

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

**NATIONAL ADVISORY COUNCIL FOR
BIOMEDICAL IMAGING AND BIOENGINEERING
Summary of Meeting¹
January 25, 2008**

The National Advisory Council for Biomedical Imaging and Bioengineering (NACBIB) was convened for its 16th meeting on January 25, 2008, at the Marriott Suites Bethesda in Bethesda, Maryland. Dr. Roderic I. Pettigrew, Director of the National Institute of Biomedical Imaging and Bioengineering (NIBIB), presided.

In accordance with Public Law 92-463, the meeting was open to the public from 8:30 a.m. to 12:45 p.m. for the review and discussion of program development, needs, and policy. The meeting was closed to the public from 1:30 p.m. to 2:10 p.m. for the discussion and consideration of individual grant applications.

Council members present:

Dr. Ronald L. Arenson
Ms. Rebecca M. Bergman
Dr. David J. Dzielak
Dr. Richard L. Ehman
Dr. Katherine W. Ferrara
Dr. Don Giddens
Dr. Gary H. Glover
Dr. Augustus O. Grant
Dr. Mae C. Jemison
Dr. Percival McCormack
Dr. David Satcher

Ex officio members present:

Dr. P. Hunter Peckham, Veterans Administration
Dr. Anne Plant, National Institute of Standards and Technology
Dr. James G. Smirniotopoulos, Uniformed Services University of the Health Sciences
Dr. Andrew Watkins, Centers for Disease Control and Prevention

Ex officio members absent:

Dr. Judy Raper, National Science Foundation
Mr. Michael Leavitt, U.S. Department of Health and Human Services
Dr. Elias A. Zerhouni, National Institutes of Health

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 have occurred. This procedure only applies to applications that are discussed individually, not to “en bloc” actions.

Executive Secretary:

Dr. Anthony Demsey

Also present:

NIBIB staff present for portions of the meeting:

Ms. Lillian Ashley	Ms. Mary Beth Kester
Dr. Prabha Atreya	Dr. Peter Kirchner
Mr. Angelos Bacas	Dr. Brenda Korte
Dr. Richard A. Baird	Dr. Lixin Lang
Ms. Sheila Barrett	Dr. Richard Leapman
Dr. Abesh Bhattacharjee	Dr. Albert Lee
Dr. Peter Bungay	Mr. Chris Lertora
Ms. Angela Burks	Dr. Hector Lopez
Ms. Barbara Cantilena	Dr. Robert Lutz
Mr. Larry Clarke	Dr. Ying Ma
Dr. Zohara Cohen	Dr. Alan McLaughlin
Ms. Shirley Coney-Johnson	Mr. Todd Merchak
Ms. Nancy Curling	Mr. Nicholas Mitrano
Dr. Emiliios Dimitriadis	Mr. Larry Morton
Dr. Henry Eden	Mr. Joe Mosimann
Ms. Angela Eldridge	Dr. Peter Moy
Dr. Zeynep Erim	Mr. Aaron Nicholas
Ms. Cheryl Fee	Dr. Grace Peng
Ms. Carol Fitzpatrick	Dr. Karen Peterson
Ms. Pam Glikman	Dr. Roderic I. Pettigrew
Dr. Valery Gordon	Ms. Patty Runyon
Dr. Ruth Grossman	Ms. Katie Serrano
Ms. Jude Gustafson	Dr. Belinda P. Seto
Dr. John Haller	Dr. Paul Smith
Ms. Rosslyn Hart	Ms. Casey Stewart
Dr. John Hayes	Ms. Kawannah Taylor
Dr. William Heetderks	Ms. Florence Turska
Dr. Lori Henderson	Ms. Stacy Wallick
Dr. Rosemarie Hunziker	Ms. Li-Yin Xi
Mr. Albert Jin	Dr. Yantian Zhang
Ms. Jeanellen Kallevang	Dr. Ruiza Zhou
Dr. Chris Kelley	

Other Federal employees present:

Dr. David Brown, U.S. Food and Drug Administration
Dr. Timothy Hays, Office of the Director, Office of Portfolio Analysis and Strategic Initiatives
Dr. Kyle Myers, U.S. Food and Drug Administration

Members of the public present for portions of the meeting:

Ms. Jennifer Ayers, American Institute for Medical and Biological Engineering
Ms. Stephanie Darby, Biomedical Engineering Society

Dr. Freeman Hrabowski III, University of Maryland, Baltimore County
Dr. Rose Maria Li, Rose Li and Associates, Inc.
Dr. Frances McFarland Horne, Rose Li and Associates, Inc.
Ms. Sarah Oliphant, American Academy of Radiology Research
Mr. Mike Peters, American College of Radiology

I. Call to Order: Dr. Anthony Demsey

Dr. Demsey welcomed attendees and called to order the 16th NACBIB meeting. He reminded attendees that the morning session of the meeting is open to the public. Dr. Demsey introduced Dr. Pettigrew, who formally welcomed all participants.

