SCIENTIFIC MANAGEMENT REVIEW BOARD

MEETING SUMMARY—December 15, 2014

Room 6, 6th Floor, C-Wing, Building 31; Bethesda, Maryland

Board Members Present:

Norman R. Augustine, Chairman
Nancy Andrews, M.D., Ph.D.
Linda S. Birnbaum, Ph.D., D.A.B.T., A.T.S.
Josephine P. Briggs, M.D.
Gary H. Gibbons, M.D. (via teleconference)
Alan E. Guttmacher, M.D.
Stephen I. Katz, M.D., Ph.D.
Scott Koenig, M.D., Ph.D.
Michael A. Marletta, Ph.D.
Gilbert S. Omenn, M.D., Ph.D. (via teleconference)
Griffin P. Rodgers, M.D.
Larry J. Shapiro, M.D.
Martha J. Somerman, D.D.S., Ph.D.
Clyde W. Yancy, M.D. (via teleconference)

Ex-Officio Members Present:

Francis S. Collins, M.D., Ph.D. (via teleconference)

Designated Federal Official:

Marina Volkov, Ph.D., Executive Secretary

Opening Remarks

Mr. Augustine welcomed Board members, invited guests, and members of the public to this meeting of the Scientific Management Review Board (SMRB), the 24th meeting of the full Board. Board members in attendance took turns introducing themselves. Mr. Augustine noted that Dr. Laurencin is now an official SMRB member.

Mr. Augustine reviewed the meeting agenda, which is primarily devoted to the SMRB effort on NIH's Grant Review, Award, and Management Process (GRAMP). Dr. Marletta will lead the GRAMP Working Group discussions, which will include input from specific Institutes and Centers (ICs) and a panel of grant applicants. Dr. Collins will call in to the meeting briefly, and the SMRB will receive an update on the NIH response to the Ebola crisis in western Africa. Lastly, the SMRB will discuss the final recommendations related to Pre-College Engagement in Biomedical Science (PEBS) and vote on acceptance of the report drafted by the PEBS Working Group.

Mr. Augustine reminded attendees that today's meeting will include an opportunity for public comment and that written statements may be submitted to the SMRB at any time via smrb@mail.nih.gov.

Mr. Augustine noted that the summary from the October 14, 2014, SMRB meeting has been completed and reviewed. The SMRB voted unanimously to accept these minutes.

Lastly, Mr. Augustine acknowledged that this is the last meeting for SMRB member Dr. Omenn. Mr. Augustine complimented Dr. Omenn's contributions to the group, including participation in three working groups, 12 SMRB meetings, and more than 30 teleconferences.

Dr. Volkov reviewed the NIH conflict of interest policy, and members reported no conflicts.

Update Regarding NIH Activities

Kathy L. Hudson, Ph.D.
Deputy Director for Science, Outreach, and Policy, NIH

Dr. Hudson reviewed the fiscal year (FY) 2015 omnibus appropriations bill, which had been passed by Congress the previous weekend. The bill includes $30.3 billion for NIH, a $150 million increase from 2014. This amount is still below the 2012 budget prior to sequestration. In addition, the FY15 omnibus includes $238 million to the National Institute of Allergy and Infectious Diseases (NIAID) for emergency funding to address the Ebola crisis. Other mandates within the appropriations include:

- The National Center for Complementary and Alternative Medicine was given a new name: National Center for Complementary and Integrative Health.
- NIH will develop an NIH-wide strategic plan.
- NIH will create a plan to decrease the average time for the first R01 grant from submission to award.
- The National Academy of Sciences (NAS) will create a Blue Ribbon Commission on Scientific Literacy and Standing to conduct a study and provide recommendations to improve scientific literacy and education and enhance scientific regard among the American public.
- The mission of the National Children's Study (NCS) will be maintained, but the bill provided flexibility as to how it will be implemented.

The report also detailed Congressional concerns related to NIH, including clinical trials, data sharing, reproducibility of research results, increased inclusion of women in clinical research, inclusion of sex as a biological variable in relevant animal research, and health disparities.

Dr. Hudson reported that President Obama visited the NIH Vaccine Research Center on December 2, 2014, and met with scientists working to combat Ebola. The President also addressed NIH staff in Masur Auditorium. He emphasized the importance of continued support for basic research at NIH and the need for Congress to authorize funds to combat the Ebola outbreak. Briefly, Dr. Hudson provided an overview of the clinical treatment that has taken place at NIH to date. Nina Pham, the nurse who contracted Ebola virus while treating a patient in Texas, was successfully treated at the NIH Clinical Center. More recently, NIH admitted an American nurse who had high-risk exposure while treating patients in Sierra Leone.

Dr. Hudson provided policy updates on Clinical Trial Data Sharing and A Single Institutional Review Board (IRB). NIH proposed these policies and they are open for public comment. With respect to the former, it was noted that researchers have an ethical obligation to share clinical trial results swiftly and transparently. Regulations require that all trials be registered in ClinicalTrials.gov and that results be submitted to the database. The current NIH policy provides clarity and options to execute the requirements. Currently, regulatory compliance includes phase II and phase III trials and all FDA-

approved study drugs; this policy update would extend the requirements to all clinical trials. Negative results are also deemed critical. Comments are due by February 19, 2015.

The second policy update is related to use of a single IRB for multisite studies. Obtaining IRB approval at each site can delay the start of a trial without increasing protections for study participants. NIH released a draft policy promoting the use of single IRBs in multisite clinical research studies with exceptions for special populations or if required by state, local, or tribal laws. Comments are due by January 29, 2015.

Dr. Hudson informed the SMRB that the Advisory Council to the Director (ACD) met recently and heard presentations on Ebola, peer review (as it relates to bias and diversity), data reproducibility, National Institute of General Medical Sciences research, and other topics. Two active ACD working groups are focused on the NCS and HeLa cell use, and another working group was created to consider issues related to the National Library of Medicine (NLM). The NLM Director will soon retire, and Dr. Collins believed this was an opportune time to consider the role of the NLM with today's technology and interconnectedness.

Dr. Hudson provided some brief background on the NCS, which was put on hold on June 16, 2014, in the wake of a critical report from the NAS and other persistent concerns. Dr. Hudson explained that the NCS had a long and tumultuous evolution. NIH planned to launch the NCS in two phases: the Vanguard Study, which was launched in 2009 to evaluate feasibility, acceptability, cost, study procedures, and outcome assessments, and the Main Study, which has not been initiated. Up to $1.3 billion has been appropriated for the NCS. Persistent concerns have been expressed, including in the NAS report, related to study design, management and oversight structure, escalating costs, the evolving landscape (both scientific and technological), and consideration of newer models for conducting robust and cost-effective research. An ACD working group was assembled to determine whether the NCS was feasible, and the ACD considered the working group's report at a meeting on December 11–12, 2014. The ACD NCS working group reached unanimity in its core finding: Although the overall goal of examining how environmental factors—defined broadly—influence health and development has merit and should be a priority for future scientific support, the NCS, as currently outlined, is not feasible. This conclusion is based on an evaluation of the aims, design, and management of the NCS. The working group recommended that the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development NCS Program Office be dissolved. Given the breadth and depth of the topics that reside around the NCS, the working group recommended a trans-NIH approach, convened and supported by the Office of the Director. In addition, the working group recommended that the Vanguard study data be archived and available for use by investigators for secondary analyses but that the Vanguard study should not collect any additional data.

