

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

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

**Summary of Meeting<sup>1</sup>  
May 18, 2017**

The National Advisory Council for Biomedical Imaging and Bioengineering (NACBIB) was convened for its 44th meeting on May 18, 2017, 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 8:15 a.m. to 12:30 p.m. for review and discussion of program development, needs, and policy. The meeting was closed to the public from 1:45 p.m. to 2:30 p.m. for the consideration of grant applications.

**Council members present:**

Dr. Kristi Anseth, University of Colorado, Boulder, Boulder, CO  
Dr. Richard Buxton, University of California, San Diego, La Jolla, CA  
Dr. Carol Espy-Wilson, University of Maryland, College Park, MD  
Dr. David Grainger, University of Utah, Salt Lake City, UT  
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

**Council member attending by telephone:**

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

**Ex officio members present:**

Dr. Vincent Ho, Uniformed Services University of the Health Sciences, Bethesda, MD  
Dr. Anne Plant, National Institute of Standards and Technology, Gaithersburg, MD  
Dr. Sohi Rastegar, National Science Foundation, Arlington, VA

**Ex officio members absent:**

Dr. Francis Collins, National Institutes of Health, Bethesda, MD  
Dr. Thomas Price, Department of Health and Human Services, Washington, DC

**Chairperson:**

Dr. Roderic I. Pettigrew

**Executive Secretary:**

Dr. David T. George

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<sup>1</sup> 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. Roberta Albert  
Ms. Holly Atherton  
Mr. Angelos Bacas  
Dr. Richard Baird  
Ms. Lily Bisson  
Dr. Michael Cheetham  
Ms. Emily Conlan  
Ms. Christine Cooper  
Ms. Zoe Ann Copeland  
Dr. Monique Day  
Mr. Anthony Dorion  
Ms. Kate Egan  
Ms. Angela Eldridge  
Ms. Katie Ellis  
Dr. Zeynep Erim  
Mr. Jason Ford  
Mr. Anthony Fransella  
Ms. Pam Glikman  
Ms. Kolbi Harrison  
Dr. John Hayes  
Dr. Jill Heemskerck  
Dr. Dennis Hlasta  
Dr. John Holden  
Ms. Alisha Hopkins  
Mr. James Huff  
Dr. Rosemarie Hunziker  
Dr. Krishna Kandarpa  
Dr. Chris Kelley  
Dr. Randy King  
Ms. Diane Kreinbrink  
Dr. Steven Krosnick  
Ms. Tiffani Bailey Lash

Ms. Truc Le  
Dr. Richard Leapman  
Dr. Raymond MacDougall  
Dr. Shadi Mamaghani  
Dr. Rishi Mathura  
Ms. Ruthann McAndrew  
Ms. Jessica Meade  
Mr. Todd Merchak  
Mr. Larry Morton  
Mr. Joe Mosimann  
Mr. Mark Murdock  
Dr. Vinay Pai  
Dr. Grace Peng  
Mr. Brandon Pleasants  
Dr. Edward Ramos  
Dr. David Rampulla  
Ms. Vicki Rein  
Dr. Antonio Sastre  
Ms. Saltanat Satabayeva  
Dr. Seila Selimovic  
Dr. Behrouz Shabestari  
Mr. Shaun Sims  
Mr. Russell Songco  
Ms. Ashley Storm  
Dr. Manana Sukhareva  
Ms. Florence Turska  
Ms. Aytaj Vily  
Dr. Shumin Wang  
Dr. Andrew Weitz  
Dr. Michael Wolfson  
Dr. Ruixia Zhou  
Dr. Steven Zullo

**Non-NIBIB National Institutes of Health (NIH) employees:**

Dr. Tatjana Atanasijevic, National Institute of Neurological Disorders and Stroke, NIH  
Mr. Eric Dishman, Office of the Director, NIH  
Dr. Irwin Feuerstein, Office of Research on Women's Health, NIH  
Dr. Amir Gandjbakhche, National Institute of Child Health and Human Development, NIH  
Dr. Dana Wolff-Hughes, Office of Behavioral and Social Science Research, NIH  
Ms. Daozhong Jin, Office of the Director, NIH  
Dr. Peter Kozel, Center for Scientific Review, NIH  
Dr. Lauren Milner, Office of the Director, NIH  
Dr. Songtao Liu, Center for Scientific Review, NIH  
Dr. Xiang-Ning Li, Center for Scientific Review, NIH  
Dr. Lawrence Tabak, Office of the Director, NIH

