National Institutes of Health

Draft Report of the Advisory Committee to the Director Working Group on Diversity in the Biomedical Research Workforce

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Prepared By:

Working Group on Diversity in the Biomedical Research Workforce (WGDBRW),

The Advisory Committee to the Director (ACD)

Advisory Committee to the Director Working Group on Diversity in the Biomedical Research Workforce Membership

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- Jordan Cohen, M.D., President Emeritus, AAMC
- Jose Florez, M.D. Ph.D., Associate Professor, Harvard Medical School
- Gary Gibbons, M.D., Chairman and Professor of Physiology, Morehouse School of Medicine
- Renee Jenkins, M.D., Chair Emeritus, Department of Pediatrics and Child Health, Howard University
- Tuajuanda Jordan, Ph.D., Professor and Dean, College of Arts and Sciences, Lewis and Clark College
- Wayne J. Riley, M.D., M.P.H., M.B.A., MACP, President and Chief Executive Officer, Meharry Medical College; Chair, National Advisory Council on Minority Health and Health Disparities, NIH; Chairman, Board of Directors, Association of Minority Health Professions Schools
- John Ruffin, Ph.D., Director, National Institute on Minority Health and Health Disparities (NIMHD), NIH – **Co-Chair**
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- Lawrence A. Tabak, D.D.S., Ph.D., Principal Deputy Director, NIH – **Co-Chair**
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- Reed Tuckson, M.D., Executive Vice President and Chief of Medical Affairs, UnitedHealth Group – **Co-Chair**
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- M. Roy Wilson, M.D., M.S., Deputy Director, NIMHD, NIH
- Keith R. Yamamoto, Ph.D., Professor and Executive Vice Dean, School of Medicine, and Vice Chancellor for Research, University of California, San Francisco
- Clyde Yancy, M.D., M.Sc., FACC, FAHA, MACP, Professor, Feinberg School of Medicine, Northwestern University

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Dr. Reed Tuckson, Co-Chair, Advisory Committee to the NIH Director Working Group on Diversity in the Biomedical Research Workforce

Dr. John Ruffin, Co-Chair, Advisory Committee to the NIH Director Working Group on Diversity in the Biomedical Research Workforce

Dr. Lawrence A. Tabak, Co-Chair, Advisory Committee to the NIH Director Working Group on Diversity in the Biomedical Research Workforce

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Executive Summary

The National Institutes of Health (NIH) has long recognized that achieving diversity in the biomedical and behavioral research workforce is critical to ensuring that the best and brightest minds have the opportunity to contribute to the realization of our national research goals. Yet, despite longstanding efforts from the NIH and other entities across the biomedical and behavioral research landscape to increase the number of scientists from underrepresented groups, diversity in biomedicine still falls far short of mirroring that of the U.S. population. Additionally, a disturbing discrepancy in success rates for research grant (R01[1]) applications between White applicants and Black applicants, even after controlling for numerous observable variables, was reported in 2011 by Ginther, et al. (see Section II).

To address the unacceptable status quo of minority underrepresentation in biomedical and behavioral research, NIH Director Dr. Francis Collins charged the Advisory Committee to the NIH Director (ACD) to form a Working Group on Diversity in the Biomedical Research Workforce (WGDBRW) to examine the findings and implications of the Ginther, et al. study results. Dr. Collins charged the WGDBRW with providing concrete recommendations toward improving the recruitment and retention of underrepresented minorities (URM), people with disabilities, and people from disadvantaged backgrounds across the lifespan of a biomedical research career from graduate study to acquisition of tenure in an academic position or the equivalent in a non-academic setting.

The WGDBRW met 13 times in person at the NIH's Bethesda campus or by telephone and used a variety of means to gather information beginning with a telephone conference on August 15, 2011. The WGDBRW:

- released a Request for Information (RFI) in January 2012
- held a public meeting February 14, 2012
- met with the ACD Working Group on the Biomedical Workforce on March 27, 2012
- conducted a workshop on the peer review system on March 28, 2012
- conducted a workshop on April 16, 2012, in collaboration with the White House Initiative with Historically Black Colleges and Universities, to solicit insight from a broad range of external stakeholders

Throughout this process, the WGDBRW also received input from two internal NIH committees, the NIH Diversity Task Force and the NIH Women in Biomedical Research Careers Working Group.

The WGDBRW analyzed available literature and gained considerable appreciation for the numerous benefits of a diverse workforce including increasing creativity, broadening the scope of inquiry, narrowing the health gap, and promoting and ensuring fairness (see Section I).

[1] The Research Project Grant -R01- is the original and historically oldest grant mechanism used by the NIH. It provides support for health-related research and development based on the NIH mission.

Moreover, diversity is a key driver of achievement in the workforce, particularly when innovation is a critical goal (Denson and Chang, 2009; Page, 2007; Hong, 2004; European Commission, 2003).

The WGDBRW carefully reviewed the publication, *Race, Ethnicity, and NIH Research Awards.* This NIH-commissioned study by Dr. Donna Ginther and her colleagues examined the funding probability of Ph.D. R01 applicants during fiscal years (FY)[2] 2000-2006 with respect to applicant race and ethnicity, using data from NIH's grants database (IMPAC II) and various other sources. Ginther, et al. found significant disparities in R01-funding probability for both Asian applicants (5.4 percentage points less likely) and Black applicants (13.2 percentage points less likely), compared to White applicants. When the researchers restricted the study sample to applicants who were U.S. citizens when they received their Ph.D., the difference observed between Asian and White applicants was no longer statistically significant, whereas the disparity between Black and White applicants persisted.

Marked differences in funding success were also observed depending upon the institution from which an applicant submitted their application. Applications from the 30 most highly NIH-funded institutions had a higher probability of funding than those from institutions ranked 31 to 200. In turn, applications from the 31 to 200 institutions were more likely to be funded than those from institutions ranked 201 and below. In all groups, a disparity was observed for Black Applicants relative to majority applicants in the same rank group.

After analyzing the Ginther et al. publication in detail, the WGDBRW requested and performed additional analyses to better understand the findings. These additional analyses confirmed the disparity in R01 funding between applications submitted by Black and White investigators in a later cohort (2006-2010) and revealed a large difference in the number of applicants and applications from underrepresented minorities compared to Whites. Of particular significance, the number of African American or Black applicants who applied for grants in the basic sciences was a very small fraction of the whole, 1 percent, compared to that of White applicants who comprised 64.6 percent of this pool.

From FY 1999 to 2009, following the first stage of the peer review process used by study sections, 73 percent of applications from Blacks were determined by review committees to not be of sufficient scientific merit to be "fully discussed" meaning they received no further review consideration, compared to 59 percent of applications from Whites. One consequence of this difference is that fewer applications from Black applicants are resubmitted for reconsideration because, in general, investigators are less likely to resubmit an application that was not discussed. See Section II and Appendix 5 for a full discussion of the WGDBRW's additional analyses.

[2] The federal fiscal year begins on October 1 and ends of September 30. The fiscal year is named by the calendar year in which it ends. For example, FY 2000 began on October 1, 1999 and ended on September 30, 2000.

While the WGDBRW had sufficient data to formulate the recommendations in this report, the Working Group recognizes that the NIH needs to be more attentive to collecting the data on an ongoing basis to better inform next steps and future actions that are required to address this problem. To that end, the WGDBRW developed a series of additional research questions for the NIH to explore to understand more fully the many factors that may influence the URM experience in biomedical and behavioral research. This represents only a starting point given the complexity of the issues, and an ongoing commitment to "continuous" review should be made.

Based on the available data, the WGDBRW formulated a number of recommendations relating to increasing the number of URM in the workforce pipeline (Section III), mentoring URM scientists and strengthening the infrastructure of comparatively under-resourced institutions with a documented track record of producing and supporting URM scientists (Section IV), and the potential role of bias (Section V). The group also made specific recommendations related to the NIH Intramural Research Program (Section VI). In sum, the WGDBRW's recommendations form a comprehensive strategy to increase the diversity of the biomedical research workforce. The 13 recommendations fall into 4 broad areas: data collection/evaluation; mentoring/career preparation and retention; institutional support at universities/academic health centers, and at NIH; and bias-related research and intervention testing. The highest-priority recommendations are:

Data Collection and Evaluation

- NIH must ensure that appropriate resources for the systematic tracking, reporting, and evaluation of the immediate and long-term outcomes of all trainees (ranging from college students engaged in summer research activities through recipients of career development awards), regardless of NIH-funding mechanism.
    - Assign a unique identifier to every NIH-supported trainee, fellow, and career development recipient, including those supported on research project grants.
    - Given the lack of data regarding sub-populations of Hispanic researchers, the lack of data regarding people with disabilities, and the suspected substantial differences between socially and educationally advantaged groups and those who are disadvantaged and marginalized, enhance NIH's data collection capabilities for these populations.
    - Require that all programs undergo systematic review and evaluation every 5 years. Those found to be particularly effective in increasing URM participation in the biomedical sciences should be used as models for other programs that are not as effective, and should be considered for expansion. (Recommendation #1)

Mentoring/Career Preparation and Retention

- NIH, through NIMHD serving the coordinating function, should partner with established minority scientific and professional groups and other trusted organizations to

implement a system of mentorship "networks" for underrepresented minority students that will provide career guidance throughout their career development. (Recommendation #5)

- Additional support should take the form of an increased number of scholarships for undergraduates (building on the NIH intramural Undergraduate Scholarship Program) that include "payback" through participating in a meaningful research experience, and additional fellowships for the anticipated increased numbers of URM graduate students in biomedical research. (Recommendation #3)
- NIH should establish a working group of the ACD, of racially and ethnically diverse scientists, to provide regular input to the Director of NIH, and the Institutes and Centers, regarding the state-of-the-art in effective programs that overcome or reduce disparities in research awards. (Recommendation #6)

Institutional Support

- Under the leadership of NIMHD, and in coordination with other Science, Technology, Engineering, and Mathematics (STEM) initiatives underway in the Department of Health and Human Services (HHS) and across other Federal government agencies, NIH should undertake a bold, well-funded, multi-year, incentive-based, competitive grant process to support infrastructure development in those comparatively under-resourced institutions with a documented track record of producing and supporting URM scientists as well as stimulating creative partnerships among these institutions and, where appropriate, including more resource-rich institutions.
    - The WGDBRW considers this action to be a bold, yet necessary initiative that reflects the urgency of the testimony presented during its deliberations. The group recommends that the NIH, along with other Federal partners, target substantial resources over 5 years to implement this recommendation at 5 or more training sites. (Recommendation #8)

- NIH should appoint a scientist as Chief Diversity Officer (CDO) and establish an NIH Office of Diversity resourced with a suitable budget. (Recommendation #12)
- Using the trans-NIH Earl Stadtman Investigator search process as a model, and learning from the program's experience, NIH should institute a more comprehensive search process for tenure-track investigators to ensure that a sufficiently diverse pool of candidates is identified. (Recommendation #13)

Research and Intervention Testing

- NIH should establish a new Working Group of the ACD comprised of experts in behavioral and social sciences and studies of diversity with a special focus on determining and combating real or perceived biases in the NIH peer review system.
    - Oversee the collection and analyses of quantitative and qualitative data relevant to the research project grant review and grant-making decision process.

    - Provide oversight to an analysis of the discourse content from peer review sessions so as to contribute to the understanding of potential bias.
    - Provide expert oversight to a text-based analysis of the commentary on individual grant reviews, including R01s and a subset of applications for those awards (career awards, fellowships, smaller research project grants, and others) most likely to precede an investigator submitting a R01 application. (Recommendation #9)
- NIH should first, pilot different forms of validated implicit bias/diversity awareness training for NIH scientific review officers and program officers to determine the most efficacious approaches. Once the best training approaches have been identified with NIH staff, pilot these programs with members of study sections to ascertain if their value is sustained. If they are, provide to all study section members. (Recommendation #10)
- NIH should design an experiment to determine the effects of anonymizing applications with respect to applicant identity as well as that of an applicant's institution. (Recommendation #11)

The WGDBRW was unable to precisely distinguish among funding disparities caused by the potential presence of bias (unintended or otherwise) during the peer review process (see Section V for a discussion of bias) and application quality, which in turn may be affected by a wide range of factors including mentorship, resource availability, release time from teaching/administrative responsibilities, all of which could potentially be influenced by institutional bias (unintended or otherwise). Thus, because the WGDBRW's analyses and discussions did not point to a single, definitive cause for NIH-funding disparities — and the group recognizes fully that causes are unlikely to be mutually exclusive — the WGDBRW has proposed a set of complementary interventions that may help clarify the root causes for funding disparities, significantly support the development and evaluation of programs that will increase diversity in the biomedical workforce, and that will do no harm.