The ACD working group report stated that the following will be important for future studies: incorporating new biological and technical advances; addressing interactions between child development and relative environmental, behavioral, biological, and societal factors; and supporting biospecimen collection. The working group proposed some future approaches for consideration, including a series of smaller, focused studies; a multi-center collaborative network; a focused cohort design; and probability sampling. In conclusion, the working group report recommended that NIH champion and support new study designs, informed by advances in technology and basic applied research which could make the original goals of the NCS more achievable, feasible, and affordable.

Dr. Collins accepted the ACD findings and recommendations, and oversight of the NCS office has been assigned to Dr. David Murray, NIH Associate Director for Prevention. Dr. Hudson added that NIH will move quickly to devise an alternative approach to achieve the goals of the NCS.

Dr. Hudson also updated the SMRB on the ACD HeLa Working Group. The history of the ethical issues related to HeLa cell use has been well documented. And yet, in March 2013, researchers in Germany posted the entire genome sequence of HeLa cells. The Lacks family, descendants of Henrietta Lacks, from whom the cells were acquired, requested that reporting of the sequence be stopped. NIH has been actively engaged with the family to understand their concerns and discuss the knowledge that has come from the use of HeLa cells. Although no scientists had or have broken any laws, based on these discussions, NIH resolved to advance science, respect the Lacks family, and catalyze policy advances that benefit both scientists and future research participants.

On August 7, 2014, NIH and the Lacks family reached a historic agreement in which the family consented to restricted access to genomic data from HeLa cells. Information about this agreement was published in *Nature*. Scientists interested in using the data must submit an application that will be reviewed by a panel that includes members of the Lacks family. The application must detail plans for sharing what is learned and acknowledging Henrietta Lacks in scientific presentations. The ACD working group did not recommend any changes to the established policy, but it suggested that NIH support a symposium on HeLa cells, including both scientific and plain language contributions. Dr. Hudson reported that NIH leaders had an in-person meeting with some of the Lacks family members, and she showed an image of Dr. Collins and others with the family. She noted it was a unique moment in the history of science.

Discussion

Dr. Koenig commented that disclosure of clinical data is complicated and that private companies grapple with how to report the data expeditiously regardless of whether the results are positive or negative. He urged that NIH find a solution that includes reporting of negative data. Dr. Hudson responded that ClinicalTrials.gov is a partial solution to that problem, but the current format may not enable easy disposition and use of data. She acknowledged that industry is taking the lead to make patient-level data available for secondary research.

Dr. Omenn commented that a report by Thornquist et al. (Streamlining IRB Review in Multisite Trials through Single-Study IRB Cooperative Agreements: Experience of the Beta-Carotene and Retinol Efficacy Trial (CARET); *Controlled Clinical Trials,* 2002) suggested streamlining IRB review through use of cooperative agreements. In addition, Dr. Omenn mentioned the tranSMART Foundation, which is a public-private partnership that attempted to enable effective sharing, integration, standardization, and analysis of heterogeneous data from collaborative, translational research. He noted that five units within the FDA and multiple pharmaceutical companies use the tranSMART platform. Dr. Omenn acknowledged that he is the chairman of the board at tranSMART.

NIH Grant Review, Award, and Management Process

Working Group on the NIH Grant Review, Award, and Management Process (GRAMP)

Michael A. Marletta, Ph.D.
Chair, Working Group on the NIH Grant Review, Award, and Management Process

Dr. Marletta noted that the GRAMP Working Group currently has preliminary findings but no recommendations. He noted that this endeavor includes numerous people with strongly held opinions and that it is intimidating to view the entire picture. The Working Group is still pursuing ideas, but he acknowledged it is a complicated process.

Dr. Marletta reviewed the charge to the SMRB: "…that the SMRB recommend ways to further optimize the process of reviewing, awarding, and managing grants in a way that maximizes the time researchers can devote to research while still maintaining proper oversight." He acknowledged the need for this charge; investigators are investing so much time attempting to acquire funding that they have less time to ponder scientific questions. Richard Nakamura wrote an article in the American Chemical Society publication *C&EN* titled "Rethinking Peer Review," which noted that the number of applications submitted to NIH has expanded from 41,000 in 1998 to more than 86,000 in 2014. The number of reviewers has grown from 5,800 to more than 15,000. This volume puts severe stress on the system.

Dr. Marletta said that in addressing the charge, the SMRB should consider how NIH can streamline the grant-making process and shorten the time from application to allocation of funds. In addition, he said, it should consider how to reduce the administrative requirements on applicants and their institutions, scientific reviewers, Council members, and NIH staff while maintaining a high-quality review and management process.

Briefly, Dr. Marletta displayed the SMRB GRAMP Working Group roster and lauded the group members' participation. He then noted several challenges that the Working Group wanted to address:

- The process from application to award for any grant may take more than one year.
- The number of applications NIH receives continues to rise, increasing the burden on the peer review system.
- Budgetary uncertainty makes it difficult to make award decisions early in the year, often resulting in a bottleneck at the end of the fiscal year.
- Investigators spend a significant amount of time applying for grants to fund research projects, leaving less time to conduct research.

Next, Dr. Marletta reviewed some of the major changes the Working Group is considering, including speeding up funding decisions by ICs, reducing the number of grants cycles per year from three to two, proposing an extension of NIH spending authority beyond the fiscal year, funding principal investigators as opposed to projects, and developing and implementing pre-application streamlining processes. Other changes under consideration include addressing inefficiencies in the application process (e.g., improving Grants.gov) and employing strategies to increase the number of peer reviewers (recruiting more intramural scientists as reviewers, conducting both in-person and virtual meetings, and providing reviewer training). Dr. Marletta added that reviewers must be treated better than what is currently allowable to make it easier for them to contribute.

The Working Group is considering procedural changes that would speed funding decisions by improving efficiency related to how the budget affects the decisions. Dr. Marletta noted that IC directors retain applications from grant cycles early in the year to consider funding them near the end of the fiscal year, causing long wait times for award decisions. One possibility would be to provide partial funding to some grants early in the fiscal year, with full funding contingent on the final budget. Dr. Marletta acknowledged that inaccurate budget predictions could result in inadequately funded projects.

NIH currently has three grants cycles per fiscal year. Applications reviewed at the September council meetings may not be funded until the following fiscal year due to budgetary uncertainty. Reducing the number of grant cycles from three to two may allow timing of council meetings to avoid the bottleneck of award decisions at the end of the fiscal year. It would also likely reduce the number of grant applications per year, as the National Science Foundation (NSF) found when it made a similar change. A third council meeting could be used for concept clearance and priority setting. Briefly, Dr. Marletta reviewed the proposed time frame for a two-cycle granting year. He acknowledged that it is not clear whether making this change would substantially change the workload for scientific review officers or reviewers. It is also unclear how the extramural community would respond. Staggering the review of certain granting mechanisms was an alternate way to potentially alleviate the stress on the grants system.

If the spending authority were expanded beyond the fiscal year, ICs would be able to execute funding actions more consistently throughout the year. This option would require Congressional action, but NIH could request this change if the SMRB believes that it will aid in the funding process. Other federal agencies with such authority indicate that it does little to lessen the workload at the end of the fiscal year and can sometimes lead to loss of unobligated funds.

