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

# NATIONAL ADVISORY COUNCIL FOR BIOMEDICAL IMAGING AND BIOENGINEERING

**Summary of Meeting**[1]
**September 15, 2016**

The National Advisory Council for Biomedical Imaging and Bioengineering (NACBIB) was convened for its 42nd meeting on September 15, 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 8:30 a.m. to 1:00 p.m. for review and discussion of program development, needs, and policy. The meeting was closed to the public from 2:20 p.m. to 2:50 p.m. for the consideration of grant applications.

**Council members present:**
Dr. Kristi Anseth, University of Colorado, Boulder, Boulder, CO
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. Charles Mistretta, University of Wisconsin, Madison, Madison, WI
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, Irvine, CA
Dr. Sheldon Weinbaum, The City College of New York, New York, NY

**Council member attending by telephone:**
Dr. Carol Espy-Wilson, University of Maryland, College Park, MD

**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

**Executive Secretary:**
Dr. David T. George

[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. Richard Baird
Ms. Barbara Cantilena
Dr. Michael Cheetham
Mr. Lavorn Colclough
Ms. Shirley Coney-Johnson
Ms. Emily Conlan
Dr. Richard Conroy
Ms. Christine Cooper
Ms. Zoe Ann Copeland
Mr. Anthony Dorion
Dr. Henry Eden
Ms. Kate Egan
Mr. Jason Ford
Mr. Anthony Fransella
Ms. Pam Glikman
Dr. John Hayes
Dr. Jill Heemskerk
Dr. Dennis Hlasta
Ms. Alisha Hopkins
Dr. Rosemarie Hunziker
Ms. Stacy Jones
Dr. Krishna Kandarpa
Dr. Chris Kelley
Ms. Margot Kern
Dr. Steven Krosnick
Dr. Tiffani Bailey Lash
Dr. Richard Leapman
Dr. Guoying Liu
Dr. Raymond MacDougall
Dr. Shadi Mamaghani
Dr. Michael Marge
Dr. Rishi Mathura
Ms. Jessica Meade
Mr. Joe Mosimann
Dr. Grace Peng
Dr. Edward Ramos
Ms. Mew Rattanawatkul
Dr. Mary Rodgers
Dr. Antonio Sastre
Dr. Seila Selimovic
Dr. Behrouz Shabestari
Mr. Shaun Sims
Mr. Russell Songco
Dr. Manana Sukhareva
Dr. Michael Wolfson
Mr. Kwesi Wright
Dr. Ruixia Zhou
Dr. Steven Zullo

**Non-NIBIB National Institutes of Health (NIH) employees:**
Dr. Irwin Feuerstein, Office of Research on Women's Health, NIH
Dr. Songtao Liu, Center for Scientific Review, NIH
Dr. Ross Shonat, Center for Scientific Review, NIH
Dr. Chiayeng Wang, Center for Scientific Review, NIH

**Members of the public present for portions of the meeting:**
Ms. Erin Cadwalader, Lewis-Burke Associates, Washington, DC
Ms. Renee Cruea, Academy of Radiology Research, Washington, DC
Mr. Jason Ezzelle, ICON Clinical Research, Wilmington, NC
Mr. Michael Peters, American College of Radiology, DC
Dr. Bruce Rosen, Massachusetts General Hospital, Charlestown, MA

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

Dr. David T. George called to order the 42nd 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 Dr. Carlo J. De Luca, an inaugural National Advisory Council Member for NIBIB, who recently passed away. Dr. Pettigrew noted that Dr. De Luca was an active member of the council. He also welcomed Dr. Karl Deisseroth, the speaker receiving this year's Third Annual Lopez Lecture Award.

**B. NIH/NIBIB Budget**

The FY16 NIH budget included a 5% increase for NIBIB. As the end of the year budget was finalized, the projected payline of 12th percentile was increased to the 14th percentile; the 19th percentile for new and early investigators.

The FY2017 budget has not yet been passed, though both the Senate and the House have passed different bills that proposed increases in the budget of the NIH.

**C. NIH Activities**

**Federal Prize to Combat Antimicrobial Resistance:** Dr. Pettigrew announced that the federal government will be awarding $20 million in phased prizes for point-of-care diagnostics to distinguish viral vs. bacterial infections and diagnose antibiotic-resistant bacterial infections.

**NIH Precision Medicine Initiative (PMI) Cohort Program Awards:** The NIH awarded $55 million to grantees in July 2016 to begin enrollment in the PMI Cohort Program, with the aim of meeting its enrollment goal by 2020.

**National Cancer Initiative (Moonshot Initiative):** The Blue Ribbon Panel issued a report on September 8th, 2016. The report made ten recommendations, five of which address areas to which the NIBIB community could potentially make contributions.