The WGDBRW was impressed by the track record of the many institutions that have devoted themselves to the training or support of URM scientists. Many of these institutions have done so despite significant resource and infrastructure constraints which limit their ability to expand efforts in response to the need for increased numbers of URM the biomedical research workforce. As such, the WGDBRW was especially interested in testimony from a number of stakeholders concerned about how best to bolster the infrastructure, resources, and human capital of graduate-level academic institutions that have a major focus on training a diverse biomedical and behavioral research workforce and that are critical to the realization of the NIH's diversity objectives.

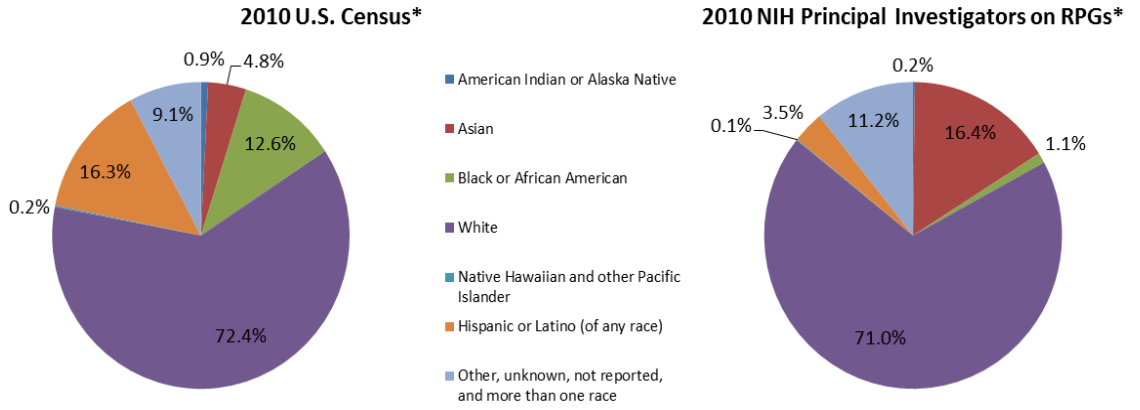
The WGDBRW recognizes that the implementation of these recommendations will require leadership, thoughtfulness, diligence, and appropriate funding by NIH. Given the importance of the issue of diversity to the nation, the WGDBRW commends the NIH on its willingness to address it directly. The Working Group expects that this report will serve as a framework that will assist the Agency to realize the fullest extent of its noble mission, and serves to recruit and support the efforts of others in the biomedical research enterprise.

Introduction

The National Institutes of Health (NIH) has long recognized that achieving diversity in the biomedical and behavioral research workforce is critical toward ensuring that the best and brightest minds have the opportunity to contribute to realizing our national research goals. Yet, despite longstanding efforts from the NIH and other entities across the biomedical and behavioral research landscape to increase the number of scientists from underrepresented groups, diversity in biomedicine still falls far short of mirroring that of the U.S. population.

This situation is at odds with the reality that historically underrepresented groups are now the most rapidly growing segment of the U.S. population, and therefore, there is an urgent need to ensure that scientific talent is nurtured, recognized, and supported from these important segments of the American population. Equally, if not more troubling, is the fact that faculty minority representation is especially low, providing a scant number of role models for youth considering research careers. Underrepresented minorities (URM) also do not fare well in securing NIH funds to conduct biomedical and behavioral research. As shown in Figure 1, underrepresented minorities — American Indian or Alaska Natives, Blacks or African Americans, Hispanics or Latinos (of any race), and Native Hawaiian and other Pacific Islanders — make up a disproportionately small component of the NIH Principal Investigator (PI) pool. For example,

Figure 1: Race and Ethnicity of the 2010 U.S. Population and the 2010 NIH Principal Investigators on RPGs



2010 U.S. Census Bureau Report, http://2010.census.gov/2010census/data/2010 (left)
NIH Principal Investigators on RPGs, NIH IMPAC II (right)

*Total percentage is over 100 because those identified as Hispanic/Latino may also have identified as other races. PI information collected by NIH includes the option for an applicant to signify both race and ethnicity.

while Blacks or African Americans comprised 12.6 percent of the U.S. population in 2010, they only accounted for 1.1 percent of NIH PIs receiving research project grants (compared to 72.4 percent and 71 percent, respectively, for Whites).

The NIH has commissioned and supported a number of studies[3] in recent years to examine the many factors that contribute to the lack of diversity of the biomedical and behavioral research workforce. One study in particular, *Race, Ethnicity, and NIH Research Awards* (Ginther, et al., 2011)[4] found a disturbing discrepancy in success rates between White applicants and Black R01 grant applicants, after controlling for observable variables. Section II describes the Ginther, et al. report findings in detail.

To address the unacceptable status quo of minority underrepresentation in biomedical and behavioral research, NIH Director Dr. Francis Collins charged the Advisory Committee to the NIH Director (ACD) to form a Working Group on Diversity in the Biomedical Research Workforce (WGDBRW) to examine the findings and implications of the Ginther, et al. study results. Dr. Collins charged[5] the WGDBRW to examine the five key transition points in the pipeline: (i) entry into graduate degree programs; (ii) the transition from graduate degree to postdoctoral fellowship; (iii) the appointment from a postdoctoral position to the first independent scientific position; (iv) the award of the first independent research grant from NIH or equivalent in a non-academic setting; and (v) award of tenure in an academic position or equivalent in a non-academic setting. Additionally, Dr. Collins charged the WGDBRW with providing concrete recommendations toward improving the recruitment and retention of underrepresented minorities, people with disabilities, and people from disadvantaged backgrounds across the lifespan of a biomedical research career from graduate study to acquisition of tenure or the equivalent in an academic setting.

Timeline and Process

The WGDBRW met first in August 2011, discussed its charge, and decided to pursue the following strategy and working plan:

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[3] Ginther, D. K., W. T. Schaffer, J. Schnell, B. Masimore, F. Liu, L. L. Haak & R. Kington (2011). "Race, ethnicity, and NIH research awards." Science 333**:** 1015-9.

Pohlhaus, J. R., H. Jiang, R. M. Wagner, W. T. Schaffer & V. W. Pinn (2011). "Sex differences in application, success, and funding rates for NIH extramural programs." Acad Med 86: 759-67.

Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline (U.S.). (2011). "Expanding underrepresented minority participation." National Academies Press http://www.ncbi.nlm.nih.gov/books/NBK83377/ (last accessed May 30, 2012).

Ostriker, J. P., C. V. Kuh, J. A. Voytuk & National Research Council (U.S.). Committee on an Assessment of Research Doctorate Programs. (2011). "A data-based assessment of research-doctorate programs in the United States." National Academies Press http://www.ncbi.nlm.nih.gov/books/NBK83404/ (last accessed May 30, 2012).

National Research Council (U.S.). Committee on Opportunities to Address Clinical Research Workforce Diversity Needs for 2010., J.-o. Hahm, A. Ommaya & National Research Council (U.S.). Committee on Women in Science and Engineering. (2006). "Opportunities to address clinical research workforce diversity needs for 2010." Washington, DC: National Academies Press.

Ginther, D. K., W. T. Schaffer, J. Schnell, B. Masimore, F. Liu, L. L. Haak & R. Kington (2009). "Diversity in Academic Biomedicine: An Evaluation of Education and Career outcomes with Implications for Policy". http://ssrn.com/abstract=1677993 or http://dx.doi.org/10.2139/ssrn.1677993 (last accessed May 30, 2012).

Committee on Maximizing the Potential of Women in Academic Science and Engineering (U.S.), Committee on Science Engineering and Public Policy (U.S.), National Academy of Sciences (U.S.), National Academy of Engineering. & Institute of Medicine (U.S.). (2007). "Beyond bias and barriers : fulfilling the potential of women in academic science and engineering." Washington, D.C.: National Academies Press.

[4] The Ginther, et al. study as well as a policy forum piece by Drs. Collins and Tabak are available at http://www.sciencemag.org/site/feature/data/hottopics/race-nihfunding/

[5] Charge of the WGDBRW: http://acd.od.nih.gov/dbr.htm

- Examine the recently published Ginther, et al. report and other available data that describe the success rates of minority and majority applicants for extramural NIH research projects, as well as the success of URM investigators within the NIH Intramural Research Program.

- Explore potential causes for the differential funding success rates observed between ethnic/racial groups, including the potential contribution of an insufficient number of URM biomedical and behavioral researchers as well as a potential culture of unconscious or conscious bias in the grant award process.

- Recommend both immediate and long-term strategies applicable to the NIH intramural and extramural programs that address identified barriers across five key transition points in the development of a Ph.D. or clinician scientist's career:

    - entry into graduate or professional degree programs preparatory for biomedical and behavioral research careers

    - the transition from graduate student or M.D./D.D.S. to postdoctoral research study

    - the transition from a postdoctoral position to the first employment or identification as an independent scientist

    - the award of the first independent research grant from the NIH or equivalent in a non-academic setting

    - establishment of an independent research program and emergence as a nationally recognized senior investigator in a researcher's chosen field

The WGDBRW met 13 times in person at the NIH's Bethesda campus or by telephone beginning with a telephone conference on August 15, 2011. The group issued a Request for Information (RFI) in January 2012 (Appendix 1), held a public meeting in February, 14 2012 to solicit comments from stakeholder groups (Appendix 2), met with the ACD Biomedical Research Workforce Working Group on March 27, 2012, conducted a workshop on the peer review system on March 28, 2012 to broadly solicit comment about the topic from stakeholders and experts in bias studies (see Section V: Bias, Diversity, and the Institution of NIH and Appendix 3), and conducted a workshop on April 16, 2012, in collaboration with the White House Initiative on Historically Black Colleges and Universities (Appendix 4) to solicit insight from a broad range of external stakeholders. Throughout this process, the WGDBRW also received input from two internal NIH committees, the NIH Diversity Task Force and the NIH Women in Biomedical Research Careers Working Group.

This final report is the culmination of the WGDBRW's data-gathering and analyses, input from a wide range of stakeholders, discussions, and considerations. It contains five sections that:

- address why workforce diversity is important to the national interest (Section I)

- provide an overview of the WGDBRW's review of the Ginther, et al. report findings, additional analyses, and lingering questions (Section II)
- summarize many of the unique issues confronting URM in the biomedical and behavioral research pipeline and present the WGDBRW's recommendations to improve recruitment and retention through key transition points (Section III)
- describe the importance of mentoring toward achieving a diverse workforce (Section IV)
- discuss the concerns about the potential for unconscious and conscious bias in the NIH grant application process with particular emphasis on the peer review system (Section V)
- describe specific challenges and recommendations for the NIH Intramural Research Program (Section VI)

The WGDBRW emphasizes that its discussions and recommendations should be considered against a complex backdrop of influences:

- institutional arrangements and differential capabilities for training and mentoring at research-intensive universities
- overlapping and long histories of discrimination against racial and ethnic minorities and immigrants
- social inequality and its effects on access to higher education
- the current legal framework about race, equity, and diversity programs
- the development and history of biomedical science training of underrepresented minorities at the university level
- generalized data insufficiency about the biomedical and behavioral research workforce, not limited to URM scientists

It can be said that achieving diversity is not easy to discuss and even harder to accomplish. Members of the WGDBRW, as scientists, doctors, and scholars also have ordinary lives as women and men, parents, immigrants, as members of specific cultural communities, and as underrepresented minorities. Collectively, the group's members represent years of experience in mentorship, training, and grantsmanship, as well as in advocacy and excellence in the pursuit of science. As such, they understand fully how individual circumstances, group dynamics, institutional policies, and many other factors contribute to slippage between commitment and achievement of outcomes. Some of these factors are beyond the control of the NIH and other organizations, and some are not.

Whether evident or hidden, obstacles that impair access for some members of the community (e.g. through overt or unconscious discrimination, dearth of role models, unclear paths to ultimate success, unwelcoming perceptions, economic disincentives, unequal access to quality early education) limit the ability of these individuals to contribute to biomedical and behavioral research. If the nation's best talent is not attracted to biomedical research careers, or if systemic flaws in the evaluation of worthy scientific talent hamper the success of some members of the community, the end result is a loss for all. Ensuring that all valuable unique

contributions find adequate expression is the foundation for leveraging the intellectual power of diversity to accelerate scientific and technological breakthroughs.

Importantly, the WGDBRW recognizes that many factors shape the current demographics of the biomedical and behavioral research workforce, as well as affect the awarding of research (R01) grants. Accordingly, a collaborative and system-wide effort extending from K-12 educational programs, academia, government, industry, and the American public will be necessary to achieve a biomedical and behavioral research workforce that is more reflective of our national census and our national goals for excellence in scientific research. Overwhelmingly, the WGDBRW recognizes the diligence and integrity of the larger biomedical and behavioral research community, which is clearly a group of well-intended individuals that contribute their considerable talents generously to benefit the scientific agenda of the United States in a fair and equitable manner. This report seeks to provide substantive recommendations that will further facilitate and support a fair and merit-based system that benefits applicants, evaluators, and most importantly, the American public whose hopes for a healthier future depends on the success of NIH-supported research and training.