Dr. Marletta noted that investigators spend a significant amount of time applying for grants to fund research projects, leaving less time to conduct research. Grants to fund investigators rather than specific projects would allow researchers more time to establish their research programs. Many ICs have piloted these types of grants mechanisms; their success has not yet been ascertained. NIH could provide longer awards or different mechanisms to support early career investigators.

The number of applications submitted to NIH continues to rise, and investigators spend a great deal of time preparing applications. For some mechanisms, NIH could require a short pre-application that undergoes peer review (or programmatic review) to determine whether a full application is warranted. Dr. Marletta noted that NIH may not have authority to limit competition through a pre-application process, and there is concern that a pre-application process could increase the overall length of the review process.

Lastly, Dr. Marletta briefly reviewed today's agenda related to GRAMP. The SMRB will hear from an acting IC director and a panel of grant applicants and will have a discussion with representatives from the Center for Scientific Review (CSR) and the Office of Extramural Research (OER).

The NINDS Grant Review, Award, and Management Process

Walter J. Koroshetz, M.D.
Acting Director, National Institute of Neurological Disorders and Stroke (NINDS), NIH

Dr. Koroshetz reviewed the general data for time from summary statement release to award for several of the NIH ICs; the time ranged from a median of 91 days to 264 days. He also showed the median time from application receipt to summary statement release, which is the component managed by CSR. This time frame was quite consistent across ICs. Dr. Koroshetz also acknowledged the challenge of the current system, noting that staff become demoralized when they must follow rules that do not make sense. Dr. Koroshetz reviewed the median time for each of the council rounds (January, May, and September); the time frames were shortest for May councils. Time frames were longest for September councils, which are considering funding decisions for the next fiscal year. Dr. Koroshetz noted that the

end of the fiscal year is a very difficult time at which decisions must be made quickly to complete everything by the deadline.

Dr. Koroshetz considered whether better scoring applications are funded more quickly. The data indicate that some of the highest scoring applications might be processed a little more quickly, but there is no major difference regardless of the IC. He also compared the time frames for two different funding mechanisms, and no significant difference was apparent.

Dr. Koroshetz reviewed the NINDS expedited award process. In the fall, NINDS establishes the next year's payline. Six weeks before council, the Institute generates a list of R01, R21, and K applications to consider for expedited awards. Grants management staff begin collecting the necessary information on these awards, and the list is forward to a subcommittee of the council to review. Before the formal council meeting, the subcommittee approves the awards for expedited funding, and any major concerns are held for discussion by the full council. Dr. Koroshetz acknowledged that many regulatory and compliance issues must be resolved before funds are released.

Dr. Koroshetz reviewed some of the factors that can slow down the awards process: partially overlapping awards from another IC or agency that requires budget renegotiation or refinement of aims, unresolved concerns about human subjects or vertebrate animals, and delays due to failure to complete necessary registration components related to payment. Dr. Koroshetz also noted that foreign grants cannot be expedited. He said that milestone-based grants can be complicated and that notice of award is the only way to enforce milestones. These can require thorough negotiations with the investigators.

Within NINDS, the average time from council approval to notice of grant award release is 4.8 months. For clinical trials it can be longer because of delays related to acquiring an Investigational New Drug (IND) designation; these take an average of 7.6 months. Because of this delay, NINDS now requires the IND number before the grant is submitted. Dr. Koroshetz acknowledged that this may be an added burden for the investigator, but NINDS believed it necessary to properly steward its funds. IRB approval is needed to finalize the award. NINDS holds pre-award start-up meetings with study teams and their business offices to resolve issues that can hold up awards. Dr. Koroshetz ended his presentation by cautioning that what he stated cannot be generalized to all NIH ICs.

Discussion

Dr. Koenig asked whether the time to award has increased over the past several years; Dr. Koroshetz did not know. Dr. Marletta posited that the increase in applications may affect some ICs more than others. Dr. Koroshetz estimated that 75 percent of NIH reviews are conducted by CSR and 25 percent by ICs.

Mr. Augustine asked whether anyone has had two review groups review the same set of grant applications to assess the validity of the system. Dr. Koroshetz replied that he has only seen that happen by accident. He also noted that NIH allowed concurrent submission of program project grants and similar individual R01 grants; the reviews were in concurrence approximately 40 percent of the time.

Dr. Omenn acknowledged that NIH ICs have different practices, priorities, and histories. He stated that acquiring information about best practices would be helpful and perhaps could lead to peer review that is performed outside of the meeting room. Dr. Koroshetz stated that many ICs have a subgroup of the council review potential awardees before the official council date. Dr. Briggs stated that comparing numbers across ICs may help the SMRB better understand differences in process. She noted that

extramural program management does consider best practices. She also stated that interventional trials include a complex set of decisions that must be considered carefully. Dr. Della Hann from OER joined the discussion. She stated that an internal working group considers best practices for the grant award process. Expedited council review was an outgrowth of the working group several years ago. She noted that every change requires careful consideration given the diversity of the ICs and their processes. Dr. Koenig said that comparing funding levels for the ICs would also be informative.

Dr. Koroshetz noted that many ICs grapple with grants that are funded with money from the previous fiscal year. Dr. Briggs stated that flexibility to fund in a later cycle is important because non-competing grants can fluctuate. She encouraged funding flexibility at the end of the fiscal year.

Dr. Koenig asked why NIH cannot use flat-line estimates for projecting the next year's funding. Dr. Briggs replied that it may be possible for the larger ICs, but the budgets for smaller ICs can fluctuate. Dr. Birnbaum agreed and noted that the current budget is not keeping up with inflation. This is in addition to the sequestration. Dr. Birnbaum added that her IC also has a subgroup council before the formal meeting and that IRB approval is required for interventional studies at that stage. Lastly, she added that it would be helpful if each IC had its own line within the NIH budget. Council meetings can be planned as much as three years in advance. Dr. Marletta noted that this discussion is similar to those of the GRAMP Working Group; it is clear that one solution will not fit all ICs.

Applicant Perspectives on Options to Streamline NIH's Grant Review, Award, and Management Process

Elva D. Diaz, Ph.D.
Associate Professor, Department of Pharmacology, University of California, Davis; 2009 Recipient of the NIH Director's New Innovator Award

Ervin R. Fox, M.D.
Professor of Clinical Cardiology, University of Mississippi Medical Center; 2011 Recipient of the Presidential Early Career Award for Scientists and Engineers

Raquel Gur, M.D., Ph.D.
Professor of Psychiatry, Neurology, and Radiology, University of Pennsylvania Perelman School of Medicine

David A. Savitz, Ph.D.
Vice President for Research, Brown University

Elva D. Diaz, Ph.D.

Dr. Diaz said she has been an independent researcher for the past 11 years. In that time, she has had 10 unsuccessful R01s. In 2009, she received Innovator funding, which has been critical for the continuation of her research. She acknowledged that she has been more successful at acquiring funding from the NSF.

Dr. Diaz acknowledged the bias implicit in the grants process. Using de-identified grants could be an interesting pilot project. She also expressed interest in the idea of a pre-application. The lack of

discussion within study sections about the grants under review is detrimental to the process. If a pre-application would allow more time to discuss fewer grants more fully, it would add value to the process. She also noted that it is very frustrating to invest time in proposal writing without sufficient feedback for resubmission or rewriting.