II. Director's Remarks: Dr. Roderic Pettigrew

A. New Members

Dr. Pettigrew welcomed one new member to the Council. **Dr. Mae Jemison** is the President of BioSentient Corporation, a medical technology company based in Houston, Texas. She is a chemical engineer, a physician, a civic leader and activist, and a former astronaut. Dr. Jemison earned a B.S. in chemical engineering from Stanford University and an M.D. from Cornell Medical College. She worked for more than 2 years as a Peace Corps officer in Sierra Leone, Liberia, and other regions of West Africa. In 1987 Dr. Jemison was selected for the astronaut corps at National Aeronautics and Space Administration, where she flew on the space shuttle *Endeavor* and was the first woman of color to go into space. Her current projects include Alpha, a satellite-based telecommunications system to improve health care in West Africa, and The Earth We Share, and international space camp for students aged 12 to 16 years.

B. Council Accomplishments

Dr. Ron Arenson was elected to the Board of Directors for the Radiology Society of North America, the world's largest professional society dedicated to research in all aspects of radiology and related sciences. Board members serve for 8 years, and only one person is elected to the Board each year.

NIBIB Director Dr. Roderic Pettigrew was elected as a member of the Institute of Medicine. Election to this organization is one of the highest honors in the field of medicine and health.

C. Budget Update

Dr. Pettigrew reported that the NIH budget appropriation for fiscal year (FY) 2008 was \$29.748 billion but that the actual budget was less because of a 1.7-percent reduction across the U.S. Department of Health and Humans Services (HHS). The actual National Institutes of Health (NIH) budget for 2008 is thus \$29.229 billion, which is a \$329 million increase from FY 2007. This increase includes an added \$13 million above the FY 2007 level of \$482 million for the Common Fund. As of FY 2007, Congress has made direct appropriations to the Common Fund rather than tapping individual Institutes and Centers (ICs) for contributions. The budget

for the NIH Office of the Director, \$1.109 billion, includes sufficient funds to continue the NIH Director's Bridge Awards program, which is intended to sustain grantees who did not successfully compete for funding. Although continuation has not been announced yet, Dr. Pettigrew anticipated that this program would carry forward. In addition, the FY 2008 budget allows 1-percent inflationary increases for non-competing research projects.

The initial appropriation to the NIBIB for FY 2008 was \$303 million, but because of the HHS reduction across the board, the NIBIB's actual operating budget for FY 2008 is \$298 million, an increase of \$1.7 million from FY 2007. Dr. Pettigrew indicated that the funding level for NIBIB, and for the NIH overall, has not kept pace with the Biomedical Research and Development Price Index, which is designed to reflect inflation-adjusted increases in the cost of doing research. This continues a trend apparent since 2004.

D. Significant Items

NIH Peer Review Evaluation

Dr. Pettigrew reminded the Council of Dr. Lawrence Tabak's presentation on the NIH Peer Review Evaluation, which was given at the September 17, 2007, NACBIB meeting. This evaluation is a comprehensive effort to examine the entire peer review system, identify challenges, and identify solutions. The effort has included the establishment of two working groups—the internal Steering Committee Working Group on Peer Review and the external Advisory Council to the (NIH) Director Working Group on Peer Review. The aim of this effort is to modify the current peer-review system to ensure that the NIH funds the best science by the best scientists, with the least administrative burden.

The diagnostic phase, which involved a large amount of information gathering, has been completed. Information was collected from approximately 2,000 respondents in the extramural community and at nationwide meetings with stakeholders, and this information is now under review. A complete analysis will be conducted at the end of February 2008, and a report outlining major problems and potential solutions will be generated and submitted to the NIH Director. Some suggested changes will be implemented as pilot programs and will be analyzed beginning in the spring.

Dr. Pettigrew reviewed some of the challenges identified during the information gathering:

- The administrative burden is high as a result of too many applications in the system. Low success rates clog the queue and create a “mentoring mindset” in some reviewers.
- Review quality is not always optimal. Summary statements might contain factual errors, and reviews place too much emphasis on methods and preliminary data rather than innovation and impact. In addition, too few reviewers often decide the fate of an application.
- Different types of review are required for different types of science. For example, reviews of applications by new investigators should facilitate entry, whereas those for established investigators should focus on stability.
- Too many funding mechanisms lead to confusion among applicants.

Public Access to NIH-Supported Research Manuscripts

In the past, the NIH has had a voluntary policy regarding manuscripts derived from NIH-supported research. Investigators were asked to make their publications available to the public within 12 months following publication. As a result of legislation passed at the end of 2007 (Division G, Title II, Section 218 of P.L. 110–161), this is now a mandatory policy. The NIH has developed a Web site to assist grantees with complying with this policy.

As of April 7, 2008, all articles based on research supported with NIH funding, even if the NIH is one of many sources, must be submitted to PubMed Central upon their acceptance for publication. The NIH will make these articles available to the public only when permission has been granted by the investigator or when the 12-month period has passed. All grant applicants must note publications in PubMed Central and include their PubMed numbers in subsequent applications and progress reports.