Section I: Why is Diversity Important?

The NIH's motto "Turning Discovery into Health" is an active phrase that underscores the notion that people are the lifeblood of biomedical and behavioral research. Creative inquiry bolstered by diligence and framed by public health relevance is the responsibility of the NIH investment of taxpayer funds that are distributed to every state throughout the nation and that are expected to reap benefits that are relevant to the health of all population groups here and even across the globe. In this incredible time of discovery, smart investments in biomedical and behavioral research and in the intellectual vigor of our increasingly interdisciplinary and diverse research community have the potential to keep our nation healthy, strong, and competitive for years to come. "In the global 21st century, the greatest hope for a future of good health for all lies in medical research — and the promise has never been greater" (NIH, 2011).

A Creative, Innovative, and Competitive Biomedical and Behavioral Research Workforce is the Foundation for Turning Discovery into Health for All.

Diversity is a key component of achievement in the workforce, particularly when innovation is a critical goal (Denson and Chang, 2009; Page, 2007; Hong and Page, 2004; European Commission, 2003). Modern study of the life sciences blends observational, analytical, computational, and ethical considerations and approaches. A range of skill sets and viewpoints borne of diverse backgrounds highlights the urgent need for diversity in both life experience and in education. The flood of information upon us, as we struggle to understand the biological meaning of complex topics such as genomics and behavior change, is humbling. The dimensions of this challenge underscore the realization that ideas whose scope is constrained by limited, or even homogeneous, approaches and tightly defined paradigms may converge quickly on common conclusions. It is not clear that conclusions reached in this manner are the best ones for a range of situations.

Achieving diversity in the biomedical and behavioral research workforce offers a number of key benefits not only for the biomedical enterprise, but also for society in general.

Increasing Creativity

Diverse teams working together and capitalizing on individuality and distinct perspectives outperform homogenous teams. This is particularly true when teams address complex problems, such as those that characterize biomedical and behavioral research, technology, and health (Page and Hong 2004; Sessa and Taylor, 2000).

Broadening the Scope of Inquiry

Increasing workforce diversity helps to expand the range of research questions, some of which may have been neglected (Leung, 2008). Enhancing diversity can also improve interactions with colleagues in global networks as well as engagement of research participants who have health concerns specific to their communities (Whitla, Orfield, Silen, Teperow, and Reede, 2003; Gurin, 2002; Noah, 2003). Investigating and solving new problems that arise through diverse approaches can lead to systemic improvements in health care.

Narrowing the Health Gap

While the United States has been a global leader in improving health throughout the world, significant health inequities and disparities continue to persist on our own shores (CDC, 2011). A workforce that brings the full power of diversity to pursue biomedical and behavioral research problems that address the needs of underrepresented racial and ethnic minorities is an important component of reducing these health inequities (Stoff et al., 2009). Former Surgeon General Dr. David Satcher has suggested that a diverse team of researchers will be more likely to ask and pursue the most appropriate questions in the most appropriate manner — whether in basic and clinical research, or in health services- and behavioral research (Satcher, 2009).

Promoting and Ensuring Fairness

The NIH is a steward of public funds, and as a matter of basic fairness, the agency should ensure that access to careers in biomedical investigation is equally open to all Americans. Furthermore, in a society where past discrimination has conditioned current workforce demographics, it is important that neither historical wrongs nor emerging circumstances hamper the pursuit of biomedical and behavioral research careers by underrepresented minorities. Without urgent and deliberate action to increase the diversity of the biomedical and behavioral research workforce, the inequities will become even more challenging for future generations. According

to demographic projections of the U.S. Census Bureau, our nation's population will become increasingly diverse over the next four decades. By 2050[6]:

- 47 percent of the general population will be non-Hispanic Whites
- 30 percent will be of Hispanic origin
- 13 percent will be Black
- 8 percent will be Asian
- 0.3 percent will be Pacific Islanders and Native Hawaiians
- 1 percent will be Native Americans
- 3.7 percent will identify as two or more races

The NIH is obligated to ensure that all of its research and training programs identify and support the most talented individuals, and that these programs will prepare these individuals to compete in the most rigorous scientific research arenas. The NIH's commitment to enhancing diversity and the interventions necessary to achieve it is aligned fully with the NIH's pursuit of scientific excellence: The two aims are not only harmonious, but even synergistic.

Section II: Summary of Findings from the Publication Race, Ethnicity, and NIH Research Awards and Additional Analyses

The NIH-commissioned study published in August 2011 (Ginther, et al., 2011) that prompted the formation of this WGDBRW and served, in part, as the basis for its charge, concluded that Black applicants were significantly less likely to receive NIH research funding than were White applicants. Even after controlling for education, country of origin, training, employer characteristics, previous research awards, and publication record, a highly significant gap in success rate persisted. A primary task of the WGDBRW was to review this study and its conclusions as a basis, in addition to other inputs, for recommendations to the NIH on ways to diversify the biomedical and behavioral research workforce. The WGDBRW notes with particular dismay that other underrepresented minority groups, notably American Indian and Alaskan Natives, did not have sufficient numbers of applicants or applications to allow for a statistically significant analysis. As such, this report focuses primarily on Blacks and Hispanics, but the recommendations are meant to apply to all underrepresented minority groups. Additionally, the WGDBRW recognizes that it did not address funding disparities for people with disabilities and suggests that further study of all funding disparities also include this group that is underrepresented in biomedicine.

In this study, Dr. Ginther and her colleagues examined the funding probability of Ph.D. R01 applicants during fiscal years (FY)[7] 2000-2006 with respect to applicant race and ethnicity, using data from the NIH's grants database (IMPAC II) and various other sources. The Ginther, et al. report findings included:

[6] http://www.census.gov/population/www/projections/analytical-document09.pdf (Table 1)

[7] The federal fiscal year begins on October 1 and ends of September 30. The fiscal year is named by the calendar year in which it ends. For example, FY 2000 began on October 1, 1999 and ended on September 30, 2000.

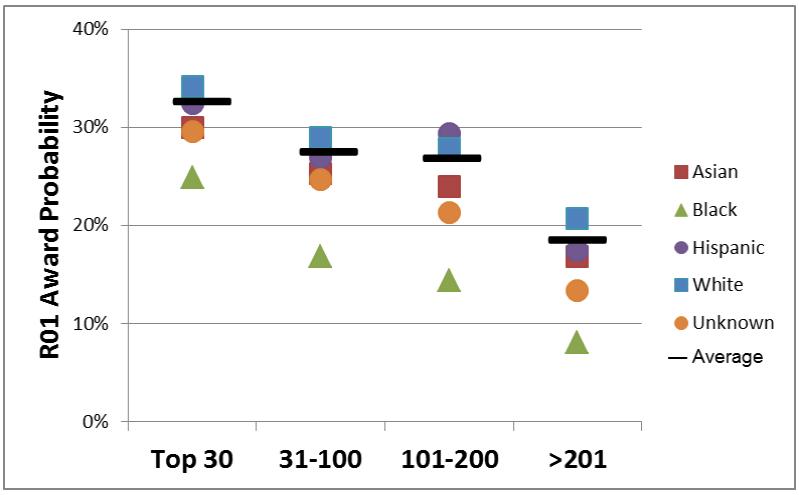
- Significant disparities in R01 funding probability for both Asian (5.4 percentage points less likely) and Black applicants (13.2 percentage points less likely), as compared to White applicants.
- Restricting the study sample to applicants who were U.S. citizens when they received their Ph.D. revealed that the difference observed for Asian applicants compared to White applicants was no longer statistically significant, whereas the disparity between Black and White applicants persisted.
- Black and Asian investigators were less likely to be awarded an R01 research grant on their first or second attempt, and Blacks and Hispanics were less likely to resubmit an application altogether. Those Black investigators who did resubmit a revised application did so more times than did White applicants before they achieved success in receiving NIH funding.
- For all groups except Blacks, an applicant's affiliation (type of research organization, NIH-funding rank, NIH review experience, and citation record) affected the probability of the application receiving a priority score.
- For Blacks, only NIH review experience and publication citation record correlated significantly with receiving a priority score[8].

Although the R01 funding probability for Hispanic applicants did not differ significantly from the funding probability for White applicants, the WGDBRW recognizes that the analysis is not clear-cut. The term Hispanics is a large, heterogeneous ethnic classification that also includes socially privileged and educationally advantaged individuals who originated from Europe and Latin America. Because the NIH does not collect data on the different populations captured within the Hispanic ethnic classification, the Ginther, et al. report analysis was unable to disaggregate the Hispanic sample data to determine how these different populations compare to other populations in R01 success rates. However, as the comparison between the 2010 U.S. national census data and the ethnic distribution of PIs on research project grants reveals clearly (Figure 1), the percentage of Hispanic PIs does not reflect the U.S. population of Hispanics — similar to the situation with Blacks.

The Ginther, et al. study also observed that award probabilities are correlated with NIH-funding rank of the applicant's institution (Figure 2). Applications from the 30 most highly NIH-funded institutions had a higher probability of funding than those from institutions ranked 31 to 200. In turn, applications from the 31 to 200 institutions were more likely to be funded than those from institutions ranked 201 and below. In all groups, a disparity was observed for Black Applicants relative to majority applicants in the same rank group.

[8] NIH applications are assigned to a study section (a committee of scientific experts in the subject areas covered by the applications assigned to the study section) for review of scientific merit. Typically three individual reviewers are assigned to each application. These reviewers recommend whether or not the application has sufficient merit to be fully discussed by the entire study section. However, if any member of the study section wants an application to be discussed further, the application is considered further. Only applications that are discussed by the entire committee receive a final "impact" score.

Figure 2: Award Probabilities by NIH Funding Rank and Race/Ethnicity



Source: Working Group communication with Dr. Donna Ginther

The extent to which these institutional differences influence scoring of NIH applications, or are a reflection of the infrastructure advantages enjoyed by the most research intensive institutions, or a combination of both, is not yet known but can be addressed through experiments proposed by the WGDBRW in which the applicant organization would be anonymized (see Section V, Recommendation #11).

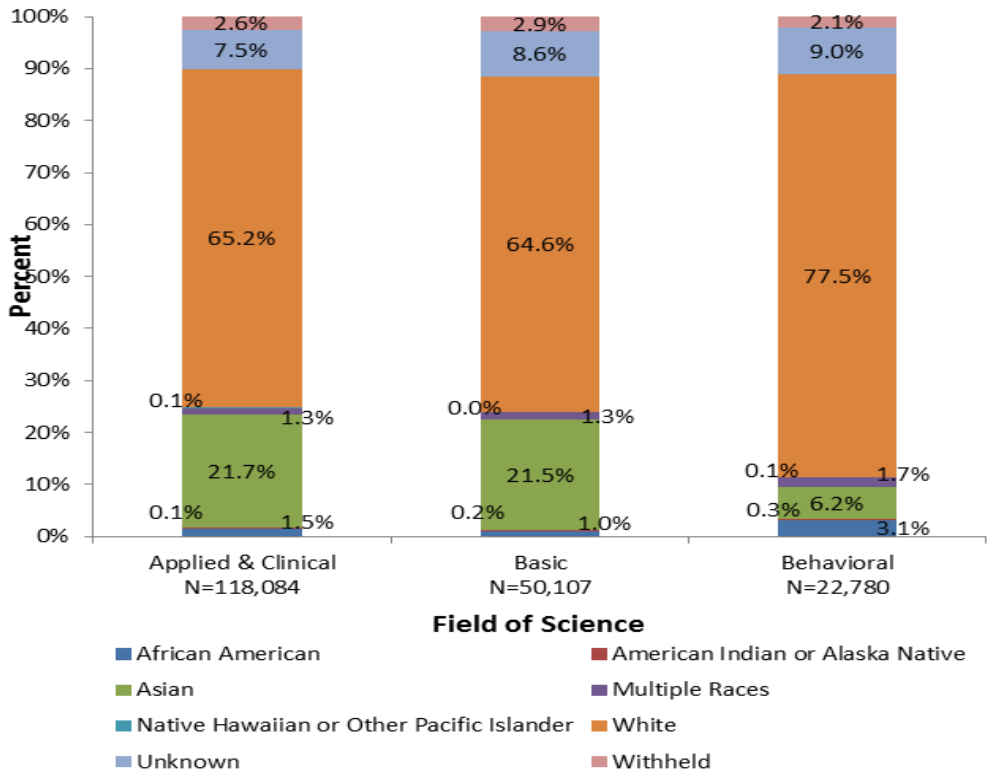
The WGDBRW met with the study's lead author, Dr. Ginther, and her colleagues via teleconference on September 26, 2011, to explore in greater depth the available data and areas that might require further investigation. The WGDBRW continued correspondence with Dr. Ginther and her colleagues throughout the course of its deliberations. The results of these efforts pointed to a number of causative possibilities that required further investigation.