**Members of the public present for portions of the meeting:**

Mr. Martin Berrios, Bolger Center, Potomac, MD  
Ms. Renee Cruea, Academy of Radiology Research, Washington, DC  
Ms. Margot Kern, Bethesda, MD  
Ms. Rachel Levinson, Arizona State University, Tempe AZ  
Ms. Martha Nolan, Academy of Radiology Research, Washington, DC  
Ms. Ariana Olshan, McAllister & Quinn, Washington, DC  
Mr. Michael Peters, American College of Radiology, Washington, DC  
Dr. Lihong Wang, California Institute of Technology, Pasadena, CA  
Mr. David Zinn, Academy of Radiology Research, Washington, DC

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

Dr. David T. George called to order the 44th 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. NIBIB Awards, Transitions, and New Staff**

Dr. Pettigrew recognized several honors bestowed on members of the NIBIB community: Dr. Charles Mistretta received the ICRU Gray Medal Award; Dr. Shawn Chen was inducted to the AIMBE College of Fellows; Dr. Bin He received the IEEE Biomedical Engineering Award; Dr. Mark Griswold and Dr. Felix Wehrli received the 2017 ISMRM Gold Medal Award; and Dr. Pettigrew received the ISMRM Distinguished Service Medal.

Dr. Pettigrew welcomed new staff to NIBIB: Roberta Albert, Chief Information Officer; Uzma Cheema, IT Specialist; Lisa Hamilton, Web Team Lead; Selam Gebreyes, Web Development Analyst; Mark Murdock, Executive Assistant to the Director; Lily Bisson, Management Analyst; Diane Kreinbrink, Management Analyst; Aytaj Vily, Management Analyst; Saltanat Satabayeva, Scientific Program Analyst.

### **B. NIH/NIBIB Budget**

The Omnibus Budget Bill was signed into law on May 5, 2017. NIH received \$34 billion, a \$2 billion increase over FY16. The budget included \$352 million for the 21st Century Cures Act, which provides funding for the BRAIN Initiative, the Precision Medicine Initiative, the Cancer Moonshot Initiative, and the Regenerative Medicine Innovation Project. NIBIB received \$357 million, a \$14 million increase over FY16. This includes a \$3.3 million increase for the BRAIN Initiative.

### **C. NIH Activities**

The Cancer Moonshot Initiative received \$300 million for FY17. Dr. Pettigrew noted that NIBIB is collaborating with the National Cancer Institute to support the development of technologies to address health disparities. NIBIB remains actively involved in the BRAIN Initiative. The million-person cohort of the Precision Medicine Initiative has been renamed *All of Us*. The Regenerative Medicine Innovation Project received \$2 million for FY17, and will receive \$10 million in its second and third year, and \$8 million in its fourth year. There is now an active FOA calling for revision applications. The National Institute on Aging received \$400 million in funds for Alzheimer's disease research. NIBIB will be announcing an opportunity for grantees to receive administrative supplements from these funds to apply currently-funded technologies to improve our understanding, diagnosis, and treatment of Alzheimer's disease.

Dr. Pettigrew announced that the focus of a collaboration between the NIH and the Bill & Melinda Gates Foundation (BMGF) will be to establish and demonstrate a standardized data acquisition and communications platform for point-of-care diagnostics. NIBIB recently hosted a meeting with BMGF and several federal partners. Attendees agreed to pursue the development of a connected home-based influenza test, which would serve as a platform for other connected home-based tests in the U.S. and in lower-middle income countries.

### **D. NIBIB Activities**

**NIBIB R21 Program:** The first round of Trailblazer R21 applications for New and Early Stage Investigators will be considered at this Council. In addition, Dr. Pettigrew announced that new NIBIB R21 guidelines are in effect for R21 applications submitted to the NIH-wide Parent and Exploratory/Developmental Bioengineering Research Grant (EBRG) R21 Programs. NIBIB will be using a select pay approach to fund well-scored applications for projects that are exploratory, high-risk, high-reward. Later this year, NIBIB will withdraw from the Parent and EBRG R21 Programs and issue its own R21 FOA to support innovative exploratory projects with no preliminary data, in the original spirit of the NIH R21 mechanism. Unlike the Trailblazer, which is limited to new investigators, the new NIBIB R21 initiative will be open to all eligible applicants.