Armed Forces Institute of Regenerative Medicine (AFIRM)

The NIBIB has worked with the U.S. Army Medical Research and Materiel Command and with the Office of Naval Research to fund a virtual institute with a goal of repairing battlefield injuries through regenerative medicine. Other partners in this effort include the Department of Veterans Affairs, the National Institute of Dental and Craniofacial Research, and the National Institute of Arthritis and Musculoskeletal and Skin Diseases. The NIBIB has taken a lead role. The AFIRM will focus on developing technologies applicable to saving lives, restoring limbs, and addressing other issues of organ damage. The Institute most likely will involve a multi-institutional, multidisciplinary team. The AFIRM will be supported at a level of \$8 million per year for 5 years. Applications have been received and reviewed, and funding decisions are pending.

NIBIB–India Agreement

On October 17, 2007, the NIBIB entered into a bilateral agreement with the Department of Biotechnology (DBT), Ministry of Science and Technology, of the Republic of India, to develop low-cost healthcare technologies aimed at the medically underserved. In addition to Dr. Pettigrew, DBT Director Dr. Maharaj Bahn, NIH Director Dr. Elias Zerhouni, and Fogarty International Center Director Dr. Roger Glass were present at the signing ceremony in New Delhi, India. A workshop will be held in India in 2008 to identify clinical needs and priorities, define opportunities, and solicit ideas for joint initiatives. A planning meeting for this workshop will take place on February 12, 2008.

Bioengineering and Imaging Research Opportunities (BIROW) Workshop

The NIBIB sponsored the fifth BIROW workshop, which focused on imaging and characterizing structure and function in native and engineered tissue. Dr. Pettigrew reported that the workshop was well attended and that the audience included scientists from both the traditional imaging communities and the bioengineering communities. He also pointed out that the BIROW acronym has been changed from Biomedical Imaging Research Opportunities to Bioengineering and Imaging Research Opportunities to reflect the more interdisciplinary nature of the workshops. Dr. Pettigrew expressed the hope that these workshops will continue as a way to foster active interdisciplinary exchange and to facilitate new partnerships.

NIBIB Initiatives

Dr. Pettigrew reported that the receipt date for applications to RFA-EB-07-004, Development and Implementation of Innovative Ultrasound Therapy Technologies, had just closed. Two other initiatives—PAR-08-023, Predictive Multiscale Models of the Physiome in Health and Disease, and PAR-06-504, Enabling Technologies for Tissue Engineering and Regenerative Medicine—are still open.

Presidential Early Career Award for Scientists and Engineers (PECASE)

Dr. Pettigrew congratulated NIBIB grantee Dr. Adam T. Woolley of Brigham Young University, who received a 2008 PECASE. This award represents the highest honor for a scientist at the beginning of his or her independent research career.

E. Science Highlights

Dr. Pettigrew highlighted several research projects supported by the NIBIB.

The **Dedicated Breast CT Scanner for Early Cancer Detection** project is headed by Dr. John Boone of the University of California, Davis. This project represents a pioneering achievement in harnessing the power of computed tomography (CT) for improving the screening and diagnosis of breast cancer. Despite the technological power of CT, it has not been developed for breast imaging because, conventionally, one cannot image the breast without imaging the thorax. Dr. Boone's group has developed the first working CT breast imager, which can acquire a study of the breast within 16.6 seconds. This imager can detect lesions of 3 to 5 mm, compared with mammography's ability to detect lesions that are 11 mm on average. The radiation dose for this imager is about the same as a two-view mammogram. The ability of this scanner to detect smaller tumors is especially significant because detecting a tumor at this size might increase the likelihood of a patient surviving for 15 years or more.

The **Magnetic Resonance Elastography: An Emerging Tool for Mechanobiology** project is headed by Council member Dr. Richard Ehman. This tool essentially uses magnetic resonance to palpate an organ, producing an image of the organ's stiffness. Much can be determined from palpation, for example in detecting breast and prostate tumors. The device developed by Dr. Ehman's group pulses a region of the body and uses a sensitive technique that detects movements as small as a few hundred nanometers to examine the displacement of an organ in response to the pulse. The device then produces a quantitative image and map of the organ's stiffness in kPa. This work is especially significant in light of the role of stiffness in both disease and the behavior of cells. Unlike contrast-enhanced magnetic resonance imaging (MRI), which can detect breast lesions, magnetic resonance elastography is designed to distinguish benign lesions from cancerous ones. Magnetic resonance elastography also has immediate potential in the diagnosis of fibrotic disease in the liver. The relative specificity of this technique is 70 percent.