To gain further clarity on these issues, the WGDBRW reviewed data on a more recent cohort of NIH grant applicants (FY 2006-2010) and determined that:

- The success rate discrepancy between White applicants and African American or Black applicants also extends to the more recent FY 2006-2010 cohort (see Appendix 5, Figures 3C to 3E).
- There is a large difference in the number of applicants and applications from underrepresented minorities compared to Whites. Of particular significance, the number of applications submitted by African American or Black applicants who applied for grants in the basic sciences was a very small fraction of the whole, 1 percent, compared to the number of applications (64.6 percent) submitted by White applicants (Figure 3). While the percentage of applications from African American or Black applicants was somewhat higher in the clinical (1.5 percent) and behavioral sciences (3.1 percent), that proportion was still dramatically lower than that of White applicants (65.2 percent and 77.5 percent, respectively) (see Appendix 5, Figures 3 to 3B). Based on U.S. census data (Figure 1), the number of applications from Black scientists would be expected to be almost 10 times this level. This shortfall suggests a failure of support infrastructure that extends from nurturing interest in biomedicine during early

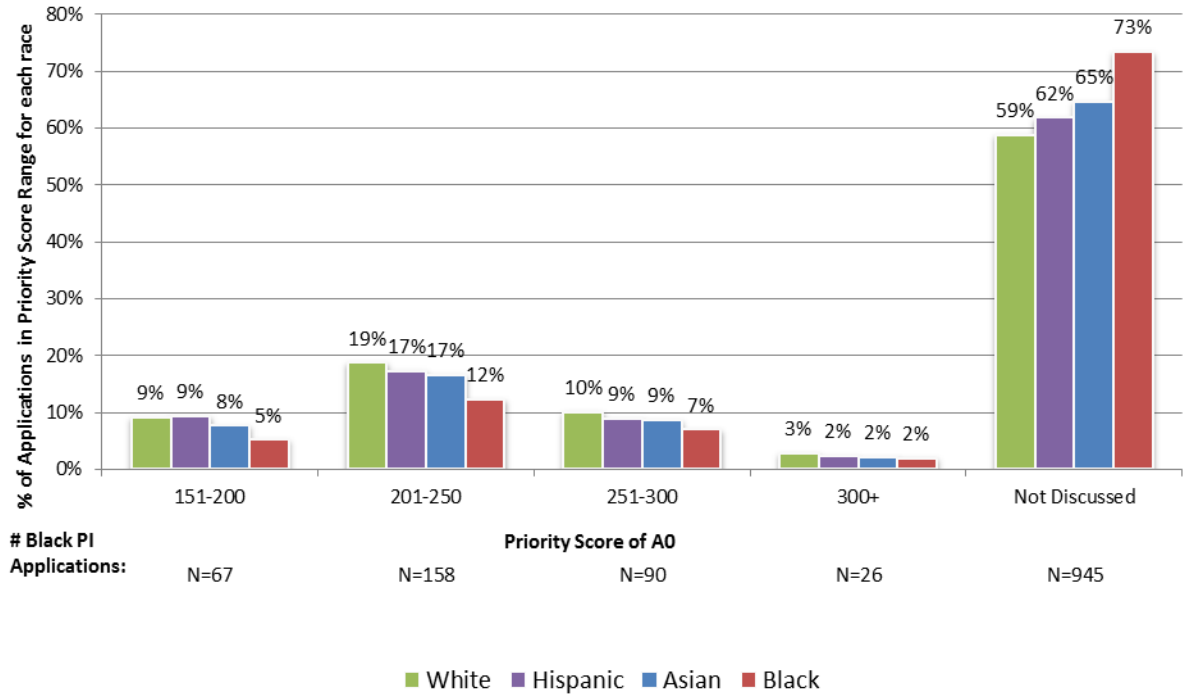
childhood through the more advanced and sophisticated stages of biomedical and behavioral research training to adequately prepare and/or support a sufficient number of Black biomedical and behavioral Ph.D. researchers to compete for NIH research grant (R01) support.

Figure 3: Distribution of Type 1 CSR Reviewed RPG Applications by Field of Science and Race of PI: Fiscal Years 2000 -2010



Once an applicant submits his or her application to the NIH, the review process begins when the study section assigned to that grant decides whether or not to discuss the application at length (although applicants receive feedback on all applications). From FY 1999 to 2009, 73 percent of applications from Black investigators were not discussed, compared to 59 percent of applications from White investigators (Figure 4). This is a significant finding because it is rare for an application that was declared "not discussed" to be ultimately funded. This difference in scoring distribution also explains much of the difference in resubmission rates between White and Black investigators because, in general, investigators are less likely to resubmit an application that was not discussed (see Appendix 5, Figures 4 to 4G).

Figure 4: Distribution of Priority Scores for each Race, Unsuccessful Unsolicited Type 1 A0 R01s, FY 1999 - 2009



See Appendix 5, Figure 3A for Distribution of Applications by Race and Overall Impact Score, FY 2010-2011

- The NIH introduced a set of significant changes to its peer review system in 2009. At that time a new set of specific "criterion" - approach, significance, investigator, innovation, and environment[9] - were introduced to guide the review of applications. The most meritorious applications, which are "fully discussed" by the study section are then given an overall "Impact" score. Because individual criterion scores are captured for each application, at the Working Group's request, NIH was able to ascertain if any one specific criterion contributed to funding success rate differences. They found that none of the individual criteria accounted for the observed differences. However, applications from African American or Blacks received overall impact scores that were 1.2 points higher (worse) than Whites, on a 10-90 scale, all else (i.e. criterion scores) being equal (see Appendix 5, Figures 9A to 9E). Since the overall impact score is not determined algorithmically from the individual criterion scores, but rather, represents a reviewer's "holistic" judgment of the application, the WGDBRW was unable to explain this difference.

There is no absolute correspondence between the score a grant application receives and whether or not it is ultimately funded. That is because NIH funding is a two-step process in which a study section of external scientists (the investigator's "peers") assesses his or her

[9] In peer review, defined as the generalized setting of the investigator's proposed research (institution, faculty, other elements of the physical and intellectual surroundings)

proposed project's scientific merit and then, secondly, NIH Institute/Center (IC) leadership, informed by IC Advisory Council review, makes final funding decisions based on a range of factors including such elements as how the proposed work aligns with an IC's mission/current strategic plan and the balance of the IC's research portfolio. Using the 20th percentile scoring range as a proxy[10] for funding probability, NIH data suggest that final Impact Scores being equal, funding decisions — (as distinguished from scoring decisions- see previous paragraph) — were race- and ethnicity-neutral (see Appendix 5, Figure 9E).

- The WGDBRW reviewed NIH-conducted analyses that suggested that the success rate of any racial or ethnic group was minimally affected by the racial and/or ethnic composition of the peer review panel. Roughly 70 percent of the reviews conducted by the NIH are performed by the Center for Scientific Review (CSR). Analysis of these data revealed a weak (albeit statistically significant) relationship between the percentage of URM scientists on a review panel and the success rate of applications submitted by underrepresented minorities reviewed by that review panel. Less than 5 percent of the success rate variation observed for URM applicants, could be explained by the percentage of URM reviewers (see Appendix 5, Figures 10A-10F).

  Since the Ginther, et al. study observed that prior review experience for Black applicants correlated with a higher probability of an application being "fully discussed," the WGDBRW also explored the status of the CSR Early Career Reviewer (ECR) program, (which began in June 2011). The ECR enables more underrepresented minorities to participate in study section peer review as ad hoc reviewers. To date, over 200 scientists have participated as ECRs in this pilot program, with 39 percent of the total participants being URM scientists. That number compares to pre-pilot URM representation of 8.1 percent of the CSR standing study sections membership. Because of the importance of increasing URM participation on peer review groups for both enhancing the deliberative process and the positive effects of such participation on applicants, the WGDBRW is pleased that a more diverse group of scientists are being exposed to peer review and strongly encourages CSR to monitor the ECR program carefully and to make appropriate adjustments to ensure its success.

Recently, Dr. Ginther and her colleagues extended their analyses by studying success rates of M.D.s and M.D./Ph.D.s[11]. Although they observed the same general disparity in funding success for Black M.D.s. as they did for Black Ph.D.s, the difference between award probability for Blacks and Whites was smaller for M.D.s than for Ph.D.s. Their analysis also revealed that applicants from medical schools have better funding outcomes than do applicants from non-medical schools. In addition, proposals with a human subjects component from Black M.D.s were less likely to obtain funding than were similar proposals from White M.D.s. Thus, the funding disparity between White and Black M.D.s appear to be partially mitigated by working at a medical school and by pursuing non-clinical research questions.

[10] The NIH Institutes and Centers set their own paylines based on the specific priorities of the Institute or Center. As the overall NIH success rate has been approximately 20% from 2006 to 2010, using the 20th percentile is a reasonable proxy for determining funding eligibility.
[11] Personal communication with Dr. Donna Ginther

Generalized Data Insufficiency and Lingering Questions

While the WGDBRW was confident that sufficient data[12] was available to make meaningful recommendations to the NIH on its journey of addressing the challenge of ethnic/racial funding disparities, as noted below, the group urges the NIH to make a bold, public commitment to pursue an ongoing review of the workforce diversity issue to better inform next steps and future actions. The group strongly urges the NIH to engage in a systematic and cost-effective effort to collect needed data to inform future decision-making.

To guide this process, the WGDBRW developed a series of additional research questions for the NIH to explore in order to understand more fully the many factors that may influence the URM experience in biomedical and behavioral research. These include the nature of an applicant's postdoctoral experience, the prestige of an applicant's postdoctoral and graduate mentors, and the nature of an applicant's scientific network (see Appendix 6).

The WGDBRW is aware that the NIH has contracted to collect additional data, and that a full analysis will be completed in summer 2012.

Section III: Creating a Racially and Ethnically Diverse Biomedical Research Workforce

The Leaky Pipeline

Several stages comprise the educational pathway to a Ph.D. degree that prepares an individual for a biological or behavioral science research career, and prepares him/her for a university, medical school, or independent research institute appointment and facilities required to submit an R01 grant application. These stages, and their cognate requirements for entry to the subsequent level, include:

- kindergarten through middle school (K-8) that prepares students for a rigorous high school education
- high school (9-12) education that generally includes 4 years of English, 4 years of mathematics, 1 year of introductory biology, 1 year of introductory chemistry, 1 year of introductory physics, and 1 year of an Advanced Placement course in biology, chemistry, or physics
- an undergraduate (B.A./B.S.) degree that includes statistics, biology, genetics, chemistry, and physics
- graduate education that includes practical, hands-on training in laboratory or human investigation and yields a Ph.D. degree
- a postdoctoral fellowship/other type of training program that provides hands-on experience in laboratory and/or in human investigation

[12] Appendix 5 provides the additional data that the WGDBRW analyzed. Appendix 6 provides a summary of the additional analysis that the NIH is currently undertaking.

- appointment as an Assistant Professor at a university, medical school, or independent research institute (This appointment is generally accompanied by appropriate space and facilities to undertake research as an independent investigator.)[13]

This multi-stage educational journey proceeds at a wide range of paces, and for underrepresented minorities, the pipeline is leaky. They exit the biomedical and behavioral research path more often than Whites, for a range of reasons. For underrepresented minorities, attrition occurs at all levels, but is most pronounced at the graduate school level.

In common with the Biomedical Research Workforce Working Group, a major challenge faced by the WGDBRW was the lack of comprehensive tracking data for NIH trainees. The NIH has tracked the short-term outcomes of pre- and postdoctoral trainees supported by T32, F31, and F32 training grants, but long-term outcomes have been documented only inconsistently. Tracking the short- and long-term outcomes of pre- and postdoctoral trainees supported by research project grants (such as R01s) has not been accomplished. A preliminary analysis by the NIH shows that 73 percent of NIH-supported postdoctoral trainees are supported by research project grants, such as R01s, not through NIH-sponsored training grant mechanisms. No data are available that track the race/ethnicity of the trainees supported by research project grants.

Recommendation #1: The NIH must ensure that appropriate resources are allocated for the systematic tracking, reporting, and evaluation of the immediate and long-term outcomes of all trainees, including those supported on all research project grants[14] .

- The NIH should assign a unique identifier to every individual at the time of his/her first NIH-funded training experience to permit tracking of undergraduates engaged in summer research through graduate and postdoctoral training through later career development. Monitoring should include those individuals supported on research project grants and other mechanisms.
- Given the lack of data regarding sub-populations of Hispanic researchers, the lack of data regarding people with disabilities, and the suspected substantial differences between socially and educationally advantaged groups and those who are disadvantaged and marginalized, the NIH should immediately being to enhance its data collection capabilities for these populations.
- All programs should undergo systematic review and evaluation every 5 years. Those programs and activities found to be particularly effective in increasing the participation of minorities in the biomedical sciences should be used as models for other programs that are not as effective, and the effective ones should be considered for expansion.