Dr. Diaz also endorsed the concept of funding researchers as opposed to projects. She believed that she was more successful with NSF grants because the NSF considered the broader impact on science. She recommended that serving on study sections be a prerequisite for receiving NIH funds. She also suggested base funding once researchers have been awarded their first R01 as opposed to competitive renewal. Study sections could then focus on new investigators and help them develop their proposals. Lastly, Dr. Diaz endorsed the idea of eliminating deadlines to reduce the number of applications.

Ervin R. Fox, M.D.

Dr. Fox introduced himself as a cardiovascular epidemiologist who has received NIH funding through the National Heart, Lung, and Blood Institute. He has received K grants, R01s, and the 2011 Presidential Early Career Award for Scientists and Engineers. He found the transition to the second R01 as significant and challenging as the transition between a K award and an R01 award. He urged the SMRB to consider ways to help young investigators to continue establishing their laboratories. If there is a gap in funding, young investigators can lose staff, which makes it more difficult for them to concentrate on research to become competitive for a second R01. Dr. Fox recommended that promising candidates be eligible for an extension of funding.

Dr. Fox also endorsed the concept of the pre-application, noting that a joint program between the American Heart Association and NIH for genome and phenome studies included that mechanism. He believed that even a quick response that an application will not be funded would be helpful to an investigator, particularly if the response provides suggestions to make the application more competitive.

Raquel Gur, M.D., Ph.D.

Dr. Gur introduced herself as someone who has acquired NIH funding, has contributed to study sections, and has participated in NIH council for the past four years. She endorsed the concept of pre-screening and suggested that study subsections could review pre-applications within four to six weeks and screen out applications that are unlikely to acquire funding. She noted that this might be done through virtual meetings. Full study section meetings could be reserved for full applications.

Dr. Gur also suggested that in-person meetings be rotated between the east and west coast; the burden of long flights would be more evenly distributed.

Dr. Gur suggested that who is contributing to the review process should be public knowledge, perhaps as part of the biosketch. Although scientific merit is the priority, serving the good of the scientific community is also important. She noted that the University of Pennsylvania uses reviewer participation as a criterion for career advancement. Lastly, Dr. Gur suggested considering a mechanism to acquire additional funds for educating junior investigators.

David A. Savitz, Ph.D.

Dr. Savitz explained that he has a wide range of experience as a grant reviewer and mentor and dealing with the machinery of research and development. He said he wanted to raise two points. The first is that the burden of grant applications is seen in hindsight when an application is not funded, and it feels like wasted effort. For every aspect of an application that is shifted to only the successful applicant, a significant burden is lifted for all who apply. Applicants also have more motivation to put forth the effort once it appears that funding will be procured. Second, Dr. Savitz stated that pre-screening might also help to encourage innovation through a more conceptual approach to grant funding.

Discussion

Dr. Marletta thanked the panel members for their comments and noted that the Working Group has discussed radical ways to consider grant processes; NSF has one approach that is modeled on game theory wherein investigators review grants competing with their own. He also acknowledged that NIH needs to encourage reviewers to participate by treating them better. The Working Group has also discussed requiring service as a reviewer, which is a sensitive issue.

Dr. Andrews suggested that peer review could be conducted via mail or e-mail through a separate set of reviewers. This may be a way to engage senior scientists without adding burden to current reviewers.

Dr. Katz noted that within the past year, NIH has focused on aspects of research related to sustainability, stability, and innovation. The ICs are doing various things to address these points, one of which is a supplement to an R01 to help investigators establish their research programs. Dr. Katz also stated that he did not believe that using a pre-application would have to prolong the time frame from application to award. He believed that the SMRB must consider whether the addition of a pre-application would add burden and that pre-applications would require peer review as opposed to programmatic review. Previously, review groups have discussed a category for applications titled “do not return,” and it was not embraced.

Dr. Savitz explained that, in his experience with a pre-application process within his university, was applicants received nominal feedback about how the decision was made. He believed that passing the pre-screening gave investigators a psychological advantage that enabled them to move forward on their full applications. Overall, he believed the pre-application to be beneficial.

Dr. Koenig noted that NIH must remain wary of creating bias within the system. He suggested that a pre-application process might be de-identified. Dr. Birnbaum endorsed this idea.

Dr. Marletta addressed Dr. Hudson, noting that some percentage of people would likely submit a full application regardless of the outcome of the pre-application. He asked whether NIH could document the result of the pre-application in the full review. Dr. Hudson replied that it would be interesting to track this type of occurrence. Her experience with a National Center for Advancing Translational Sciences drug rescue program was that none of the people dissuaded from applying submitted formal applications. Dr. Hann added that the X02 mechanism was added for the purpose of pre-application review, but it was performed by the program office. It has only been used for specific programs, and there are numerous caveats. Dr. Hudson stated that the X02 mechanism does add time to the process. Dr. Andrews urged implementing mechanisms that support young investigators. Dr. Birnbaum stressed that the SMRB must consider specifics of who would have to manage a pre-screening process (CSR versus IC).

Dr. Shapiro suggested having some ICs volunteer to experiment with voluntary pre-application. Dr. Savitz noted that most people would prefer a quick rejection and that most major journals are moving toward sending fewer manuscripts to full review. Dr. Marletta liked the idea of testing the concept with specific ICs wherein the GRAMP Working Group might help define the process. NIH could then assess the outcome to determine whether the process should be used NIH-wide. Dr. Koenig recommended using an editorial review board for the pre-application process and study sections for the full application process. He noted that if the review cycles were reduced to two, different groups could perform the pre-application review and the full application review. This would result in no added burden to the reviewers.

Mr. Augustine asked why investigators receiving NIH funds are not required to participate in the grant review process. Dr. Katz replied that the researchers are not paid for their time as reviewers and therefore cannot be required to participate. ICs are allowed to strongly encourage participation, and it is a consideration for receipt of merit awards. Dr. Hann added that the current language regarding reviewer participation is "high expectation," but NIH has no legal authority to require participation. Dr. Birnbaum endorsed the concept of including reviewer participation in the investigator's biosketch. Dr. Shapiro noted that an unintended consequence of this action would be unfavorably viewing a researcher who has not been asked to participate in study section review.

Dr. Marletta informed the Board that he is a senior editor for eLife, a web publication that allows quick feedback on pre-applications through a computer program that enables review editors to have efficient discussions about merit. The review editors then select the manuscripts that will be submitted for full review. In this process, one editor recruits two additional people and they review collectively. The author receives a compiled review from the three reviewers. The reviewers may not know one another, and the reviews take place virtually, but Dr. Marletta believed that it works quite well. Dr. Savitz was intrigued by the concept of group review. He also believed that reducing the burden of travel for reviewers was important, although he acknowledged that he preferred the final, formal review of an application to be an in-person meeting. Dr. Gur noted that a pre-application process may help identify applications with a fatal flaw, such as improper patient population.