The **Building the Neurovascular Regeneration Team for a Quantum Leap in Stroke Treatment** project is headed by Dr. Karen Hirschi of the Baylor College of Medicine. This project aims to implant a unit, consisting of a vessel of endothelial cells surrounded by neural stem cells, into a stroke patient. The unit would continue to grow and integrate with existing

tissue to ameliorate the functional losses associated with stroke. As a first step, Dr. Hirschi's group has produced a series of studies supporting the concept that such growth and integration occurs in the brain. This Quantum Project team includes Baylor, Rice University, the National Institute of Medical Research (London), Kings College of London, and the University of Edinburgh.

The **Nanoscale Engineering of Multifunctional Probes for Gene-specific Intervention and Treatment** project is headed by Dr. Gayle Woloschak of Northwestern University. This project focuses on the development of therapeutic magnetic resonance probes based on the semiconducting properties of titanium oxide. Dr. Woloschak's group has shown progress in conjugating the magnetic resonance contrast agent with a fluorescent agent and an oligonucleotide tail to target a gene sequence for silencing. This project represents an entry into "theragnostics," in which diagnosis and therapy can occur at the same time. Probes can be used for intracellular manipulation, imaging, and gene silencing.

III. Review of Council Procedures and Regulations: Dr. Anthony Demsey

Dr. Demsey noted for the record that a quorum was present for this Council meeting, and that ex officio member Dr. Judy Raper was unable to attend today's meeting.

A. Council Regulations, Policies, and Procedures

Dr. Demsey summarized elements of the Government in the Sunshine Act and the Federal Advisory Committee Act that govern all Advisory Council meetings. These Acts require the U.S. Department of Health and Human Services to open Advisory Council meetings to the public except when proprietary or personal information is discussed. To comply with these regulations, the NACBIB meeting is open to the public for all but the review of individual grant applications. Dr. Demsey reviewed the guidelines with Council regarding conflict of interest, confidentiality, and lobbying.

B. Future NACBIB Meeting Dates

The next NACBIB meeting is scheduled for May 16, 2008, at the Marriott Suites Bethesda in Bethesda, Maryland. Dr. Demsey asked Council members to inform him of major conflicts with upcoming meeting dates. He also raised the tentative idea that future January meetings be held through teleconferencing or videoconferencing, given the "lighter" agenda and higher likelihood for inclement weather.

C. Approval of the September 17, 2007, NACBIB Meeting Minutes

A motion was forwarded and seconded to approve the minutes of the September 17, 2007, NACBIB meeting with one correction (noted below). The minutes were approved unanimously with the correction.

In Dr. Satcher's presentation on health disparities, he discussed a study published in the *Journal of Health Affairs*, which assessed mortality data from 1960 through 2000 and asked how the

statistics for the year 2000 might have looked if health disparities had been eliminated in the last century. Thus the approximately 83,500 excess deaths mentioned in the September 17 minutes were for the year 2000, not cumulative as written.

D. Reaffirmation of Council Procedures

A motion was forwarded and seconded to reaffirm Council operating procedures, with no modifications. The Council operating procedures were reaffirmed unanimously.

IV. Research, Condition, and Disease Categorization: Dr. Timothy Hays

Dr. Hays described a new process underway at NIH to categorize both intramural research and research grants supported by the NIH. At present, the NIH reports to Congress and the public how much is spent, and estimates of future spending, in approximately 250 research and disease categories. Each IC provides a central office with data on what they have spent on a particular category. How the category is defined depends on the IC – there have been no central definitions for the categories on which the NIH reports.

In 1998, the National Academies issued a report recommending that the NIH improve how it categorizes research. The Academies reiterated this recommendation in a 2003 report. In addition, Congress expressed that it was difficult to understand how the NIH generated the numbers it reported, and Congress requested improvements. In 2004, the NIH piloted bioinformatics tools and text-mining approaches for categorizing research, and at the same time the NIH began to rely more heavily on electronic submission vehicles, such as grants.gov. In the 2006 NIH Reform Act, Congress mandated that this process be used to automate coding and categorization.

The Research, Condition, and Disease Categorization (RCDC) is an electronic system that reports NIH spending across the 27 ICs each fiscal year in approximately 360 research and disease areas. The NIH is working with experts to develop central definitions for each category. The RCDC system is not expected to satisfy everyone's definition for a particular category; instead, the NIH aims to include project listings based on titles, abstracts, and specific aims, and to rely on investigators to define their projects accurately. The RCDC offers consistency, as one definition will be used across the NIH; transparency, as the RCDC displays every project listed in a category, allowing staff to answer questions more quickly; and efficiency. In addition, the new system provides opportunities for further NIH portfolio analysis.

Dr. Hays showed an example of a typical crosscutting disease area, which includes a definition, symptoms, and examples of how different ICs apply the area to their research portfolio. In capturing these and applying definitions uniformly, RCDC staff has found examples of IC-supported research that fit into categories that the IC might not have used previously. Thus, relying on a central definition could prove beneficial.

To categorize a project, the RCDC looks first at the project title, abstract, specific aims, and public health relevance, then runs it against a medical thesaurus with thousands of medical concepts. The system determines how often a topic appears in that project and generates a

weighted list of concepts that are used in category definitions. The weighted list is compared with other definitions at the NIH, and the project is listed under any category with a sufficient match. Thus, projects might appear in multiple categories.