Tracking individuals over time is essential to ascertaining the quality and efficacy of predoctoral and postdoctoral training. Monitoring the experiences and outcomes of trainees informs how well training environments achieve their intended purposes, as well as enable mid-course

[13] Please refer to the ACD Biomedical Research Workforce Working Group report for a complete description of the pipeline
[14] A number of NIH mechanisms fall under the research project grant grouping including R01s

corrections in design and administration in response to ever-changing external circumstances and the needs of trainees. For descriptive data on the race/ethnicity of NIH grantees from FY 2000 to 2010, from predoctoral fellowships through R01 and R01 equivalents, please see Appendix 5, Figures 11A to 11I.

A Break in the Pipeline: K-12 Science, Technology, Engineering, and Mathematics (STEM) and Undergraduate Science Education

A small proportion of talented URM scientists advance through the American educational system, pursue STEM, and gain admission into the nation's best colleges and universities. Yet, the success stories are far too uncommon. Educational disparities play a role in the lack of sturdiness of the pipeline both in the numbers of interested URM students and in their preparation for advanced study. Inequities in educational preparation stem from a multitude of factors including socioeconomic status and access to quality preschool education. Under the influence of these factors, many URM children enter elementary school with some educational disadvantage (Sadowski, 2009). This disadvantage in early learning, along with compounding disadvantages in later educational experiences, makes it more difficult for URM students to keep pace as the intensity and depth of school coursework increases (Sanders & Horn, 1998). As a consequence of this and other disadvantages, only 50 and 53 percent, respectively, of African- and Hispanic-American students graduate from high school, compared to 75 and 77 percent, respectively, of White and Asian-American students (Rampell, 2010).

The WGDBRW appreciates the tremendous importance of the K-12 phase of the pipeline, but the group also knows that K-12 education is not within the NIH's Congressional mandate. Thus, the focus on K-12 STEM aligns better with the mission of numerous other organizations and Federal agencies besides the NIH. Yet, the WGDBRW believes that such realities do not and should not preclude the NIH from leveraging its extraordinary public support and scientific community leadership toward efforts that go beyond the walls of the NIH campus. The WGDBRW heard loud and clear from representatives of the public who expressed concerns about the importance of K-12 STEM and undergraduate education during the February 2012 public meeting (see Appendix 2), via the RFI (see Appendix 1), as well as through unsolicited e-mail communications. Thus, this matter deserves serious attention despite the NIH's formal limitations.

Direct NIH involvement in the pre-college educational arena is largely limited to providing research experiences for high school and college students, and through training of high school and community college science teachers. Despite the value of these efforts, though, the numbers of students and teachers enriched by NIH-sponsored programs are very small. The WGDBRW believes that, in addition to NIH, other Federal agencies as well as public and private organizations that have a central role in the nation's K-12 STEM pipeline must make a concerted effort to increase the numbers of URM students who progress through the educational pipeline to pursue an independent research career.

Recommendation #2: The NIH should take a direct leadership role in developing the interest and curiosity of greater numbers of K-12 and undergraduate URM students in biomedical and behavioral sciences through the design and dissemination of NIH-specific activities; providing an increased number of research experiences for high school students and their teachers; and by advocating for and promoting cooperative efforts across Federal agencies and with private and philanthropic organizations.

A Break in the Pipeline: Undergraduate to Graduate School and Subsequent Ph.D. Award

Several analyses have examined the flow of prospective Ph.D. candidates by race/ethnicity from college graduation through receipt of doctoral degree. For underrepresented minorities, although the pipeline is leaky throughout the biomedical educational continuum, the overwhelming racial/ethnic disparity resides in the completion of Ph.D. programs, particularly in the biological sciences, chemistry, and physics. This shortfall in Ph.D. completion has been documented in the National Science Foundation's "Women, Minorities, and Persons with Disabilities Report 2011" (Tables 5.7 and 7.4, reporting 2000-2008 data). Notably:

U.S. colleges and universities awarded 711,062 B.S./B.A. degrees in biological sciences, chemistry, and physics to citizens and permanent residents:

- 69 percent (489,064) were awarded to Whites.
- 13.2 percent (93,899) were awarded to Asians.
- 7.7 percent (55,040) were awarded to Blacks.
- 5.4 percent (38,679) were awarded to Hispanics.
- 0.7 percent (4,803) were awarded to American Indians or Alaska Natives.

In the same time period, U.S. universities awarded 82,704 Ph.D.s:

- 50 percent (41,297) were awarded to Whites.
- 19.9 percent (93,899) were awarded to Asians.
- 2.3 percent (1,912) were awarded to Blacks.
- 2.9 percent (2,430) were awarded to Hispanics.
- 0.3 percent (4,803) were awarded to American Indians or Alaska Natives.

In summary, during from 2000 to 2008, the average number of underrepresented minorities (Black, Non-Hispanic; Hispanic; and American Indian or Alaska Native) [15] who obtained a Ph.D. in the biological sciences, chemistry, or physics averaged 507 people per year. This is strikingly low compared to the average of 4,589 Ph.D.s earned by Whites in these fields during the same time period (Figure 5). It is also noteworthy that of the top 49 baccalaureate institutions that yield Black science and engineering doctorate recipients, Black Ph.D.'s received their undergraduate degrees from HBCUs (54 percent) rather than at majority-serving research-intensive institutions (46 percent) (see Appendix 5, Figure 5A). Given the small size and limited infrastructure common to many of HBCU undergraduate programs, compared to similar programs at research-intensive institutions, this track record of success should be considered a fruitful resource for expanding best practices designed to help address the bachelor's to doctoral degree pipeline transition.

Figure 5: Awarded Degrees in Biological Sciences, Chemistry, and Physics to Citizens and Permanent Residents by US Institutions (2000 to 2008)

	BS/BA Total		BIO (PHD)	CHEM (PHD)	PHYSICS (PHD)	PhD Total		BS/BA to PhD Ratio
Totals	711,062		51,126	20,353	11,225	82,704		0.12
White, Non-Hispanic	489,064		27,518	9,318	4,461	41,297		0.08
Asian or Pacific Islander*	93,899		14,777	1,224	493	16,494		0.18
Black, Non-Hispanic	55,040		1,315	451	146	1,912		0.03
Hispanic	38,679		1,728	535	167	2,430		0.06
American Indian or Alaska Native	4,803		150	53	14	217		0.05
URM BS/BA Total	98,522		URM PhD Tota			4,559		0.05
Average URM BS/BA per Year	**10,947**		**Average URM PhD per Year**			**507**		**0.05**

*Anyone reported as "Asian" or "Asian or Pacific Islander" is reported above in the "Asian or Pacific Islander classification. This changed after 2008, when "Native Hawaiian or Other Pacific Islander" was included as a separate racial classification.

Source: NSF Women, Minorities, and Persons with Disabilities Report 2011, Tables 5.7 and 7.4

If the proportion of Black and Hispanic students graduating with a Ph.D. degree in science were the same as for attaining a B.S./B.A. degree in science, 4,456 more Blacks, and 2,036 more Hispanics would have attained science Ph.D.s in the same time frame. This would roughly triple the number Black science doctorates and double the number of Hispanic science doctorates recipients annually.

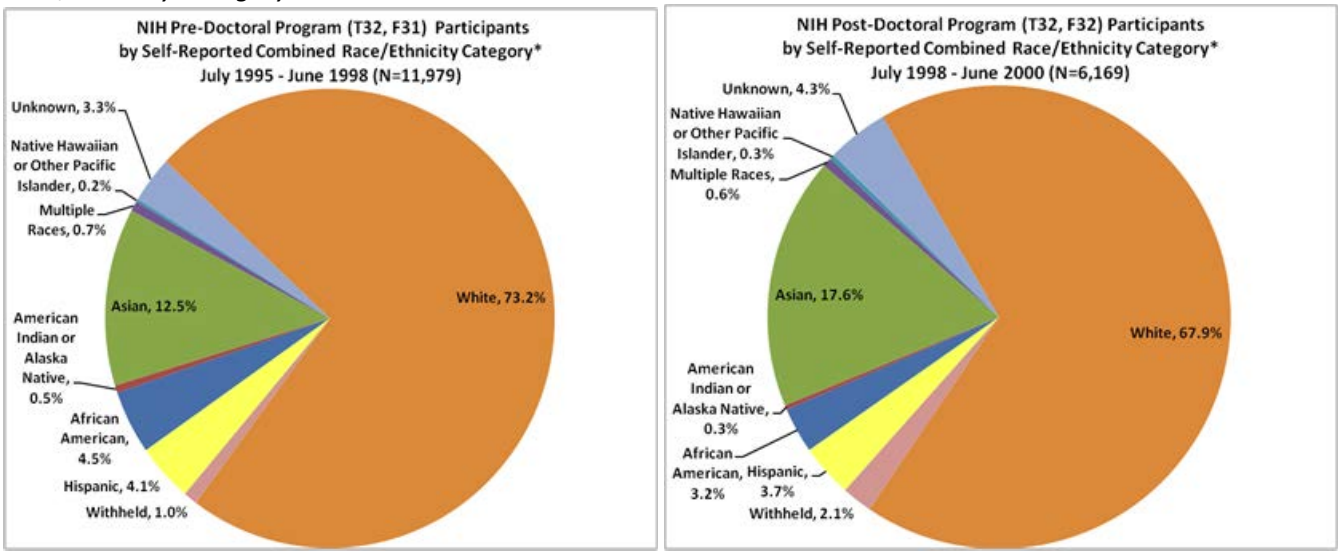
[15] Anyone reported as "Asian" or "Asian or Pacific Islander" is reported above in the "Asian or Pacific Islander classification. This changed after 2008, when "Native Hawaiian or Other Pacific Islander" was included as a separate racial classification. Therefore, for this analysis, "Native Hawaiian or Other Pacific Islander" was not included. The Working Group recognizes that this population is also underrepresented and must not be forgotten.

The most recent NSF data provides evidence that an increased number of underrepresented minorities are enrolling in science and engineering graduate programs with a 2000-2010 increase of 4.9 percent for Hispanics and 3.7 percent for Black or African Americans (see Appendix 5, Figure 5B). Unfortunately, this gain is offset by decreased percentages of American Indians and Alaskan Natives and Native Hawaiians or other Pacific Islanders. The WGDBRW notes that despite this modest gain, there is still a long way to go in achieving full diversity in biomedicine.

NIH-sponsored predoctoral training programs (The Ruth Kirschstein National Research Service Awards (NRSA, T32, and F31) grants) are considered by much of the academic and industry communities to represent very high-quality training experiences. However, most NIH-funded predoctoral trainees are not supported on NRSA grants, but via a faculty-awarded R01 grant. Unfortunately, the NIH does not currently track R01-funded trainees.

Overwhelmingly, NRSA-funded trainees, both pre- and postdoctoral, are White or Asian (Figure 5). Underrepresented minorities made up only 10 percent of total predoctoral program participants, whereas Whites and Asians, combined, represent 85.7 percent of predoctoral trainees in NIH-sponsored NRSA training programs (Figure 6; see Appendix 5, Figures 11A to Figure 11C and 11E for additional descriptive statistics of predoctoral trainees). The low representation of URM trainees in NRSA-sponsored programs may put them at a disadvantage later when these trainees seek NIH funding (Figure 7).

Figure 6: NIH Predoctoral (left) and Postdoctoral (right) Program Participants by Self-Reported Combined Race/Ethnicity Category[1]



[1] Due to the time period of the cohorts, and the race/ethnicity data collection structure during that time period, ethnicity is reported in conjunction with race, so that persons reporting Hispanic ethnicity are only included in the Hispanic total, and are not included in any of the race totals.

Recommendation #3: NIH should increase number of scholarships for undergraduates (building on the NIH intramural Undergraduate Scholarship Program) that include "payback" through participating in a meaningful research experience, and additional fellowships for the anticipated increased numbers of URM graduate students in biomedical research. This needs to be supplemented by enhanced mentoring as outlined in Section IV, Recommendation #5.