NIH Director's Message and Ebola Update

Message from the NIH Director

Francis S. Collins, M.D., Ph.D.
Director, National Institutes of Health

Dr. Collins called in to the SMRB meeting from London, England, where he was attending a meeting of the Global Alliance for Chronic Diseases. He called to express his appreciation for Mr. Augustine's contributions and efforts, because this is the last SMRB meeting for which he will serve as SMRB chair. Dr. Collins reviewed Mr. Augustine's distinguished career, including chairing the panel that crafted the 2005 report *Rising Above the Gathering Storm,* which energized constituents with an interest in scientific progress and continues to be relevant today. Mr. Augustine also received the National Medal of Technology from the President of the United States. He has been the SMRB chair since the Board's inception in April 2009 and has chaired 24 meetings and numerous teleconferences and provided invaluable leadership. With Mr. Augustine's leadership, the Board embraced the process of deliberation and produced a useful guide for deliberating organizational change and effectiveness. Dr. Collins reviewed the SMRB reports released under Mr. Augustine's tenure, including reports on the role of the

NIH clinical system, translational medicine, small business innovation research, assessment of the value of biomedical research, and PEBS. Dr. Collins told Mr. Augustine that it has been an absolute pleasure working with him and that his humor, perspectives, and ideas will be missed. Dr. Collins thanked Mr. Augustine for his time, effort, and leadership.

Mr. Augustine responded that serving on the SMRB has been his privilege. He complimented Dr. Collins' ability to ably lead NIH through some very challenging times. He noted that life expectancy increased from 49 years to 79 years within the last century predominantly due to advances in biomedical research, underlying the importance of NIH's work.

NIH Response to the Ebola Crisis

Richard T. Davey, Jr., M.D.
Deputy Clinical Director, National Institute of Allergy and Infectious Diseases, NIH

Dr. Davey began his presentation with information about Ebola virology. Ebola is part of the filovirus family. The genus of Ebola virus comprises five species: Bundibugyo, Zaire, Reston, Sudan, and Tai Forest. Mortality rates for Bundibugyo, Zaire, and Sudan are, respectively, approximately 30 percent, between 50 and 90 percent, and approximately 50 percent. Reston is not transmitted to humans, and there has been one nonfatal human case of Tai Forest. The current outbreak in West Africa involves a Zaire strain.

Briefly, Dr. Davey reviewed the anatomy of the filovirus and the Ebola transmission cycle. He noted that a fair amount is known about this virus as a result of many years of study. Although the reservoir for the virus is not entirely known, because the evidence is inconclusive, current models indicate that fruit bats are transmitting the virus to other animals.

Dr. Davey also reviewed the tropism, or pathogenesis, of Ebola virus, which is an area of significant research interest. Infection is fairly ubiquitous; transmission occurs through bodily fluids, which leads to infected macrophage and dendritic cells, resulting in cytokine release, cell apoptosis, and vascular leakage. These can then result in systemic inflammatory response syndrome. Dr. Davey noted that the later stage of hemorrhage is fairly uncommon. Dr. Davey reviewed the timeline for the typical clinical course of Ebola infection, including a 2- to 21-day incubation period, symptoms for up to 10 days, and possibly death. Symptoms include weakness, fever, or influenza-like illness on days 1–3; vomiting, diarrhea, and hypotension on days 4–7; and confusion, possible bleeding, and shock on days 7–10. Dr. Davey noted that most untreated cases result in death.

Dr. Davey showed a depiction of the spread of the current West Africa Ebola outbreak from May through December 2014. Cases were detected in Guinea and, to a lesser extent, in Sierra Leone and Liberia in May; the outbreak then blossomed to more than 3,000 cases in Liberia alone in September. As of December 2014, almost 8,000 cases had occurred in both Sierra Leone and Liberia, and more than 2,000 cases were documented in Guinea. Dr. Davey noted that the spread appears to be lessening in Liberia, but there has been an upsurge in Sierra Leone.

Dr. Davey showed a graph comparing the size of the 2014 Ebola outbreak to that of previous outbreaks; this event exceeds all of the others combined by severalfold. Researchers analyzed ninety-nine genomic sequences from 78 individuals from May and June of 2014. They identified three hundred ninety-five mutations, but there was no significant evidence of a functional change in the virus.

Briefly, Dr. Davey reviewed the U.S. response to the Ebola outbreak. More than 3,000 troops have been sent to the area, and they have constructed Ebola treatment units. In addition, they have created a 25-bed facility for health care workers. There is ongoing Centers for Disease Control and Prevention (CDC) and U.S. Agency for International Development (USAID) support. Dr. Davey showed a quote from President Obama from September 16, 2014: "Faced with this outbreak, the world is looking to us, the United States, and it's a responsibility that we embrace…We are going to keep leading the effort."

Six patients have been medically evacuated from Western Africa to the United States. Two inadvertent importations of infected cases have occurred; one was a traveler in Dallas, Texas, and one was a health care worker in Bellevue, New York. Two transmissions have taken place in the United States, both of them in Dallas. Three health care workers were evacuated to the United States due to high-risk exposure. There have also been medical evacuations to other countries.

NIH has a special clinical studies unit that is a designated Ebola treatment facility. The University of Nebraska and Emory University also have facilities to treat Ebola patients.

Briefly, Dr. Davey reviewed the airport procedures for screening for Ebola virus infection. Exit screening is conducted in the West African countries, including screening for fever, presence of symptoms, and understanding of contact with Ebola patients. Upon entry into the United States, all passengers are routed through five major airports and monitored for fever, symptoms, and contact with any Ebola patients. Passengers are quarantined if warranted.

Between August and September 2014, more than 36,000 potential passengers underwent exit screening at West African airports. Seventy-seven people were denied boarding due to the criteria listed above; none had Ebola. Most people had fever due to malaria.

The CDC has revised its guidelines for characterizing travelers as high risk, some risk, low risk, and no risk. These guidelines are important to determine how people are screened, monitored, managed in quarantine, and allowed public activities and travel. Each state makes its own determination about the course of action for risk management.

Dr. Davey next reviewed the research and development related to Ebola vaccines. NIAID and GlaxoSmithKline have engineered a chimpanzee adenovirus type 3 vaccine candidate that confers 100 percent non-human primate protection at five weeks and 50 percent protection at 10 months. NIH started a phase I trial of a bivalent form in Zaire and Sudan in September 2014. The University of Oxford started a phase I trial of a monovalent form in Zaire around the same time. Manufacturing for larger scale evaluation is ongoing. Recently, the *New England Journal of Medicine* published a preliminary report indicating that the vaccine is well tolerated in humans and that antibody and CD8+ T-cell responses were consistent with the protective non-human primate response. Additional studies with this vaccine are ongoing.

A second vaccine that is replication competent is also being tested; it was developed by Merck and the Public Health Agency of Canada. It is currently being tested at three different dose levels and appears to be fairly well tolerated. Other studies are also ongoing.

A U.S.–Liberian Clinical Research Partnership has been established to conduct a phase II/III trial that will include two vaccines and a placebo. The trial will include 27,000 patients in Liberia and potentially other

countries. Currently, Dr. Clifford Lane from NIAID will meet with the Liberian Minister of Health to discuss this trial. The current assumption for this trial drug is 50 percent efficacy and evidence of disease in 1 percent. Dr. Davey stressed that in patients with Ebola, fluid resuscitation is the primary need.

Briefly, Dr. Davey reviewed therapeutic targets in the Ebola life cycle; there are a variety of epitopes to target with either antibodies or anti-sense molecules. Use of plasma may have potential, although it has had mixed results in the past.