**D. NIBIB Activities**

**DEBUT (Design by Biomedical Undergraduate Teams):** NIBIB, in partnership with VentureWell, offered $75,000 jointly to six winning teams. There were 72 applications submitted from 30 universities in 17 states with a total of 334 students engaged in the competition. Dr. Pettigrew summarized the six winning projects:

- A Tuberculosis-diagnosing smart pill
- A point-of-care sepsis diagnostic device
- A speculum-fitted camera to diagnose cervical cancer
- A device that eradicates bacteria in central venous catheters
- A device that helps physicians insert a guide wire for central venous catheters
- A device that aims to reduce inflammation caused by acute pancreatitis

**NIBIB Trailblazer Award:** Dr. Pettigrew announced the publication of a new initiative designed specifically for new and early stage investigators—the Trailblazer Award. Using the R21 grant mechanism and carrying no requirement for preliminary data, it encourages:

- Early stage development of transformative ideas
- High-risk/high-reward projects

The idea for the Trailblazer Awards was inspired by discussions during previous council meetings and after a review was conducted of the NIBIB R21 program for the Council Task Force on Efficient Spending. Early interest in the award has been robust.

**Grand Challenges in Affordable Healthcare Technologies:** Dr. Pettigrew spoke about an Indo-US collaboration attempting to develop a new technology to passively measure and record blood pressure. 11 projects were funded (5 from the US and 6 from India) and Dr. Bruce Tromberg, current NIBIB Council member, chaired a recent review of the program.

**Interagency Working Group on Medical Imaging (IWGMI):** IWGMI was started at the behest of Congress. The group is active, with membership from numerous government agencies. Many experts presented to IWGMI in 2016 over the course of three recent meetings on the status of imaging research and

the challenges that remain in the field. The most recent meeting on September 1st, 2016, focused on future directions and challenges. Three major themes that were identified were quantitative imaging, deep learning, and high-value imaging (high diagnostic information in a small amount of time). One goal of this inter-agency working group is to curate and present publicly a database of completely characterized human images providing clinical, histological, genomic, proteomic, and outcome data—and making this database available to the research community.

**NASA Deep Space Human Health Challenges:** Dr. Pettigrew has been named the NIH liaison to NASA to work on a possible NIH-NASA collaboration to assist NASA in identifying and addressing the challenges facing human health in long-duration space travel (focusing specifically on a trip to Mars). In addition to that collaboration, an NIBIB grantee had an experiment travel to the International Space Station earlier this year. The experiment is studying bone cells in microgravity to investigate osteopenia mechanisms.

**E. News and Science Highlights**

**NIBIB Hosted Congressman Michael Burgess, MD (R-TX):** On September 12, 2016, Congressman Burgess visited the NIH and took a tour of NIBIB intramural researcher Dr. Xiaoyuan (Shawn) Chen's lab.

**NIBIB Staff Volunteers at Children's Inn:** Members of NIBIB volunteered at the Children's Inn, making a meal for child patients and their family members.

**In Utero Imaging of Fetal Brain Functional Network Development:** NIBIB-funded researchers are using specialized fMRI techniques to map brain activity in utero. This technology will allow new investigation into the development of the fetus and guidance on procedures and interventions.

**Liver in a Drop:** Researchers funded by NIBIB have created a microfluidic device that produces millions of oil-based droplets containing microtissues that are made up of two different types of liver cells. For the first time, the researchers were able to combine the two cell types inside the droplet to better mimic real liver tissue, allowing them to communicate to carry out liver-like functions.

**Photoacoustic Computed Tomography: Deep Penetration with Optical Contrast and Ultrasonic Resolution:** A team of NIBIB-funded researchers have developed a laser light that heats tissue, causing thermal expansion, which can be detected by ultrasound. The ultrasound is able to differentiate melanoma cells from healthy cells because they absorb the light at different wavelengths.

**Discussion and Questions:**

Concerning the DEBUT challenge, one council member commented on the prevalence of submissions from California schools. Another council member responded that the University of California school system is starting to require that bioengineering students submit to contests like this. Multiple people suggested contacting the chairs of bioengineering programs directly to increase participation and encourage submissions from a greater diversity of institutions and states.

In regards to the Trailblazer Awards, a question was asked surrounding preliminary data and the peer review process. Dr. Pettigrew and Dr. George assured the council that NIBIB is working in partnership with CSR to ensure that reviewers are well informed of the goals and requirements of the new Trailblazer Awards, including the requirement that there be little or no preliminary data.

## III. Report on NIBIB-India Collaborations: Drs. Vinay Pai & Bruce Tromberg

Dr. Vinay Pai, NIBIB's Director of the Division of Health Informatics Technology, presented an overview of the collaboration between NIBIB and India's Department of Biotechnology (DBT) on the Grand Challenge

of developing unobtrusive technologies to passively measure blood pressure with the goal to "Think Outside the Cuff." Hypertension is a problem that does not just affect low-income countries, but is also a problem in wealthier countries.

NIBIB funded one project for five years and two projects for two years. DBT funded four projects for two years. On August 16th-20th, NIBIB and DBT held the first face-to-face meeting of the US and India project teams to evaluate progress. The evaluation of the teams was lead by NIBIB's own council member, Dr. Bruce Tromberg.