Dr. Hays reported that the NIH will introduce the RCDC to the public in the summer of 2008 and that the RCDC will launch with FY 2008 projects. FY 2008 data will be reported in February 2009. However, reporting for 2007 will be redone to allow comparisons.

Discussion

Dr. Satcher asked whether health disparities were included. Dr. Hays responded that both minority health and health disparities are listed in the RCDC as research categories. He noted, however, that typically, projects are listed under these categories based on the populations reported in these studies, and automating these definitions has been challenging. Dr. Hays acknowledged Dr. Satcher's point that disparities are not limited to racial and ethnic minorities. He reported that rural health, socioeconomic status, and race and ethnicity are included in the RCDC categorizations and that the National Center for Minority Health and Health Disparities (NCMHD) is helping with these definitions.

V. Report of the Joint Strategic Plan Implementation and Training and Career Development Working Groups: Dr. David Satcher

Dr. Satcher reported that the NIBIB issued a request for information (RFI) on how it can better support the goal of eliminating disparities in health. About 40 people responded.

Respondents suggested Telehealth and point-of-care technologies as promising efforts that could reduce or eliminate disparities in health access and outcomes. They noted that physical barriers and knowledge barriers impeded the delivery of health care to patients. In-home monitoring and diagnoses allowing for immediate treatment of patients were suggested as ways to address these challenges. Dr. Satcher mentioned a study published in 2007 by investigators at the University of California, Los Angeles, which demonstrated that the likelihood that a patient needing coronary endarterectomy would actually get it varied by geography and socioeconomic status. The NIBIB could help in making the technology associated with this procedure available to more people.

Several potential initiatives were also suggested. The NIBIB could offer Small Business Innovation Research (SBIR) grants as well as other grant opportunities to develop new medical devices and technologies that would meet the needs of underserved populations. The development of innovative technology, improved use of current technology, and use of information technology to reduce risk factors and improve management of chronic diseases also were suggested. Other suggestions included:

- Development or improvement of technologies that could enhance and improve access to a healthy lifestyle.
- An initiative for public schools to reinstate and improve physical education to help children develop lifetime habits of physical activity and good nutrition.
- Integration of cure-management measures and disease outcomes with healthcare delivery.
- Development of effective dissemination technologies for prevention and treatment.

- Promotion of medical adherence, which will become more important as the population ages.

Respondents also provided comments about cultural, infrastructure, social, and economic barriers and noted that more researchers are needed whose backgrounds are consistent with those suffering disproportionately. Technologies to improve quality of care are also needed.

Dr. Satcher noted the potential for work described by Dr. Pettigrew in his remarks. For example, even though the incidence of breast cancer is lower among African-American women, the mortality rate from breast cancer is higher. The reasons underlying this disparity are not known. Dr. Satcher reported that the Centers for Disease Control and Prevention had implemented a program to make mammography available to low-income, minority women. Although it might be too soon to study the program's impact, the disparity could be explained in part by population-based differences in the sensitivity and specificity of mammography. Dr. Satcher emphasized that asking the right questions and being sensitive to issues of health disparities form the first steps in improving quality of care.

Dr. Satcher also summarized working group discussions about the NIH Strategic Plan for Eliminating Disparities in Health and the overriding role of policy in determinants of health. In terms of funding, policies are not consistent with the stated commitment to eliminating health disparities. The NCMHD has a budget of \$200 million, less than 1 percent of the overall NIH budget, and it is not clear what percentage of other ICs' budgets are devoted to reducing or eliminating health disparities. Dr. Arenson reported on the working groups' suggestion that the NIBIB use its tradition of leveraging limited resources and forming partnerships with other ICs, Government agencies, and States to reach rural and inner city populations. The Delta Project in Mississippi is one example of this approach.

In closing, Dr. Satcher reported on presentations the working groups heard about new NIBIB award programs. The Integrative Science Awards are similar to the NIH Pioneer Awards in that they identify and reward individuals who demonstrate excellence in their work. Applicants are judged on the strength of their prior research as well as their proposed research and whether it addresses significant problems and charts new territories, as opposed to making incremental progress. Awardees will have the intellectual freedom to follow unexpected directions and contribute in unique ways. This program has an emphasis on creative scientists without prior NIH support. The NIBIB Integrative Science Discovery Award is designed to support basic research that has broad transformative potential but for which the direct clinical application of the research might not be apparent.