Dr. Davey reviewed current patient outcomes. Mortality in the United States was approximately 20 percent (with one death) compared to as high as 80 percent in Western Africa. He estimated that the overall mortality rate was between 40 and 50 percent for the current outbreak. The patients treated in the United States received numerous investigational therapies. The nurse treated at NIH received four separate experimental treatments. This means that researchers cannot determine which drugs were most effective. It is impossible to draw inferences about the best way to treat Ebola from the cases in the U.S. given the differing levels of disease severity, different times of action within a patient's clinical course, and the administration of multiple interventions. The two most promising treatments are ZMapp, which is a triple monoclonal antibody cocktail, and favipiravir, which is a broadly acting RNA polymerase inhibitor. Currently, ZMapp is not in supply, although the preliminary data on its efficacy show promise. Dr. Davey stressed that to determine the efficacy and risks related to each treatment, scientists must conduct randomized controlled trials. Clinical infrastructure is needed for trials to be conducted in the countries where the virus is spread.

Discussion

Dr. Andrews asked if there was any information about the cellular responses in people who were exposed but did not become ill. Dr. Davey responded that some IgG levels were detected, but it is not clear whether there is a clinical correlation to viral protection. The vaccines may be working through different mechanisms, such as cell-mediated response or humoral antibody response.

Dr. Koenig noted that the Ivory Coast did not appear to have any cases of Ebola and asked if that has remained true. Dr. Davey responded that the borders are very porous but that the Ivory Coast has implemented border control. Nigeria and Mali also had minor, controlled incidents.

NIH Grant Review, Award, and Management Process *(cont.)*

Public Comments

There was no public comment.

Discussion of Preliminary Findings and Recommendations of the GRAMP Working Group

SMRB Members

Richard K. Nakamura, Ph.D.
Director, Center for Scientific Review, NIH

Della M. Hann, Ph.D.
Deputy Director, Office of Extramural Research, NIH

Dr. Marletta noted that previous discussions have included the idea of a pre-application or pre-screen of applicants. He cautioned that although speeding up the process is desirable, the SMRB must also consider how to improve the process.

Dr. Nakamura stated that a pre-application would be helpful from the CSR perspective. He has been told that, legally, NIH cannot implement it without a change in the authorization. Based on previous experience, he said, asking for a change in authorization can open a door to other, unpredictable changes. CSR has considered ways to reduce reviewer workload, and it may be legally viable to implement editorial board–like processes with mail-in reviewers. He believed the idea was worthy of further consideration.

Dr. Hann noted that there are many issues to address and the action will depend on the goal. Reducing burden on peer reviewers is distinct from improving reviewer feedback to applicants. Goals should be prioritized, and then experimental systems can be tested to assess any collateral results. She stressed that although NIH can provide feedback on whether or not to pursue an application, it cannot tell an applicant "do not come back." Dr. Koenig urged the SMRB to consider options that might have one objective but solve several problems. Dr. Nakamura noted that the details are important; having CSR and staff perform reviews would likely not be feasible. Dr. Marletta stressed that the Working Group would like to consider ways to reengage senior scientists. It was also noted that the ICs have very different processes that should be taken into account.

Dr. Briggs noted that her IC's advisory council contributes to determining the programmatic balance within the payline, which is not compatible with expedited concurrence. She posited that advisory councils of larger ICs likely are not involved to the same degree.

Dr. Marletta asked Dr. Nakamura to elaborate on the concept of extending spending authority beyond one year. Dr. Nakamura expressed the belief that extending the time for spending would help avoid dead zones in the funding cycles. However, using it to delay award of applications would be deleterious. He suggested it would be best used to spend a portion of the budget at specific intervals. Dr. Hann added that this would require institutional commitment to change spending habits. Dr. Katz noted that, in the past, NIH has been challenged on why it spends so much money in the second half of a fiscal year. More than any other federal agency, NIH is a granting institution. Dr. Hann noted that planning for larger initiatives is typically reserved for the end of the fiscal year to ensure that NIH has sufficient funds; two-year spending authority could obviate that.

Mr. Augustine stressed that the report should emphasize that an inefficient and prolonged review system risks lost opportunities for science. The speed of discovery is significant, and progress could be lost if the system is not improved. This led to a discussion of who assists researchers during funding gaps. The Board agreed that laboratories must be kept running at a base level to maintain critical functions; Dr. Marletta noted that institutions face severe pressures to temporarily assist researchers. Dr. Diaz suggested federal bridge funding for funding gaps; Dr. Nakamura responded that it could be construed as welfare for science. Dr. Nakamura also said he was appalled that U.S. citizens seemed to be resigned to losing prestige and standing in science; other countries are following our previous example and investing heavily in science.

Dr. Nakamura was asked to comment on reducing the number of grant cycles from three to two. He responded that it would cause a number of changes, including an increase in the number of applications per cycle, and the committees would have to be redistributed. The third council meeting would be used

for other purposes, like strategic planning. Dr. Hann noted that the SMRB will have to consider whether this would prolong the time for investigators to resubmit their applications. Dr. Briggs stated that the Board should consider methods that incentivize institutions so that they are not encouraging as many applications as possible. Dr. Birnbaum said that the current process is also a burden for universities and that NIH should partner with these institutions to enact positive change. Dr. Hann acknowledged that the increase in applications is due primarily to the number of people in the system. She also acknowledged that some researchers are staying in the system longer. Dr. Gur noted that many university systems rely on R01 status as a basis for promotion, and having only two cycles per year could impair researchers' ability to obtain tenure within a short time frame.

Dr. Rodgers suggested effecting change in study section behavior and noted that it is helpful to simulate the potential effects of a new policy. Dr. Nakamura added that it is helpful to try to guess how scientists might strategize their submissions based on current rules.

Dr. Shapiro expressed concern about trying to sustain a system that has reached its maximum capacity. Dr. Diaz advocated making the review process as efficient and fair as possible, providing helpful feedback for all applicants. She believed the Board should also consider reviewer training and education. Dr. Marletta commented that, given the current stress on the system, giving every proposal a substantive review would be very challenging. He also noted that the system is not meant to be a learning process. Dr. Gur agreed, noting that senior investigators should commit to providing support and training to help new investigators at their institutions write competitive applications. Dr. Andrews supported the concept of institutional mentoring but expressed concern that grant nominations within institutions could introduce bias.

Dr. Somerman expressed concern about the concept of pre-screening and instead suggested that applicants include a three-page summary with their applications for preliminary review. This would decrease reviewer burden, but Dr. Diaz noted that it increases work for the applicants. Instead, she suggested a letter of institutional support once the pre-application process was completed. Dr. Marletta believed that letters of institutional support are of limited value.

Dr. Nakamura noted that an analysis of the top 100 research institutions found no correlation between their grant success rates and the numbers of dollars they received. Some institutions had steadily better success rates, but what made those institutions more successful is unknown. Dr. Hann noted that the data per institution are surprisingly stable, aside from success rate.

Dr. Marletta thanked the discussants. Dr. Hann thanked the SMRB for its consideration of this topic, acknowledging that it is a daunting task.

Pre-College Engagement in Biomedical Science

Presentation of the SMRB Working Group on Pre-College Engagement in Biomedical Science (PEBS) Recommendations and Report

Clyde W. Yancy, M.D.
Chair, PEBS Working Group

Dr. Yancy led the SMRB through a presentation via teleconference. He reviewed the PEBS charge: "To recommend ways to optimize NIH's pre-college programs and initiatives that both align with the NIH

mission and ensure a continued pipeline of biomedical science students and professionals." Dr. Yancy noted that preliminary discussions dealt with the confusion as to whether there were too many PhDs in the workforce and galvanized the Working Group's effort to understand the population being educated and the definition of "biomedical workforce."