The funded projects include:

- Pulse Transit Time: Contact (BCG-Based) System and Non-Contact (Video Processing) System
- Arterial Applanation Tonometry
- Ultrasound-based Approaches
- Acoustic Radiation Force Measurement
- GelSight Tactile Sensor
- Machine Learning Algorithms for Calibration-free Blood Pressure Estimation

Dr. Tromberg talked about the evaluation process. The evaluation panel used the following criteria:

- Are we close to achieving the vision?
- Are all technologies represented?
- How do we build collaborations among the teams?
- Future vision for the program/Where do we go from here?

He discussed the future of the program and the suggestion to partner with NHLBI. Dr. Tromberg identified the strengths in the US projects as: new methods, measurements, hardware, and principles and the Indian projects' strengths as: low cost, clever integration of established technologies, wearable emphasis, computation, deep learning, and feature extraction.

The evaluation team posed the final thoughts for discussion about the future of this program: should NIBIB reissue the initiative, issue new modified initiatives, or is the work ready for industry?

**Discussion**

The discussion revolved around the accuracy and importance of blood pressure measurements. Blood pressure measurements are highly variable based on the time of day and the operator. It was suggested that it might be beneficial to find a new mechanism that would be more accurate.

Other suggestions included developing technology that would allow for continuous blood pressure monitoring, exploiting the natural collaborations that could form between hardware and software engineers, and the possibility to taking advantage of pre-competitive industrial collaborations.

Finally, Dr. Pettigrew emphasized the overall importance of lowering blood pressure and the benefits that would result from it. He talked about how accurate blood pressure is in predicting adverse health effects and how dangerous hypertension can be for patients.

## IV. BRAIN Update: Dr. Bruce Rosen

Dr. Rosen gave an overview of the BRAIN initiative, describing the current state of the initiative and the road map for the future. The first awards went out two years ago and there have been several cycles of the awards since then. He informed the council that there were more than 130 BRAIN-related publications. The early years of the BRAIN Initiative focus on technology development and have been successful. Both the Senate and House of Representatives have shown interest in continuing to support the BRAIN initiative.

In the Executive Summary, seven key areas were identified to focus on for future of BRAIN:

- Short Courses
- Cell-Type Classification
- Novel Tools-Cells and Circuits
- Next Generation Human Imaging
- Next Generation Human Invasive Devices
- Large-scale Neural Recording & Modulation
- Integrating Approaches to Understand Circuit Function

Dr. Rosen summarized the progress of each of the areas of focus, reporting that the "Cells and Circuits" and "Next Generation Imaging" areas have been early successes of the BRAIN Initiative. In addition, a BRAIN Informatics focus is getting underway with plans to issue three FOAs in FY2017 to support standards for data collection, data repositories, and data analysis and integration tools.

He also mentioned that the BRAIN Neuroethics Workgroup has met twice and, in June 2016, released a new Request for Information (RFI): Guidance for Opportunities in Neuroethics.

NIH is actively recruiting staff for BRAIN; they are looking for a BRAIN Director as well as BRAIN Program Directors.

## V. Third Annual Lopez Lecture: Optical and Chemical Engineering of the Brain: Dr. Karl Deisseroth

Dr. Karl Deisseroth presented his research in modulating the activity of individual neurons in the brains of mice using optogenetic interventions. Using a low-energy laser beam directed at a specific neuronal cells, Dr. Deisseroth has shown that he can control neuronal activity. In one example, he mentioned an experiment using optogenetic technology that seemed to be able to reverse the addictive effects of cocaine on mice. He discussed the challenges in using optogenetic interventions—the first being identification of relevant neuronal cells. The solution was to develop a technology that simultaneously records the activity of neurons while applying the laser light to affect the behavior of the animal. Furthermore, Dr. Deisseroth discussed how he overcame the challenges with imaging axonal interconnections by using hydrogel embedding. By removing the membrane lipids he was able to create an intact transparent brain that could be imaged to reveal neurons and their projections. This technique, known 'Clarity', is much more durable than a regular fixed brain slice and is able to be non-destructively stained, re-stained, and imaged multiple times. This allows for whole-brain axonal projection mapping without bleaching native fluorescent proteins while also maintaining very strong color labeling of both proteins and nucleic acids.

### Discussion

The discussion revolved around the areas of uncertainty that still remain in optogenetic interventions, especially in their potential benefits to the human brain. Studies thus far have been conducted in animals, and translating these findings to a similar approach in humans is a major challenge. Dr. Deisseroth pointed out that, while optogenetics might not be useable in humans, studies in animals could be used to help pinpoint the exact area to stimulate in humans, for example using transcranial magnetic stimulation (TMS).

In response to a question regarding what is currently limiting research in this area, Dr. Deisseroth discussed the challenge of handling the very large volume of data produced by these methods. He suggested that one of the biggest problems in many research areas is the ability to both store and analyze massive amounts of data once collected. Along these lines, he emphasized the importance of having data scientists embedded in research settings.

## VI. Adjournment

Dr. Pettigrew expressed his thanks and appreciation for the exiting Advisory Council Members, Dr. James Thrall, Dr. Bruce Tromberg, and Dr. Sheldon Weinbaum.

The open session of the NACBIB meeting was adjourned at 1:00 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 2:50 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

Roderic 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 January 24, 2017, and corrections or notations will be stated in the minutes of that meeting.