VI. NIBIB Research Training: Where Are We and Where Are We Going? Dr. Richard A. Baird

Dr. Baird provided the Council with a report on the "state of the training division." He noted that the NIBIB has conducted an external needs assessment study to identify the origins and characteristics of trainees and compare them with trainees across the NIH. The study, undertaken by ORC-Macro, consisted of interviews with leaders in academia, industry, and Government and an analysis of training data from the NIH, the National Science Foundation (NSF), the HHMI, and the Whitaker Foundation. Respondents suggested that the NIBIB

continue to support the entire career continuum, including the support of undergraduate research experiences. They also suggested that the NIBIB continue to focus on transitional points in that continuum by linking academic training with laboratories in Government and industry and by facilitating the transition from institutional training to career development. In addition, respondents suggested that the NIBIB support curriculum development in bioengineering and target new and early-career investigators. To continue this process, the NIBIB plans to hold biennial needs assessment workshops, which will alternate with its biennial grantee meetings.

The NIBIB has determined that the best training model to support its research missions is one that attracts bioimagers and bioengineers to biomedical research, benefits the research of current grantees, and creates future biomedical researchers. To that end, the NIBIB has implemented internal tracking and evaluation procedures to evaluate the effectiveness of its training programs. These procedures will determine what the entry and exit points are for NIBIB trainees and grantees, how many trainees succeed in obtaining research grants, and how the grant history of individuals supported by training grants compares with those of individuals supported by research grants. The NIBIB also wants to know how many people supported by research grants have had previous training and whether that training makes it more likely that an applicant will secure future funding.

Dr. Baird reported on the evaluation of the Bioengineering and Bioinformatics Summer Institutes (BBSIs), which are jointly funded with the NSF, and noted that a more detailed report will be presented to the Training and Career Development working group at the May 2008 NACBIB meeting. Preliminary results indicate that these Institutes are multi-institutional and multi-departmental, drawing faculty not only from bioengineering but also from biology, chemistry, computational biology, computer science, and mathematics. Most importantly, they have been successful in attracting students to bioengineering and in targeting women and members of underrepresented racial and ethnic groups.

In reviewing the NIBIB training portfolio, Dr. Baird indicated that the NIBIB supports more than 500 trainees or mentored awardees, the large majority at the undergraduate or predoctoral level. The number of individual (F), institutional (T), and career development (K) trainees has continued to rise. The number, but not the size, of institutional awards has increased, reflecting a shift from individual to institutional training to balance the research and training portfolios. The apparent growth in the number of career development awards reflects the introduction of the K99/R00 "Pathway to Independence" award, a hybrid award that allows 2 years of mentored postdoctoral support followed by 3 years of independent research support. This award began in FY 2006. The NIBIB funded five K99/R00 awards for FY 2007 and expects to fund five more awards in FY 2008. Of the first cohort of NIBIB K99/R00 awardees, one has transitioned to the R00 in December 2007, one has recently accepted a faculty position, two have been interviewed for faculty positions, and one has begun applying for faculty positions. Dr. Baird concluded that the first cohort of K99/R00 awardees has been highly successful, and he noted that the NIBIB is paying close attention to what happens with the next cohort and will evaluate the success of this program in the near future.

Dr. Baird reported that the success rate of institutional training applications has dropped during the past two fiscal years because of a sustained increase in the number of new applications. In

response, the NIBIB has restricted the size and slowed the growth of existing training programs, but not so much as to affect operation. The NIBIB also has encouraged a mix of smaller and focused, larger and broad-based, and short-term training programs and increased co-funding of training programs with other NIH institutes. These steps have allowed the Institute to fund training programs in new and underrepresented mission areas, many with internships in industry or national laboratories. The NIBIB training portfolio currently includes 39 T32 awards and 1 T35 award, and the Institute is working to maintain a modest level of new programs. The first of its existing programs have recently submitted competing renewals, and this process will accelerate over the coming years.

Dr. Baird noted that previous attempts to support interdisciplinary training were carried out by the Burroughs-Wellcome Interfaces Program, which is no longer in existence, and the NSF Interdisciplinary Graduate Education and Research Training (IGERT). These programs, although well intentioned, did not provide support in a flexible manner or for a long enough period to achieve their desired impact. To address this problem, the NIBIB and the HHMI have partnered to offer the HHMI–NIBIB Interfaces Initiative, which is intended to provide flexible support and longer continuous support for interdisciplinary training programs focused on the interfaces among biology, physical science, and engineering. The first phase of the Interfaces Initiative, which appeared in a 2005 HHMI program announcement, aimed to promote academic and institutional change, to develop innovative and interdisciplinary coursework and community-building activities, and to evaluate and disseminate institutional best practices. In November 2005, the HHMI funded 10 interdisciplinary programs under this program announcement. The second phase of the Interfaces Initiative, which will soon be issued by the NIBIB, will solicit applications from newly established interdisciplinary programs, including funded Phase 1 programs for a June 2008 receipt date. These applications will be scientifically reviewed in the fall of 2008 and reviewed by the Council in January 2009, and awards will be announced in the spring of 2009.