Dr. Yancy reviewed the elements of the PEBS charge. In addressing this charge, the SMRB should examine the evidence base for successful approaches for pre-college biomedical science programs aimed at strengthening the biomedical workforce pipeline; identify the attributes, activities, and components of effective pre-college biomedical science programs, including the role and relative importance of teacher training programs; identify the points in the pre-college biomedical workforce pipeline where NIH's efforts could be applied most effectively, given finite resources; and define ways for NIH to improve the evidence base for effective pre-college biomedical science programs. Dr. Yancy reiterated previous commentary that noted that the Working Group was not asked to consider the entire pre-college education system.

Next, Dr. Yancy reviewed the Working Group's general findings. He said that alarming trends suggest that the current and rising scientific workforce may not be fully prepared to address the increasingly complex nature of biomedical research, nor reflect the diversity of students seeking careers in relevant fields. Disparities in education harm millions of students, especially minority and poor students. Distribution of well-trained science teachers and resources is uneven, and academic and career expectations are lower for underrepresented minority students. These issues will need to be addressed nationally by political and community leaders, policy makers, and other decision makers. Dr. Yancy urged the meeting attendees to read the Executive Summary of the PEBS report. The guiding principle for this report is that NIH's pre-college science, technology, engineering, and math (STEM) activities need a rejuvenated, integrated focus on biomedical workforce preparedness with special considerations for underrepresented minorities.

Dr. Yancy reviewed the recommendations from the report, beginning with the overarching recommendation: To establish a transformative body with strong, galvanizing leadership and representation of all relevant NIH ICs, NIH offices, and committed non-NIH stakeholders to oversee the following:

- Development of a uniform reporting template for NIH-sponsored pre-college STEM programs
- Creation and maintenance of an inventory of all programs
- Development of optimum processes for the functionality of all current and planned programs
- Coordination of these programs, including synergy with other federally supported pre-college STEM activities
- Development of evaluative criteria to gauge the success of these programs

Dr. Yancy stressed that this is not a statement for a new initiative, but rather a single, operational recommendation to lead all of the recommendations to follow. Steps for NIH include focusing pre-college efforts on the most pressing workforce needs, coordinating and cultivating effective programs and approaches, and leveraging strengths of the public and private sectors.

Next, Dr. Yancy reviewed each of the findings detailed in the PEBS report.

Finding 1: Underrepresented minority and low-socioeconomic-status (SES) students have limited opportunities to engage in biomedical science education. Overall makeup of the biomedical workforce is decidedly lacking in diversity, especially in leadership positions. STEM attitudes are positive at a young

age across gender and racial/ethnic groups, but access and performance gaps begin to appear in elementary school. There is a strong need to engage and retain underrepresented and low-SES students and to improve their access to educational and career opportunities.

Recommendations for Finding 1:

- Better target NIH-funded education outreach to students from underrepresented groups and their teachers.
- Promulgate best practices of exemplar programs with a track record of directing students who are underrepresented minorities toward careers in biomedical science.
- Use demonstrably successful NIH enrichment programs (e.g., summer internship programs) as opportunities to enhance diversity.
- Closely monitor the outcomes of NIH's nascent undergraduate underrepresented minority recruitment, mentoring, and training programs (e.g., the National Research Mentoring Network, Building Infrastructure Leading to Diversity) to determine whether these strategies could also be employed with middle and high school students and their teachers.

Finding 2: NIH should convey a broadening of workforce categories to pre-college youth who might consider careers in biomedicine. Dr. Yancy noted that there is no consensus on the optimal size of the biomedical workforce and that new job categories are constantly emerging. There is a need to cultivate cross-disciplinary science and opportunities for young people to bring new capabilities. Without a broader conceptualization of cross-disciplinary scientific needs and a more encompassing definition of careers in biomedical science, it is difficult to assess the quality of the workforce and to define future needs. Dr. Yancy showed an example of the typical view of the biomedical workforce, including principal investigators, clinician scientists, and postdoctoral researchers, but the workforce also includes professions like technology transfer officers, science teachers, journal editors, statisticians, science policy analysts, veterinarians, clinical nurses, and grant managers.

Recommendations for Finding 2:

- Emphasize the wide range of current and future career options available to students.
- Promote the cross-disciplinary nature of innovative biomedical science.
- Ensure that NIH's STEM education programs are informed by the work of the NIH Division of Biomedical Research Workforce Programs to understand the composition of the current biomedical workforce, project future workforce needs, and identify emerging skills that should be fostered in K–12 education settings.

Finding 3: NIH has a large portfolio of pre-college STEM activities and should seek to streamline and enhance effectiveness through increased coordination. NIH supports a number of STEM programs targeted at pre-college students and teachers (e.g., the Science Education Partnership Awards, summer research programs), but these efforts are largely ad hoc and uncoordinated. The suite of current NIH programs lacks both a central reporting structure and an ongoing infrastructure to ensure accountability. Currently, NIH supports 246 pre-college STEM activities, including 117 grant awards, 35 internship programs, 19 curriculum supplements, 66 teacher development activities, and other activities.

Recommendations for Finding 3:

- As set forth in the Working Group's overarching recommendation, NIH should establish a transformative body to develop plans for coordinating, monitoring, and systematically evaluating its pre-college activities. This body should emphasize efforts to:
    - Strongly encourage all NIH-supported STEM programs to increase outreach to underrepresented populations.
    - Identify best practices and expand exemplar programs.
    - Identify resources to be provided to those who teach or mentor pre-college students.
    - Provide an infrastructure and a process to enable curriculum developers to identify and collaborate with subject matter experts at NIH.

Finding 4: No standard measures of success exist for the NIH pre-college STEM activities. A more rigorous evaluation process could strengthen all activities and produce new best practices. Currently, NIH programs use a diverse set of evaluative methods, including progress reports, milestone reports, and independent evaluation. Some projects use more than one evaluative method. This variety of evaluative methods speaks to a key challenge of the STEM education enterprise: the lack of strong, evidence-based criteria by which to gauge effectiveness. Little empirical evidence exists on specific programs or educational approaches that are effective for improving either science teaching or student learning outcomes. Without an evidence base for what works, it is impossible to precisely define the attributes of effective STEM programs. However, NIH has opportunities to improve evaluation of its pre-college activities. Dr. Yancy acknowledged a public comment received on this point that denoted risks to centralizing the process, but he believed that NIH needs a base for all activities.

Recommendations for Finding 4:

- Identify and track the development of STEM education best practices and evaluation standards.
- Define successful outcomes (including careers listed under the broader definition of the biomedical workforce).
- Develop metrics needed to evaluate the effectiveness of extant NIH STEM programs.
- Apply systematic and comparable evaluation practices for NIH's pre-college programs.
- As the evidence base for pre-college STEM education grows, determine the feasibility of expanding evaluation metrics to include measures of long-term program effectiveness.
- Work with other federal agencies and organizations to improve the collection of longitudinal, student-level data, especially as they relate to pre-college students' exposure to biomedical and human health learning experiences and eventual career trajectories.