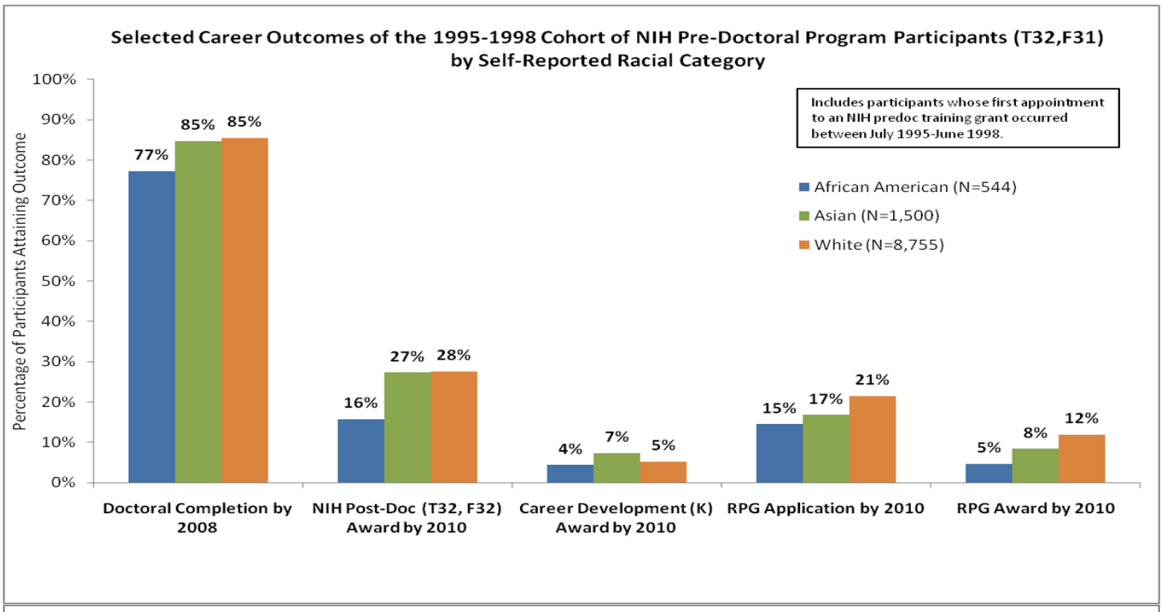
A Break in the Pipeline: Postgraduate Training

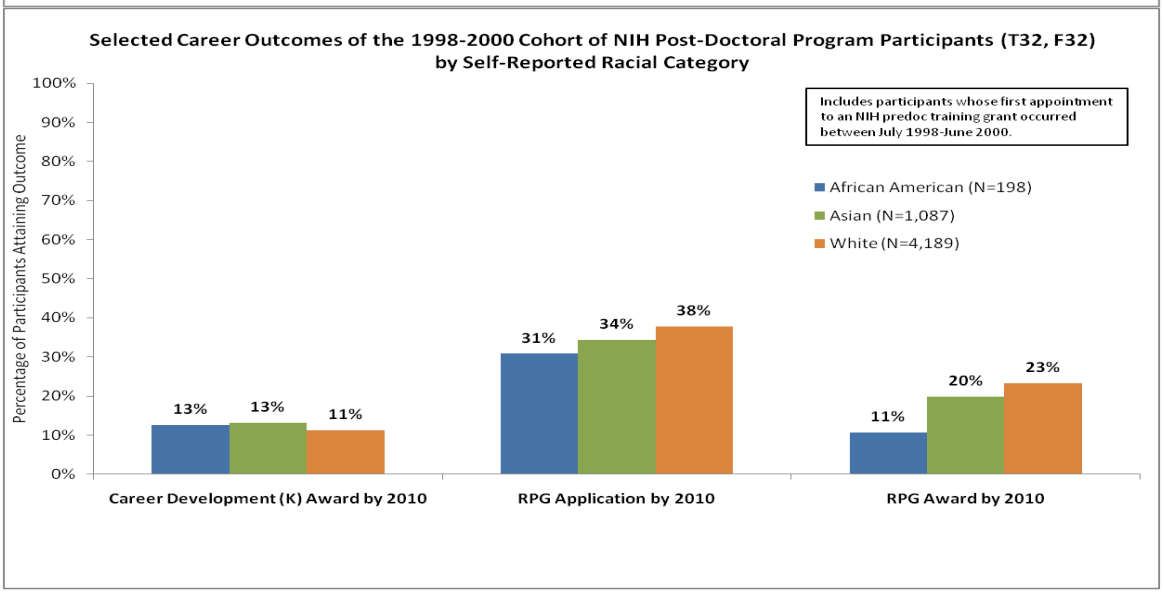
The likelihood of career success — one metric for which is receiving an NIH-funded research project grant award, such as an R01 — is enhanced by participating in postdoctoral study. It is the rare Ph.D., irrespective of ethnicity or gender, who is ready to establish an independent laboratory and career immediately after doctoral training. A postdoctoral fellowship in the laboratory of an experienced, creative, and caring mentor provides an opportunity for the vast majority of Ph.D.s to select a direction for future research, acquire new conceptual and practical skills, and mature as a scientist. Additionally, it is the current convention throughout the field that independent investigator candidates have completed postdoctoral work. In common with NIH-sponsored NRSA predoctoral programs, NIH-sponsored NRSA postdoctoral training programs are considered to be a high-quality experience. In a FY 1995-1998 cohort, URMs comprise 8.1 percent of all NRSA-sponsored postdoctoral fellows (Figure 6, right panel). Again, most postdoctoral fellows are supported via faculty-awarded R01 grants, and the NIH does not currently track these individuals.

To get a snapshot of the NIH-funded trainee population as these individuals progress through training, the WGDBRW monitored the progress of the FY 1995-1998 cohort of graduate students through 2010 (represented in Figure 6). Among recipients of NIH pre-doctoral training awards (T32, F30, F31), White trainees represent 28 percent of NIH-supported (T32, F32) postdoctoral fellows whereas African American trainees constitute only 16 percent of this cohort (Figure 7, top). Of this same predoctoral cohort, 5 percent of the African American trainees received an NIH RPG by 2010. In contrast, 12 percent of the White trainees receive an RPG by that time. For all groups, recipients of NIH postdoctoral fellowships (T32, F32) fare better in ultimately being awarded an NIH RPG compared to those with only predoctoral support (Figure 7, bottom) but disparities among African American, White, and Asian fellows exist.

In summary, the data suggest that participation in NIH-funded pre- and postdoctoral NRSA training prepares trainees for future NIH-funding success, and URM trainees may therefore be at a disadvantage if they do not participate in such programs.

Figure 7: Selected Career Outcomes of the 1995-1998 Cohort of NIH PreDoctoral (T32, F31) and NIH Postdoctoral (T32, F32) Program Participants by Self-Reported Combined Category





Recommendation #4: The NIH should assess the reason(s) for the disparity in the frequency of awards to African American applicants for postdoctoral positions on T32 training grants and F32 fellowships (Figure 7 (top)), and take appropriate remedial actions once the reason(s) for this disparity have been determined.

Section IV: Mentoring

As documented in Section III, although the pipeline is leaky throughout the educational continuum, the WGDBRW identified the small number of underrepresented minorities that complete Ph.D. programs in the biological sciences, chemistry, and physics, as a key point for NIH to intervene. In addition to Recommendation #4 above, the WGDBRW identified the availability and quality of mentoring support for graduate students and newly graduated doctorates as an important variable in successfully enhancing the proportion of URM students who will ultimately obtain an independent position in a research university, medical school, or independent research institute, and finally, successfully compete for R01 grants — one proxy for scientific independence and the critical issue identified by the Ginther, et al. report. Additionally, those applicants with scant direct or indirect experience in NIH "grantsmanship" are likely to be disadvantaged in their ability to compete for NIH funding, regardless of the scientific merit of the proposal they write and submit. Having access to an experienced mentor to help shape a junior investigator's ideas and formulate a compelling proposal could help level the playing field for URM scientists.

The Mentoring Process

Traditionally, mentors have been viewed as advisors who have career experience and share their knowledge of it; supporters who give emotional and moral encouragement; tutors who provide specific feedback on performance; employers to graduate students; sponsors who are sources of information and opportunities; and models of identity who serve as academic role models (Zelditch, 1990). However, this notion of mentoring lacks appropriate attention to cultural competence, and thus is likely to be inadequate for Black, Hispanic, American Indian or Alaska Native, Asian, or Native Hawaiian or Pacific Islanders scientists, as well as for recent immigrants.

In practical terms, dissertation sponsors in most STEM disciplines are synonymous with a student's mentor, and in the view of many, these individuals are the most critical determinant of a graduate student's success and ultimate receipt of a Ph.D. degree. The faculty sponsor generally discusses with the mentee a dissertation project, helps the student design his or her initial experiments, and — assuming the student is successful in carrying these out and documenting the studies — helps the student to amplify his or her preliminary findings into a full-scale research project that will ultimately qualify as a Ph.D. dissertation. Because currently the median time to a Ph.D. in the biomedical sciences is 5.5 to 7 years[16], a graduate student and his or her mentor must work together in great harmony and trust for a significant period of time. The faculty mentor is often also responsible for many practical issues of great importance to a student: his or her stipend, access to facilities, and other benefits.

Recognizing the complexity of the sponsor/mentor-graduate student relationship in a climate in which the racial, ethnic, and national origin of the student population is rapidly changing, many

[16] Please refer to the ACD Working Group on the Biomedical Research Workforce for further discussion on timeline to earn a Ph.D.

research-intensive universities have established offices/programs that offer training in culturally appropriate sponsorship/mentorship for faculty and in traineeship for students. Many helpful publications are available; for example:

- Adviser, Teacher, Role Model, and Friend: On Being a Mentor to Students in Science and Engineering. National Academy of Sciences, National Academy of Engineering, Institute of Medicine[17]
- Mentoring Minority and Underrepresented Students, Harvard University[18]
- University of Michigan, Quick Tips for Promising Practices Mentoring[19]
- Science Mentoring[20]
- Felder, P., On Doctoral Student Development: Exploring Faculty Mentoring in the shaping of African-American Doctoral Student Success[21]

Unfortunately, there is little objective evidence that suggests one mentoring approach is preferable or more successful than another. Given the diversity of cultures and institutional norms operational at different types of research universities (e.g., public vs. private) and in different regions of the United States, no one-size-fits-all program or approach is likely to be uniformly successful. Moreover, there is a wide range of familiarity and expertise about obtaining NIH funding among individuals — minority or majority — emerging from research training programs.

Although many mentoring programs are available and effective, the WGDBRW agreed that the Feed Forward Grant-Mentoring Program at the University of California, San Francisco, has many desirable attributes and is worth highlighting as an example of a program that represents a "best practice" at a research-intensive institution.

Spotlight: The Feed Forward Grant-Mentoring Program

Feed Forward is a mentoring program at the University of California, San Francisco, in which the grant applicant (mentee) identifies three established, well-respected scientists, all with NIH grant-review experience, to serve as his/her grant mentoring committee. The mentee arranges two, 90-minute meetings with this committee, bringing together all of the mentors. The first meeting is a "science conversation," in which the mentee describes a research project that he or she seeks to approach in an R01 grant application, explains the potential impact of successfully completing the project, and describes the primary biological systems, methods, and experiments that would be used. The grant committee engages in a rigorous, but supportive, discussion with the mentee, who defends his or her project, but remains attentive to the points raised by the mentors, their areas of agreement and disagreement, and the resolution of those

[17] http://www.nap.edu/catalog.php?record_id=5789 [downloaded 5/7/12]
[18] http://www.faculty,harvard.edu/teaching-andadvsing/advising/mentoring-minority-and-underrepresented-students [downloaded 5/7/12]
[19] http://www.rackham.umich.edu/faculty_staff/information_for_programs/academic_success/mentoring_advising [downloaded 5/7/12]
[20] http://ehrweb.aaas.org/sciMentoring/ [downloaded 5/7/12]
[21] http://www.nova.edu/ssss/QR/QR15-2/felder.pdf [downloaded 5/7/12]

disagreements. The mentee then prepares a one-page document stating the biological problem or question to be addressed, and summarizing three to five specific aims. This one-page document becomes the focus of a second, 90-minute science conversation with the committee, in which the mentee again defends, but is also attentive to the discussion and debate within the committee. At this point, the mentee will have written only a single page of text about his or her idea and plans, but will have benefited from nine senior investigator-hours of exclusive attention to the proposed work. Importantly, as a result of this process, the mentee should have a clear idea of the organization and content of a full application that would be required to carry out the research — and sufficient time to prepare and submit the application by its specified deadline.

Could less resource-intensive research institutions mimic programs such as Feed Forward? One possible approach would be to construct a scenario where the mentee would select one or two of his or her committee members from a pool of senior investigators from around the country who have volunteered to serve in this capacity.[22] External mentors could attend remotely, such as by videoconference. Optimally, such a program would enable sufficient time for the outside mentors to review the junior investigator's final, full application, but that step may be less important than the initial conversations. The WGDBRW believes that this simple, scalable, low-cost system could potentially increase the success rate of NIH grant applications from URM scientists, including those at less research-intensive institutions. It has the added feature of engaging well-established senior scientists at research-intensive institutions directly in mentoring, nurturing, and supporting URM scientists across the country. For the URM mentee, it is likely that the mentors, including those from the external investigator pool, would likely become personally engaged and invested in the mentee and his or her future.