**ESTEEMED (R25) Enhancing Science, Technology, Engineering and Math Educational Diversity:** Dr. Pettigrew announced a new training program called ESTEEMED to support undergraduate freshmen and sophomore students

from underrepresented groups pursuing Science Technology Engineering and Math (STEM) degrees in preparation for graduate study and biomedical careers.

**Restoring function after spinal cord injury:** Dr. Pettigrew presented concept clearance for two new initiatives to leverage promising results from efforts to restore bladder, bowel and sexual function to individuals with complete paralysis. One initiative will be a pilot study to understand and optimize spinal stimulation approaches to improve bladder, bowel, and sexual function. A second initiative will develop technologies to provide paralyzed individuals with sensory awareness and control over bladder and bowel function.

**10<sup>th</sup> Anniversary of the Multiscale Modeling Consortium Meeting:** The Interagency Modeling and Analysis Group (IMAG) celebrated the 10<sup>th</sup> anniversary of the Multiscale Modeling Consortium Meeting in March. More than 300 consortium members attended the meeting and discussed a wide array of advances from ways to model the spread of infections such as Ebola and Zika to developing models and feedback systems to improve training for medical staff.

**Biomedical Engineering Day:** NIBIB launched its inaugural Biomedical Engineering Day on May 12<sup>th</sup>. Eighteen high school classes—hailing from 10 schools across six states—participated in a live Google Hangout with NIBIB Program Staff. Students interacted with Program Staff in real-time by submitting questions about topics and careers in biomedical engineering.

**NIBIB-Coulter College Technology Commercialization Boot Camp:** A cohort of 16 NIH-funded researchers recently completed an intensive six-month commercialization boot camp run by Coulter College. The teams received business coaching from active entrepreneurs and investors. At the end of the session, the researchers received expert feedback as they pitched their technologies as they would to prospective investors. In the three years that SBIR grantees have participated in the boot camp, they have raised more than \$32 million in capital and one product has received FDA 510(k) clearance.

**CIBR Medical Imaging Technology Showcase:** The 8<sup>th</sup> annual showcase was held on Capitol Hill on March 28<sup>th</sup>. As part of the event, a cohort of early career investigators visited NIBIB the day before the showcase to learn about the NIH grant process. At the showcase, NIBIB unveiled two innovative tablet/phone apps: *Understanding Medical Scans*, which helps patients learn about medical imaging so that they can ask their provider informed questions and *Surgery of the Future*, an interactive virtual operating room that highlights NIBIB-funded research to improve surgical procedures.

**NIH Science Day:** NIBIB participated in NIH Science Day on April 7<sup>th</sup>. Students listened to interactive presentations by NIBIB intramural researchers on infrared technology and light sheet microscopy. They also interacted with NIBIB's *Surgery of the Future* app and *Who Wants to Be a Biomedical Engineer?* game. NIBIB's interactive apps were also in high demand at NIH's **Take Your Child to Work Day** on April 27<sup>th</sup>.

**NIBIB New Horizons Lecture:** Dr. Nicole Seiberlich presented the 5<sup>th</sup> annual NIBIB New Horizons Lecture at the International Society for Magnetic Resonance in Medicine Annual Meeting. The goal of the lecture is to provide an opportunity for a rising star to present a forward-looking lecture on exciting new work in his or her area of expertise. The title of Dr. Seiberlich's lecture was: Strength in Numbers, Unleashing the Power of Quantitative MRI.

**FIRST Global Robotics Challenge:** NIBIB staff will participate as volunteers in the National Academies of Engineering (NAE) *FIRST* Global's annual international robotics challenge held in D.C. this year. The event is an Olympic-style robotics competition for high schoolers from more than 100 countries that aims to address one of the 14 Grand Challenges of the NAE. NIBIB staff will serve as team advisors and event volunteers for Team Venezuela.

## **E. Grantee News**

**Presidential Early Career Awards for Science and Engineering (PECASE):** NIBIB grantees Dr. Craig Duvall of Vanderbilt University and Dr. Benjamin Mayhugh of the University of Minnesota received **Presidential Early Career Awards for Science and Engineering (PECASE)**. Dr. Duvall is developing a degradable polymer to promote wound healing, and Dr. Mayhugh is developing functional 3D materials and devices for regenerative medicine.