Dr. Baird also discussed NIBIB-supported diversity programs. He reminded the Council that a high percentage of racial and ethnic minorities leave undergraduate programs before completing their degrees, that racial and ethnic minorities make up a small proportion of students in graduate programs at major institutions, and that the percentage of minorities earning science doctorates is in the single digits and might even be decreasing. Several problems in the pipeline have been identified, including the lack of mentors and role models in science. NIBIB-supported diversity training programs include the BBSI program and the Meyerhoff Scholarship Program, both of which support undergraduate training; institutional training and individual fellowships for predoctoral and postdoctoral training; and Diversity Supplements. Dr. Baird noted that the NIBIB recently held its first Diversity Grantee Meeting in conjunction with the American Society of Mechanical Engineers summer bioengineering conference to give them a forum to present their work, to discuss grant application writing skills, and to stimulate thinking about the next steps in their careers.

Future diversity outreach activities include:

- The NIBIB–NSF BBSI Grantee Meeting in April 2008, which will include a presentation of the BBSI Evaluation Study and a discussion of diversity pipeline issues.

- The NIBIB Training Grantee Meeting in June 2008, which will include a discussion of diversity recruitment and retention issues.

Dr. Baird closed his presentation by noting that although the NIBIB has made a good start with regard to training underrepresented minorities, especially at the undergraduate level, it still needs to fully develop a creative mix of diversity programs focused at both the early and later stages in the career pipeline. He indicated that the NIBIB is working to develop and target outreach materials to diversity candidates and to partner with historically black colleges and universities (HBCUs) and professional societies working to increase minority representation among biomedical researchers. In addition, he suggested that the institute should also consider developing diversity supplement programs with dedicated diversity slots whose funding was tied to innovative mentoring programs.

Discussion

Dr. Gary Glover noted that the K99/R00 award is viewed as prestigious by the scientific community and that it offers the added strength of being open to scientists outside the United States. He asked whether the NIBIB could take a proactive role in developing programs that would support the training of foreign students. Dr. Baird responded that, if successful, the K99/R00 might serve as a model for NIH-supported training programs that are more open to the global community. He also noted that some Roadmap programs, such as the T90 program, are open to international scientists but that this mechanism is not yet open to individual NIH institutes.

VII. Beating the Odds: Preparing Minorities for Research Careers in Science and Engineering: Dr. Freeman Hrabowski III

Dr. Freeman Hrabowski has served as President of the University of Maryland, Baltimore County (UMBC), since 1992. He has published several articles on science and math education, with a particular emphasis on the preparation and performance of minority students.

Dr. Hrabowski consults with the NSF, the NIH, and various universities and school systems, and he sits on several national, corporate, and civic boards. His many honors include election to the American Academy of Arts and Sciences and the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. Dr. Hrabowski has coauthored two books focusing on high-achieving African-American students in science. These books are used by school systems and universities nationwide. In addition, the Meyerhoff Scholarship Program at the UMBC produces more minority students in science, mathematics, and engineering who go on to earn doctorates than any other university in the United States. Dr. Hrabowski graduated from Hampton University with a B.S. in mathematics and highest honors, and he earned a Ph.D. from the University of Illinois at Urbana-Champaign.

Dr. Hrabowski spoke to the Council about efforts to produce more underrepresented minority scientists and engineers.

The UMBC is a predominantly White research campus that produces 1,000 Ph.D.s each year, many in the sciences. The student body comprises 12,000 students, 14 percent of whom are Black. One hundred forty countries are also represented in the UMBC student body.

Montgomery County, Maryland, is the largest feeder system into the university. Dr. Hrabowski noted that before the UMBC began its Meyerhoff Scholarship Program, he could not find one U.S.-born Black student who had earned an “A” in any upper-level science course. He also noted, on the other hand, an impressive academic rigor among foreign-born students, who are accustomed to studying harder than even the most talented American students. Before the UMBC Meyerhoff Scholarship Program, he was unable to find a predominantly White university that produced large numbers of underrepresented minorities who major and excel in science and engineering and go on to do well in graduate school. Since then, UMBC students have consistently formed a third of applicants interviewed for M.D./Ph.D. programs across the country.

To set the context for his discussion, Dr. Hrabowski read a quote from Albert Einstein’s 1946 paper “The Negro Question,” which concludes, “We must try to recognize what in our accepted tradition is damaging to our fate and dignity—and shape our lives accordingly.”² He also mentioned Dr. Edward Bouchet, the first African American to earn a Ph.D. in physics, who was unable to find employment as a physicist. Dr. Hrabowski shared that his philosophy has been rooted in the idea of “The Talented Tenth” expressed by W.E.B. DuBois in his 1903 treatise *The Souls of Black Folks*: To school the best and most capable in the colleges and universities of the land.

Dr. Hrabowski contended that it takes researchers to produce researchers, and the generation of new researchers cannot be produced in environments where active research is absent. Dr. Hrabowski argued that high achievers should be identified and given the type of support talented athletes receive. He noted that there are fewer underrepresented-minority Ph.D.s in science and engineering because universities have not done a good job of encouraging active researchers to get involved in the work of producing them. There are well-meaning minority staff attempting to support talented students, but universities need to get these students into the laboratories and make sure they do well in the first 2 years of undergraduate science coursework.

