of structured illumination microscopy (SIM), TIRF-SIM (total internal reflection fluorescence-SIM) and non-linear SIM. In these approaches, only a small area is illuminated or only a subset of labels is turned on at once, allowing molecular resolution imaging without excessive light exposure. Dr. Betzig showed spectacular example images using these techniques to visualize things like cytoskeletal and intracellular vesicle dynamics. SIM only works in two dimensions, however. Dr. Betzig also introduced lattice light sheet microscopy to look at small multicellular organisms in four dimensions, showing examples in *C. elegans* and zebrafish.

Dr. Betzig indicated that, although these techniques are very exciting to researchers, they produce massive amounts of data, at the terabyte scale, which pose an analytical challenge. He suggested that the urgent problem of how to manage and analyze these large data sets was an important problem for NIH.

Discussion

The discussion revolved around specific techniques for various applications, e.g., visualizing ion channels and looking at biochemical dynamics. Dr. Betzig mentioned that a microscope's optical resolution is often overemphasized and the signal-to-noise ratio is also important to obtaining the desired image. When asked whether the ability to see cellular processes at this new level of detail has yielded surprising biological insights, Dr. Betzig cited the behavior of actin flowing through cells as one example, but stressed that there are likely countless novel insights buried in the enormous datasets produced by these approaches. The present challenge for new discovery is to overcome limitations in data analysis so that the images can be readily produced and studied.

VI. Adjournment

The open session of the NACBIB meeting was adjourned at 12:45 p.m.

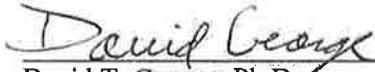
VII. Closed Session

Review of Council Procedures and Regulations: Dr. David T. George

The grant application review portion of the meeting was closed to the public in accordance with provisions set forth in Section 552b(c)(4) and 552b(c)(6), Title 5, U.S. Code, and 10(d) of the Federal Advisory Committee Act, as amended (5 U.S.C. appendix 2). The closed session was adjourned at 2:53 p.m.

Certification:

We certify that, to the best of our knowledge, the foregoing minutes are accurate and complete.²



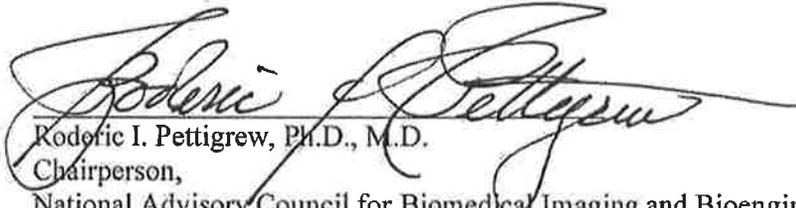
David T. George, Ph.D.

Executive Secretary

National Advisory Council for Biomedical Imaging and Bioengineering

Acting Associate Director for Research Administration

National Institute of Biomedical Imaging and Bioengineering



Rodoric I. Pettigrew, Ph.D., M.D.

Chairperson,

National Advisory Council for Biomedical Imaging and Bioengineering

Director,

National Institute of Biomedical Imaging and Bioengineering

² These minutes will be approved formally by the Council at the next meeting on September 15, 2016, and corrections or notations will be stated in the minutes of that meeting.