The WGDBRW's discussions of the vital role of mentoring for all trainees, but especially for those from underrepresented groups, prompted several specific recommendations:

Recommendation #5: NIH, through NIMHD serving the coordinating function, should partner with established minority scientific and professional groups and other trusted organizations to implement a system of mentorship "networks" for underrepresented minority students that will provide career guidance throughout their career development. The mentorship networks would be expected to make available a cadre of investigators who would, among other mentoring activities, provide workshops in grant writing, grant presentations, and optimal participation in editorial and NIH review processes.

Recommendation #6: Establish a working group of the ACD, of racially and ethnically diverse scientists, to provide regular input to the Director of NIH, and the Institutes and Centers, regarding the state-of-the-art in effective programs that overcome or reduce disparities in research awards.

[22] Various organizations such as the Association of Academic Minority Physicians and the Society for the Advancement of Chicanos/Hispanos and Native Americans in the Sciences have pledged support of their seasoned members in mentoring junior faculty to improve their chances of obtaining a R01 grant. The Institute of Medicine has also offered its support in providing any assistance requested by the NIH.

This new ACD working group should develop guidelines for colleges and universities that are recipients of NIH grants. These guidelines should describe the NIH's expectations of faculty mentors, as well as provide examples of mechanisms that academic departments and institutions should have in place to assure compliance with the guidelines. All applications for any NIH-sponsored training, fellowship, and research grants that support graduate students and/or postdoctoral fellows should include a section certifying that the mentor has been through the necessary training for culturally appropriate mentorship of graduate students and postdoctoral fellows.

In addition, the working group should consider a range of mentoring experiences/opportunities:

- university-specific mentoring programs
- external, professional association mentoring
- mentoring by a consortium of colleges and universities (e.g., HBCUs)
- models that include a combination of any of the above

Recommendation #7: Investigators whose applications are unscored should be provided with a more detailed explanation of the factor(s) that led to this determination, thus enabling an applicant to better understand the areas of concern leading to the decision about his or her proposal. Ideally, these comments from the peer reviewers should help the applicant decide whether he or she should "resubmit or rethink" an unscored application.

A Systems Approach to Enhance the Research/Training Capacity of More Diverse Set of Institutions

The WGDBRW was unable to precisely distinguish among funding disparities caused by the potential presence of bias (unintended or otherwise) during the peer review process (see Section V for a discussion of bias) and application quality, which in turn may be affected by a range of factors including mentorship, resource availability, release time from teaching/administrative responsibilities, all of which could be influenced by institutional bias (unintended or otherwise). Thus, because the WGDBRW's analyses and discussions did not point to a single, definitive cause for NIH-funding disparities — and the group recognizes fully that causes are unlikely to be mutually exclusive — the WGDBRW has proposed a set of complementary interventions that may help clarify the root causes for funding disparities, significantly support the development and evaluation of programs that will increase diversity in the biomedical workforce, and that will do no harm.

The WGDBRW was impressed by the track record of the many institutions that have devoted themselves to the training or support of URM scientists. Many of these institutions have done so despite significant resource and infrastructure constraints which limit their ability to expand efforts in response to the need for increased numbers of URM the biomedical research workforce. As such, the WGDBRW was especially interested in testimony from a number of stakeholders concerned about how best to bolster the infrastructure, resources, and human

capital of graduate-level academic institutions that have a major focus on training a diverse biomedical and behavioral research workforce and that are critical to the realization of the NIH's diversity objectives. Stakeholders offered important insights into the strategic investment challenges faced by institutions that must be overcome if they are to be successful in creating a surge in the production of new biomedical talent from diverse populations. The WGDBRW expressed interest in many of the suggestions:

- enhanced core support in areas, such as fellowships and scholarships, to support students enrolled in science degree programs
- reduced teaching loads for faculty conducting research and training students as part of their research programs
- grants management capabilities
- technical writing advisors
- upgrades in instrumentation, equipment, and facilities
- other resources that are essential for success

The WGDBRW also resonated with a call for enhanced and equitable partnerships between these institutions that have a major focus on training a diverse biomedical and behavioral research workforce and other interested, resource-rich institutions.

Recommendation #8*:* Under the leadership of NIMHD, and in coordination with other STEM initiatives underway in HHS and across other Federal government agencies, NIH should undertake a bold, well-funded, multi-year, incentive-based, competitive grant process to support infrastructure development in those comparatively under-resourced institutions with a documented track record of producing and supporting URM scientists as well as stimulating creative partnerships among these institutions and, where appropriate, including more resource-rich institutions.

The WGDBRW considers this action to be a bold, yet necessary initiative that reflects the urgency of the testimony presented during its deliberations; the group recommends that the NIH, along with other Federal partners, target substantial resources over 5 years to implement this recommendation at 5 or more training sites.

Section V: Bias, Diversity, and the Institution of NIH

Examination of Bias

Given the importance of the Ginther, et al. report findings for the broader scientific community, and in particular, for the NIH's own self-evaluation on this matter, the WGDBRW is concerned with both actual bias and as well the appearance of bias in NIH R01 funding. The WGDBRW had extended discussions about possible explanations for the disparities reported in the Ginther, et al. study including potential sources of conscious and unconscious bias in the NIH R01 review process, as well as biases that could occur at the institutional level.

The WGDBRW's extensive dialogue with experts, including the convening of a workshop on March 28, 2012 (see Appendix 3), was insightful in revealing how peer reviewers may be prone to exhibit an unconscious bias against applicants that have a background or research training "pedigree" that is different from the reviewer's normative experience. The experts recognized that this type of bias could result in poorer outcomes from meritorious applicants from diverse backgrounds. The experts also provided input on issues including individual bias; group dynamics and social processes associated with the evaluative judgments; various levels of institutional review; measuring unconscious and implicit bias; and approaches to addressing and preventing bias. [23] This commonly observed potential for unconscious bias in the group dynamics of entities such as study sections raised the plausibility of the hypothesis that the differential outcomes of R01 funding reported in the Ginther, et al. study could be attributable in part to bias. These deliberations were a touchstone for examining a set of related concerns — namely, biases that may occur during training and mentoring of a diverse workforce in the biomedical and behavioral sciences.

Based upon this aggregate input, the WGDBRW was left with the following understandings:

- The exploration and determination of bias is extremely complex, subtle and nuanced. Given the available data and information, it is not possible for the WGDBRW to reach a definitive conclusion regarding either the presence or absence of specific bias, conscious or unconscious, solely based on race or ethnicity in the review process. To do so would require new information derived from the deliberative process sourced from actual review committee transcripts and subjected to highly specialized analytics overseen by a group of knowledgeable experts.

- Many factors enter into group-driven evaluation processes that extend beyond the intellectual merit of a scientific idea and encompass perceptions and judgments regarding individual capabilities to conceptualize and perform complex work. These may include race, scientific discipline, institutions, mentor advisors, and previous NIH review panel service, among others.

- The literature regarding interventions designed to protect against bias is itself complex and challenging. Based upon the unanimous consultation of the WGDBRW's experts, the group concluded that there are no definitive interventions that can be uniformly offered as best practices or that can be administered without

[23] Ko SJ, Muller D, Judd CM, Stapel DA. Sneaking in through the back door: How category-based stereotype suppression leads to rebound in feature-based effects. *Journal of Experimental Social Psychology.* 2008;44(3):833-839.
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risk of unintended consequences. As such, interventions must be introduced carefully and their effects evaluated.

Members of the WGDBRW, several of whom have participated or currently participate in the NIH peer review process, approached bias-related concerns with great caution and substantial discussion. Above all, the group was unanimous in its appreciation for the selfless and voluntary contributions of expertise and time to the review process by so many of the nation's dedicated and talented scientists. The group understands fully that NIH grant reviewers, as well as NIH staff who facilitate the peer review process, seek to achieve the goals of excellence in biomedical and behavioral research and equity and fairness in the review process.

As such, the WGDBRW does not want, through its recommendations, to in any way discourage the willingness of scientists to participate in NIH peer review. On a related note, the group feels an obligation to not only assist in ensuring that all applicants receive a fair evaluation, but that reviewers can also feel confident that processes are in place to preemptively address any concerns regarding the appearance or occurrence of bias.

Given the testimony noted above from the experts who consulted with the WGDBRW indicating the need for caution and ongoing research related to interventions, the Working Group is impressed by the need for more intensive research on the presence or absence of bias using material already available from the grant review process. The WGDBRW spent considerable time examining the potential impact of bias awareness training for study section staff, chairs, and panel members. The preponderance of advice indicated that such an effort must be approached with great care so as to do no harm and it must be evaluated meticulously. Therefore, the Working Group makes the following recommendations:

Recommendation #9: The NIH should expeditiously establish a new Working Group of the ACD comprised of experts in behavioral and social sciences and studies of diversity with a special focus on determining and combating real or perceived biases in the NIH peer review system. In particular, this new Working Group should:

- Oversee the collection and analyses of quantitative and qualitative data relevant to the research project grant review and grant-making decision process.
    - If this additional analysis provides evidence of bias, provide guidance and insight on potential actions that the NIH could take to combat bias.
    - Provide oversight to an analysis of the discourse content from peer review sessions so as to contribute to the understanding of potential bias.
    - Provide expert oversight to a text-based analysis of the commentary on individual grant reviews, including R01s and a subset of applications for those awards (career awards, fellowships, smaller research project grants, and others) most likely to precede an investigator submitting a R01 application.
- Oversee other efforts that investigate potential effects of unconscious bias in peer review.

While current understanding of the precise origins of the disparities reported in the Ginther, et al. study and confirmed by the WGDBRW's additional analyses awaits more detailed examination, the WGDBRW members' expertise in the NIH review process suggested important ideas for safeguarding the review process. Hence, Recommendation #12 calls for a limited set of randomized, trial interventions for imminent R01 funding cycles, to examine the impact of training on study section chairs and members of review panels. Conducting limited, randomized trials of study section behavior requires significant technical and expert consultation on the nature of the question of study and on experimental design. The WGDBRW's consultation with experts in the area of bias, implicit bias, and experimental design led the group to recognize that proper research design of limited randomized trials is absolutely crucial. The WGDBRW has vetted the concept of randomized trials with experts on bias and implicit bias, and their concurrence on this matter was instrumental toward formulating this recommendation.

Recommendation #10: NIH should first, pilot different forms of validated implicit bias/diversity awareness training for NIH scientific review officers and program officers to determine the most efficacious approaches. Once the best training approaches have been identified with NIH staff, pilot these programs with members of study sections to ascertain if their value is sustained. If they are, provide to all study section members.

In addition, the WGDBRW was impressed by the efforts of the NSF and others to experiment with anonymizing the application process for key variables (Bhattachararjee, 2012). While this might prove difficult for the NIH peer review system, the Working Group considers the concept worth of study and evaluation. Studies anonymizing the identity of the applicant organization should yield insight into potential biases, positive or negative, that are derived from the perceived stature of the applicant's home institution. Anonymizing the identity of the applicant may yield insights into possible "pedigree or Matthew" effects (Merton, 1968).

Recommendation #11: NIH should design an experiment to determine the effects of anonymizing applications with respect to applicant identity as well as that of an applicant's institution.

The WGDBRW understands that the nature of implicit bias cuts across processes, structures, organizations, and societal groups. The prospect of bias in the NIH peer review process is a serious matter that calls for deliberative action in a timely fashion.

Section VI: NIH Intramural Research Program

The NIH Intramural Research Program (IRP) encompasses 23 ICs and is located at NIH facilities in Bethesda, Baltimore, and Frederick, Maryland; Research Triangle Park, North Carolina; Hamilton, Montana; and Phoenix, Arizona. The IRP is a large biomedical research institution with 1,200 PIs and more than 4,000 postdoctoral fellows. The IRP faces some of the same diversity challenges as the extramural community, but it also has a unique challenge as it has traditionally followed a decentralized hiring model that has made it difficult to attract a large, diversified pool of candidates to select from.

Appendix 5, Figures 8 to 8D provides data on the race and ethnicity of the IRP from post-baccalaureate fellows to senior leadership positions. In general, the IRP shows a lack of diversity, and even more troubling, a lack of movement toward a more diverse workplace. For example, the number of Black or African American Principal Investigators (PIs) has remained constant (15[24]) since 1993 with only slight fluctuations between those years (Figure 8). While the number of Hispanic/Latino PIs has risen since 1993, that component is very small: only 3 percent of all IRP PIs.