Finding 5: NIH's research community has untapped potential. Leveraging NIH's existing network of funded research centers offers an effective and cost-efficient opportunity to increase NIH's impact on PEBS. NIH supports more than 300,000 research personnel at more than 2,500 universities and research institutions, as well as 6,000 scientists and clinicians in the intramural program. Many NIH-funded universities, investigators, and trainees already devote time and resources to teaching, tutoring, mentoring, and providing hands-on research experiences to pre-college students and teachers. NIH should continually identify effective, scalable programs at U.S. universities that can be highlighted and emulated around the country. The biomedical research community needs to make pre-college student outreach part of its culture, and NIH can spearhead this effort.

Recommendations for Finding 5:

- Increase the impact and reach of pre-college STEM education efforts by leveraging existing investments in university researchers, trainees, and infrastructure.

- Offer supplemental funding to grantee institutions, researchers, and trainees to provide educational outreach, including summer internships, research seminars, science fairs, and hands-on science experiences.
- Communicate the importance of pre-college student and teacher engagement, especially engagement of low-SES and underrepresented minorities, as a cultural value of the biomedical research community endorsed by NIH leadership, including all IC directors:
    - Engage pre-college students and teachers in science enrichment activities.
    - Elevate teaching as a career option for trainees.
    - Provide opportunities for researchers and trainees to mentor pre-college students and teachers on a long-term basis.

Finding 6: NIH has many opportunities to partner with other entities committed to pre-college STEM outreach. Many other government agencies are engaged in STEM education; the U.S. Department of Education (ED) and the National Science Foundation (NSF) are responsible for the largest share of federal STEM education programs. The biomedical and pharmaceutical industries, medical and health research professional societies, and philanthropic organizations also spearhead numerous STEM efforts. Because NIH's unique strength is its expertise in biomedical research, it must seek opportunities to share that expertise. By using the leverage of NIH, the varied entities in this space could improve the coordination of their collective efforts with the goal of complementing each other's roles, thus achieving greater impact than they can by working in isolation. The Committee on Science, Technology, Engineering, and Math Education (CoSTEM) is made up of 15 federal entities and currently is addressing five national goals, including improving preschool through 12th grade (P–12) STEM instruction. It also seeks to better serve groups historically underrepresented in STEM fields. Another example is from NSF and ED; they are building the evidence base for effective science education interventions and striving to strengthen evaluation approaches and collect data on primary and post-secondary STEM education.

Recommendations for Finding 6:

- Seek opportunities to provide expertise and guidance to private and nonprofit organizations that support pre-college programs and biomedical science outreach and to learn from them.
- Monitor the subcommittee activities of the CoSTEM, especially the subgroups devoted to increasing the diversity of biomedical students and trainees and improving P–12 STEM instruction.
- Leverage NIH's expertise to support government-wide efforts to improve STEM education and strengthen the evidence base.
- Provide expertise to ED and NSF as they build and implement evaluation standards for STEM programs.
- Partner with ED and NSF to improve data collection at the undergraduate and pre-college levels that will be useful for biomedical workforce analysis.

Public Comments

There were no public comments.

Discussion of Recommendations and Report of the PEBS Working Group

SMRB Members

Dr. Marletta asked where the authority lies for enacting a transformative body for PEBS. Dr. Yancy replied that this type of change must start from the top of the organization and that Dr. Collins has used his authority wisely by having the ACD consider diversity in the biomedical workforce. Dr. Yancy stressed that this type of change requires cooperation beyond the formation of a single committee. Dr. Katz said that many of the recommendations include clearly actionable items, and there is a clear need for proper evaluation of pre-college STEM programs. Dr. Yancy added that part of authority is self-generated.

Dr. Hudson asked whether the Working Group discussed timelines or surrogate measures for evaluation of pre-college STEM programs. Dr. Yancy said that, based on the testimony heard by the SMRB, significant attrition occurred at the point of entry into college, particularly for minorities. He also noted that the trajectory for many children is determined by the time they enter middle school. Dr. Yancy acknowledged that he found current methods of evaluation to be superficial.

Next, Dr. Hudson asked whether the Working Group believed that having many PEBS programs is bad and that NIH should consider aggregating programs. Dr. Yancy said that the Working Group appreciated that every IC made efforts in this area but that the group could not determine which programs were most effective because it could not accurately define the scope, range, or targets. A strict evaluation process will determine the future of the NIH PEBS programs.

Dr. Birnbaum asked whether the Working Group considered engagement of parents and communities to keep young students interested in science. Dr. Yancy acknowledged the need for investment from families but also noted that science teachers receive little supplemental education or support for their curricula. Dr. Tabak added that encouraging parent engagement is outside NIH's purview. Dr. Briggs added that the dimension of inclusion of underrepresented minorities is one way to for NIH to contribute to this focus, because it has a significant impact on the future biomedical workforce. Mr. Augustine asked that NIH staff review the previous materials about the amount of teacher continuing education for science teachers per year to be included in the report.

Dr. Katz referred to a letter that the SMRB received as a public comment, which stated that oversimplification for endpoints would be a mistake. Dr. Yancy agreed that the comments were thoughtful, but he noted that there could be a process to capture the influences on program effectiveness. He added that it may be helpful to have each program define success.

Dr. Omenn noted that, with respect to a comment on the importance of the inclusion of math, the report imbeds this point in several examples (figure 2, which depicts career paths, and page 11, which refers to computational biology). Dr. Hannah Valentine complimented the report and emphasized the importance of evaluation and accountability of programs.

SMRB Vote on Recommendations and Report of the PEBS Working Group

Clyde W. Yancy, M.D.
Chair, PEBS Working Group

The SMRB voted unanimously to approve the recommendations and report from the PEBS Working Group.

Vote: Approved–10, Opposed–0, Abstained–0

(Note that Andrews, Koenig, Marletta, and Shapiro were *Ad Hoc* members at this time, and were therefore unable to vote. Collins is a non-voting *ex officio* member.)

FAREWELL AND ADJOURNMENT

Farewell to Norman R. Augustine

Marina Volkov, Ph.D.
Executive Secretary, Scientific Management Review Board

Dr. Volkov stated that Dr. Amy Patterson had planned to attend the meeting to thank Mr. Augustine for his service on the SMRB, but she was unable to attend because of a family issue. Dr. Volkov stated that NIH is indebted to Mr. Augustine for his tremendous leadership of the SMRB. She recited some favorite quotes from Mr. Augustine:

"If a sufficient number of management layers are superimposed on top of each other, it can be assured that disaster is not left to chance."
"The early bird gets the worm. The early worm gets eaten."

Mr. Augustine received a certificate of acknowledgment for his contributions. He repeated that serving on the SMRB has been an honor and a privilege, and he called NIH a national asset. He thanked his fellow Board members for their contributions and support. He also thanked the NIH staff that supports the SMRB.

Closing Remarks

Norman R. Augustine
Chair, Scientific Management Review Board

Mr. Augustine allowed the SMRB members an opportunity for a final statement before the meeting was adjourned. The Board members took turns thanking Mr. Augustine for his work with the SMRB.

The meeting was adjourned at 3:41 p.m.

We certify that, to the best of our knowledge, the foregoing meeting minutes of the NIH Scientific Management Review Board are accurate and correct.

Nancy Andrews
SMRB Acting Chair

Marina Volkov
SMRB Executive Secretary