Dr. Hrabowski observed that there is a general lack of science preparation at the K through 12 levels, and many undergraduates who are interested in science are weeded out or leave for other reasons during the first year. The UMBC has revamped its introductory courses to focus on teamwork, to get students involved, and to get students of all races excited about the sciences. In addition, Dr. Hrabowski called on schools to attract students who are resilient and best in their high schools and are highly motivated to be the best. Attracting talented undergraduate students from all races will result in a substantial increase in the number of students continuing in science. In short, improving the undergraduate experience is one way to meet the challenge of preparing underrepresented minorities for careers in science and engineering.

Underrepresented minorities also face academic and cultural isolation in the sciences. The problem of low expectations is a particular challenge. For instance, faculty may make discouraging statements without realizing it. To address these challenges, the UMBC has been developing a community of scholars who can share ideas. Mentoring is especially important in this community. Peer support is also important, and students are encouraged not only to form groups with people of similar ethnic and minority backgrounds but also to join other groups to

² Jerome F, Taylor R. *Einstein on Race and Racism*, New Brunswick, N.J.: Rutgers University Press; 2005:141.

learn from people with different backgrounds. The UMBC also teaches its students to be honest with themselves and with each other about performance and to have a realistic idea of how difficult the work can be. This pushes students to become more proactive and assertive.

Dr. Hrabowski also noted efforts toward changing the university culture, to build an environment that emphasizes evaluation at both the individual and collective levels—by interest, major, department, or faculty member—to help faculty and the university find ways to be more effective. Dr. Hrabowski noted that institutions—and the Nation—should have a vision of encouraging all students to pursue scientific research careers, and more people, including grantees, should take ownership of this vision and become involved in the process. In addition, efforts should be made to help faculty understand what mentoring entails. Dr. Hrabowski added that the UMBC has employed these same concepts with the UMBC Advance grants, which encourage more women to pursue careers in scientific research.

Dr. Hrabowski suggested that the NIBIB provide opportunities to help students gain access to laboratories, both during the summer and throughout the year, to learn more about scientific work. He concluded his talk by reiterating a vision to have the best scientists in the country mentoring students from underrepresented groups and proceeding with rigor and passion.

Discussion

On the basis of her own work, Dr. Mae Jemison echoed Dr. Hrabowski's point that the academic preparation of students from other countries is more rigorous and intense than that of American students. Dr. Jemison also pointed out that in many cases, women and members of underrepresented minority groups achieve "in spite of," and that faculty should be held accountable. She noted that true change will come by making it the responsibility of tenured faculty who head departments, rather than junior faculty. Dr. Hrabowski underscored Dr. Jemison's points by noting that the people who have made a real difference at the UMBC are the full professors. He suggested that faculty's attitudes toward underrepresented minorities can be changed by finding ways to reward, highlight, and recognize those faculty members who make a difference.

Dr. Jemison also noted that for many years, the minority students most successful in graduate study came from HBCUs rather than from predominantly White research institutions. The same was also true of women coming from women's colleges. Dr. Hrabowski responded that this trend has changed to some degree. He acknowledged that HBCUs have done a good job preparing students for graduate school, but he said that more is needed. He also pointed out that although HBCU graduates are highly represented among successful graduate students, more than 70 percent of Black undergraduate students attend predominantly White institutions. Dr. Satcher said that the HBCU issue is an important one, and he emphasized the importance of supporting what HBCUs do well and identifying opportunities for partnerships. He cited the alliance between Georgia Institute of Technology and a number of HBCUs (Morehouse College, Spelman College, and Clark Atlanta University).

Dr. Pettigrew noted that as Dr. Satcher had offered a prescription for America's good health when he was Surgeon General, Dr. Hrabowski has given a prescription for success in increasing the number of women and underrepresented minorities in science and engineering careers.

Dr. Pettigrew also was struck by Dr. Jemison’s observation about HBCU graduates being better prepared and doing better in graduate school than minorities coming from predominantly White institutions. He noted that this most likely is the case because HBCUs already offer the prescription that Dr. Hrabowski described. Dr. Hrabowski added that he often thinks of his approach as “providing [an HBCU] experience at a predominantly White university,” and he concluded by emphasizing the need to get beyond thinking about “the exception,” “the first,” or “the only” when talking about underrepresented minorities in science.

VIII. Adjournment

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

IX. Closed Session

This portion of the meeting, involving specific grant review, was closed to the public in accordance with the 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 2:10 p.m.

X. Certification

We certify that, to the best of our knowledge, the foregoing minutes and attachments are accurate and complete.³

Anthony Demsey, Ph.D.
Executive Secretary,
National Advisory Council for Biomedical
Imaging and Bioengineering
Director,
Office of Research Administration
National Institute of Biomedical Imaging
and Bioengineering

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Chairperson,
National Advisory Council for Biomedical
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³ These minutes will be approved formally by the Council at the next meeting on May 16, 2008, and corrections or notations will be stated in the minutes of that meeting.