## **F: Science Highlights:**

**High-Speed MRI:** Dr. Pettigrew highlighted research by Dr. Daniel Sodickson at the NYU School of Medicine. Dr. Sodickson has developed high-speed MRI methods that can resolve motion, such as a beating heart, which could potentially be used to diagnose congenital heart diseases *in utero*.

**Digital Health:** Dr. Grace Peng highlighted an advance from the MOBILIZE Center, an NIH BD2K Center of Excellence. One focus of the Center is the development of statistical learning approaches that extract insight from large amounts of complex data generated by wearable sensors, smartphones, and clinical databases. Dr. Peng highlighted the Center's recent publication in PLOS Biology in which they recorded over 250,000 measurements from wearable sensors used by 86 subjects. Using their statistical learning approaches, the researchers could extract clinically relevant information. For example, the researchers detected physiological differences between insulin sensitive and insulin resistant individuals. This information could someday be used to determine a person's risk for developing type II diabetes.

### **III. Accelerating Precision Health for All of US: Mr. Eric Dishman, Director of *All of Us* Research Program**

Mr. Dishman briefed Council on the status of NIH's *All of Us* Research Program, formerly known as NIH's Precision Medicine Initiative, which the overarching goal of accelerating health research and medical breakthroughs by enabling individualized prevention, treatment, and care for *All of Us*. He discussed the intended makeup of the million-person research cohort. Seventy-five percent of the cohort will include individuals typically underrepresented in biomedical research, while fifty percent of the cohort will be minorities. The cohort will consist of direct volunteers and volunteers recruited by health care organizations.

Mr. Dishman said that the beta version of the program is expected to launch in the next several weeks. He stressed that NIH institutes will have an opportunity to provide input for future versions of the program at a workshop to be held in the spring. He then suggested potential areas of opportunity for NIBIB collaboration including: 1) expand and deepen Electronic Health Record data for research purposes; 2) build upon the knowledge from the NIBIB/Radiology Society of North America (RSNA) Image Share network to scale medical imaging sharing; 3) leverage innovative devices, sensors, and mHealth interventions being developed through the Big Data to Knowledge (BD2K) and Pediatric Research Using Integrated Sensor Monitor Systems (PRISMS) programs; and 4) explore new ways to scale up better privacy and provenance for health data.

### **Discussion**

A Council member voiced concern that an image archive was not included as part of the initial roll out and Mr. Dishman assured that it would be included in subsequent versions. When asked about his vision for leveraging the NIBIB/Radiology Society of North America (RSNA) Image Share network, Mr. Dishman expressed enthusiasm for the program and said there would be an opportunity to explore it in detail at the NIH workshop meeting in the spring. A Council member asked whether the program is interested in pulling in patient mammograms that already exist and linking these to genetic profiles. Mr. Dishman replied that this is an area of interest for the program. When asked how the program would ensure the quality of data being generated from a given sensor technology, Mr. Dishman replied that they're going to begin by capturing data from all devices currently owned by volunteers. Once they have acquired large enough data sets, they hope to determine which technologies currently on the market provide true clinical value. He acknowledged that the program may eventually need industry to make a device tailored for their purposes.

### **IV. Redefining the Spatiotemporal Limits of Optical Imaging: Photoacoustic Tomography, Wavefront Engineering, and Compressed Ultrafast Photography, Dr. Lihong Wang**

Dr. Lihong Wang from the California Institute of Technology presented his research on expanding the spatiotemporal limits of optical imaging. Dr. Wang explained that optical imaging can be used to image *in vivo* at multiple scales without requiring ionizing radiation or surgery. Traditionally, optical imaging has been hindered by the optical diffusion limit, which causes images to become distorted beyond several millimeters of penetration into the skin. Well over a decade ago, Dr. Wang broke this diffusion limit with the invention of a technique called photoacoustic tomography (PAT). Dr. Wang explained that in PAT, a laser is passed through the tissue, which causes it to emit acoustic waves. Data from these waves can then be used to reconstruct images from depths of up to several centimeters beneath the skin. Dr. Wang's lab has used this technique as well as photoacoustic microscopy (PAM) to conduct *in vivo* anatomical and functional imaging in rodents and humans at scales ranging from organelles to organs.

Dr. Wang's lab is currently using panoramic PAT to create 3D scans of the breast, which could enable visualization of tumors without exposing patients to ionizing radiation. Using PAM, Dr. Wang has been able to image through the skin

of the human palm to visualize networks of blood vessels as well as typical skin structures. More recently, his lab has been able to visualize a single circulating melanoma cell in a patient who had recently undergone resection of a primary tumor. Eventually, Dr. Wang hopes to use a laser to destroy these circulating tumor cells non-invasively. He has also demonstrated the ability to create label-free photoacoustic histology, which could allow intraoperative tumor detection.

Dr. Wang also touched on time reversal wave-front imaging, which enables light to be focused deep within the tissue using the astronomer's equivalent of a guide star. In addition, he spoke of his lab's invention of a camera that can image at 100 billion frames/second. Using the camera, Dr. Wang could capture the movement of light as well as high-speed biological phenomena, such as the propagation of action potentials in neurons.

#### **Discussion**

Dr. Wang was asked what happens to the imaging capability of PAT/PAM when tissue properties change during disease states, such as fibrosis. Dr. Wang explained that the ultrasound transducers in these technologies can be used to acquire ultrasound images, which would allow you to correct for acoustic property variations in the tissue. He also added that the soft tissue variation is minute and does not usually cause interference.

Dr. Wang was asked to expand on how his photoacoustic imaging techniques could be used therapeutically. Dr. Wang said that there is a sweet spot where you can focus the laser to damage melanoma cells without harming normal blood cells due to the high contrast in absorbance between pigmented melanoma cells and other blood cells.

#### **V. Enhancing Stewardship: New Efforts to Promote a Stronger and More Stable Biomedical Research Workforce**

Dr. Lawrence Tabak spoke about NIH's efforts to bolster the biomedical research workforce. He began by presenting data that suggests the distribution of NIH awards is skewed towards well-established investigators. He then went on to explain that NIH has attempted to determine whether this skewed distribution yields optimal productivity, since it may simultaneously jeopardize the ability to maintain newer investigators in the biomedical research workforce. Using relative citation ratio (RCR) as a surrogate for productivity it was found that RCR increases substantially with an investigator's first and second grant, but begins to level off by the third and fourth grant. From this, it was concluded that there is diminishing return with greater numbers of awards to an individual awardee. Guided by this conclusion, NIH is considering steps to ensure that early stage and mid-career investigators receive adequate funding in the currently highly competitive funding environment.

#### **Discussion**

There was discussion as to whether the reason the long-established grantees are getting more awards is because they're writing more grants or because they're better at writing grants. Dr. Tabak acknowledged that the data hasn't been analyzed to answer this question but they intend to do so in the future. There was some discussion about indirect costs. Dr. Tabak stated that HHS sets the indirect cost rate and NIH has not looked at how reducing indirect costs might affect productivity.

#### **VI. Strategic plan**

NIBIB is beginning a new strategic planning effort. Council members were asked to volunteer to be part of a working group to provide input on the plan. The working group will convene prior to the September council meeting and present an initial outline for discussion at the September Council meeting. NIBIB plans to reach out to the broader community for input through a Request for Information (RFI). The goal is to have a final plan to present to Council in January.

#### **VII. Adjournment**

The open session of the NACBIB meeting was adjourned at 12:30 p.m.

**VIII. 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 2:30 p.m.

Certification:

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



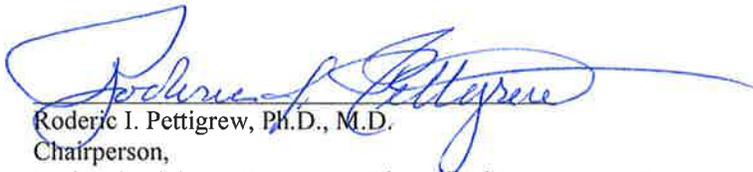
David T. George, Ph.D.

Executive Secretary

National Advisory Council for Biomedical Imaging and Bioengineering

Acting Associate Director for Research Administration

National Institute of Biomedical Imaging and Bioengineering



Roderic I. Pettigrew, Ph.D., M.D.

Chairperson,

National Advisory Council for Biomedical Imaging and Bioengineering

Director,

National Institute of Biomedical Imaging and Bioengineering

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<sup>2</sup> These minutes will be approved formally by the Council at the next meeting on September 12, 2017, and corrections or notations will be stated in the minutes of that meeting.