Figure 8: NIH Intramural Research Program Principal Investigator Race/ Ethnicity Demographics

Principal Investigator Race/Ethnicity Demographics										
	1993-1994	2001-2002	Aug-04	Nov-05	Oct-06	Apr-07	Oct-08	Oct-09	Oct-10	Apr-11
Black or African American	15	22	15	14	13	14	14	15	14	15
Hispanic	24	33	41	39	37	36	35	38	37	37
American Indian/Alaska Native	2	3	2	1	1	1	1	1	1	1
Asian/Pacific Islander	98	115	146	147	150	169	175	194	198	201
White	1163	1090	1048	1009	999	1018	972	968	961	945
Foreign National	-	-	-	-	-	-	-	27	31	24
TOTAL	1302	1263	1252	1210	1200	1238	1197	1243	1242	1223
Principal Investigator Race/Ethnicity Demographics - %										
	1993-1994	2001-2002	Aug-04	Nov-05	Oct-06	Apr-07	Oct-08	Oct-09	Oct-10	Apr-11
American Indian/Alaska Native	0.15%	0.24%	0.16%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%
Asian/Pacific Islander	7.53%	9.11%	11.66%	12.15%	12.50%	13.65%	14.62%	15.61%	15.94%	16.43%
Black or African American	1.15%	1.74%	1.20%	1.16%	1.08%	1.13%	1.17%	1.21%	1.13%	1.23%
Hispanic	1.84%	2.61%	3.27%	3.22%	3.08%	2.91%	2.92%	3.06%	2.98%	3.03%
White	89.32%	86.30%	83.71%	83.39%	83.25%	82.23%	81.20%	77.88%	77.38%	77.27%
Foreign National	-	-	-	-	-	-	-	2.17%	2.50%	1.96%
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

[24] As of April 2011

The NIH has taken recent steps to address the IRP's lack of diversity. The Earl Stadtman Investigator[25] program provides an opportunity for tenure-track positions for creative and independent thinkers eager to take on high-risk, high-impact research. The search process is conducted across the entire NIH and not limited to specific ICs. This process has allowed the NIH to recruit a much broader pool of applicants to be considered than normally would be included in traditional IRP tenure-track searches. In 2011, the NIH instituted an initial discussion with the Stadtman search committees to review the "filters" that committee members use consciously or subconsciously in selecting individuals for inclusion in the pool of interview candidates. This discussion, coupled with additional outreach, resulted in more URM candidates being included in the final interviews. The Earl Stadtman Investigator search process remains active.

Given the situation in the IRP, the WGDBRW recommends a series of actions that will enable the NIH to enhance the balance of its own IRP researcher portfolio, and thus serve as a model for other institutions.

Recommendation #12: Appoint a Chief Diversity Officer (CDO) and establish an Office of Diversity with a suitable budget. The CDO should be an established biomedical scientist with considerable expertise in diversity in academic and academic medical settings. The CDO should report directly to the NIH Director and be responsible for ensuring the coordination of diversity-focused efforts across the NIH, including:

- developing diversity training programs for investigators
- providing resources to facilitate the recruitment of URM scientists, women, persons with disabilities, and veteran candidates
- supporting scientific research in diversity as related to STEM professions, health care, the interrelationship of a diverse health care workforce to a diverse scientific community, health care policy, health care delivery, and other related areas
- undertaking a systematic and thorough review of all IRP programs and determining appropriate intervention points
- recruiting and retaining diverse tenure-track scientists
- training post-baccalaureate, postdoctoral, and other levels of scientists at the NIH

Recommendation #13: Using the trans-NIH Earl Stadtman Investigator search process as a model, and learning from its experience, the NIH should institute a more comprehensive search process for tenure-track investigators to ensure the identification of a diverse pool of candidates.

Conclusion

The WGDBRW undertook its general charge to examine the factors that contribute to the current state of diversity in the biomedical and biobehavioral research workforce and its

[25] http://irp.nih.gov/careers/tenured-and-tenure-track-scientific-careers/earl-stadtman-tenure-track-investigator

specific charge to examine the findings and implications of the Ginther, et al., publication with seriousness and intellectual discipline. While the Working Group notes that there is a regretful absence of data that is required for a complete understanding of the full spectrum of etiological factors and remedial solutions to the concerning persistence of inequities in the biomedical science workforce, the WGDBRW could conclude unequivocally that the problem is serious and worthy of significant financial and other resource attention.

This report's 13 recommendations speak specifically and urgently to the need for enhanced data collection, and its analysis, so as to better design and refine training and mentorship programs that produce optimal results, and that use taxpayer's dollars cost-effectively. They speak to the need for, and opportunities to enhance the capacities of universities whose mission is devoted to training and support of URM scientists through direct support and via inter-university collaborations with other more resource intense research institutions. The WGDBRW's recommendations focus on the importance of, and the mechanisms necessary, to create a stronger support infrastructure and a more welcoming environment that facilitates the contributions of excellent URM scientists to achieving national health goals. Finally, this report celebrates the important contributions made by the devoted scientists who participate in the review of NIH grants and suggests the necessary next steps to support them in conducting their work in an environment free from the presence, or even the appearance, of bias and that is essential to reassuring applicants that their proposals are evaluated fairly.

Our current biomedical workforce census is a result of the numerous factors and forces that make up the delicate "ecosystem" of biomedical research consisting of NIH, academia, industry, healthcare, and public and private funding agencies. As such, solutions that enhance the diversity of the biomedical research workforce require partnerships beyond the NIH and that include all stakeholders.

This report and its recommendations are a first step in the resolution of a problem long in the making. The WGDBRW believes it is an important first step. However, it cannot be emphasized strongly enough, that NIH and the Federal government must take this problem seriously. Taking it seriously means exhibiting the appropriate leadership from the NIH Director's Office, enforcing accountabilities for the performance of senior managers across the agency, and making available the funding required to implement the WGDBRW's recommendations.

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Appendix 1: Request for Information Summary

INTELLIGENT PROJECT MANAGEMENT™

NIH REQUEST FOR INFORMATION: DIVERSITY IN THE BIOMEDICAL RESEARCH WORKFORCE

ANALYSIS OF PUBLIC COMMENTS

APRIL 16, 2012

Executive Summary

Recognizing that achieving diversity in the biomedical research workforce is critical to the full realization of our national research goals and is in the best interest of our country, the National Institutes of Health (NIH) Advisory Committee to the Director (ACD) formed a Working Group on Diversity in the Biomedical Research Workforce.[26] The Working Group was charged with the task of examining issues related to diversity in the biomedical research workforce in the United States. As part of the process, the Working Group gathered input from the extramural community through a Request for Information (RFI): "Input into the Deliberations of the Advisory Committee to the NIH Director Working Group on Diversity in the Biomedical Research Workforce" (NOT-OD-12-031).[27] Ripple Effect Communications, Inc. was contracted to provide third party analysis of the comments received through the RFI; this report provides analysis of the 140 responses to the RFI and summarizes respondent suggestions. The Working Group will make recommendations to the ACD to help ensure a diverse and sustainable biomedical and behavioral research workforce.

The diversity Working Group identified two primary categories with a total of six issues and ten sub-issues as important to consider for enhancing diversity in the biomedical research workforce. Respondents were asked to consider the identified issues as they responded to the following three questions:

1. For any of the areas identified above and any other specific areas you believe are worthy of consideration by the Working Group, please identify the critical issues(s) and impact(s) on institutions, scientists, or both.
2. Please identify and explain which of the issues you identified are, in your opinion, the most important for the Working Group to address and why.
3. Please comment on any specific ways you feel these issues would or should affect NIH policies or processes.

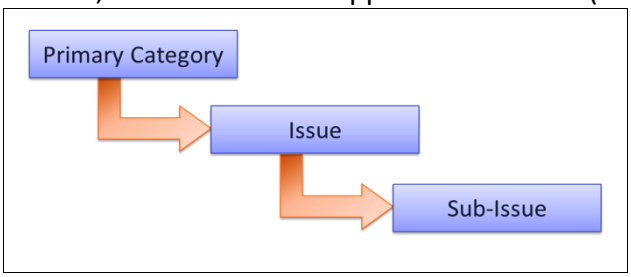
Data and methods

NIH received submissions from 140 respondents, most of whom provided feedback from a personal perspective (self, 68%; organization, 32%). The 140 respondent submissions were parsed into 547 comments and each comment was coded according to the issues identified by the Working Group, and others that emerged from the data.

A coding scheme was developed based on the two primary categories, six issues, and ten sub-issues identified by NIH. That structure provided the conceptual foundation, which team members further developed using an iterative, grounded theory approach. The final coding scheme consisted of the two primary categories, six issues, and ten sub-issues identified in the RFI, plus 14 sub-issues derived from the data. Responses to one issue, *Influence of Role Models*,

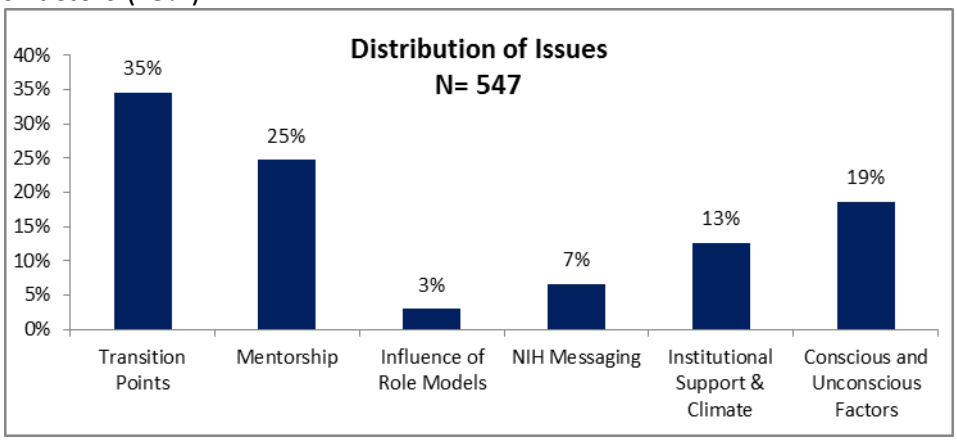
26 http://acd.od.nih.gov/dbr.htm
27 http://grants.nih.gov/grants/guide/notice-files/NOT-OD-12-031.html

did not warrant the development of sub-issues; those comments were coded at the issue level. In total, 25 "codes" were applied to the data (one issue, 24 sub-issues).

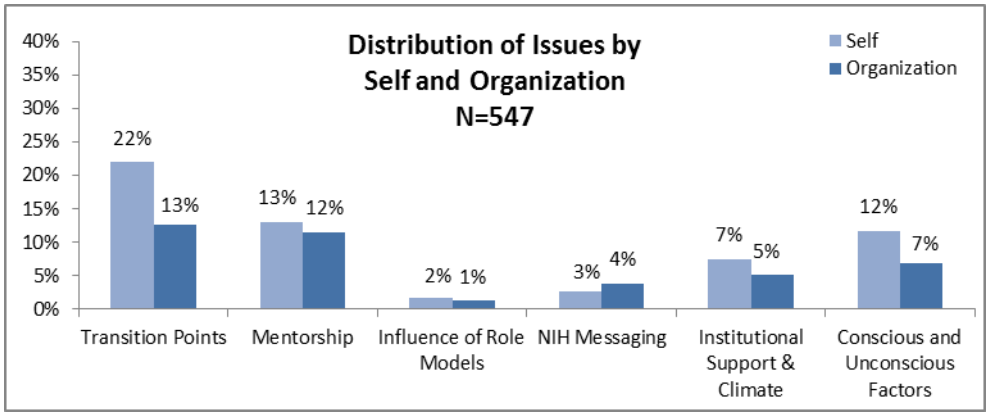


Frequencies, Priority and Recommendations

Of the two primary categories identified by NIH, respondents most frequently commented about the Biomedical Research Workforce Pipeline. At the issues level, the top three most frequently coded issues were *Transition Points* (35%), *Mentorship* (25%) and *Conscious and Unconscious Factors* (19%).



When analyzed by self-reported affiliation, there were slight differences in how the codes were distributed. Those who self-identified as commenting from a personal perspective (self: n=96; 69%), commented more frequently about transition points, institutional support and climate, and conscious and unconscious factors in the review process, compared to those who self-identified as commenting from an organizational perspective (organization: n=44; 31%).



Priority was assigned to comments that explicitly stated it was a priority concern. The order of frequency distribution across priority issues matched the order of the larger dataset; however, at the sub-issue level, affiliation made a difference. Both groups identified transition points as the highest priority, but individuals voiced greater priority for the review process, while organizations voiced greater priority for mentorship.

Collectively, respondents recommended that NIH increase efforts at priming the pump before graduate school, work with organizations and institutions toward supportive collaborations at all institutional levels (to provide resources, such as professional development and mentorship opportunities), and evaluate NIH programs and funding sources to maximize NIH diversity efforts.

Background

NIH Request for Information

Recognizing that achieving diversity in the biomedical research workforce is critical to the full realization of our national research goals and is in the best interest of our country, the National Institutes of Health (NIH) Advisory Committee to the Director (ACD) formed a Working Group on Diversity in the Biomedical Research Workforce.[28] The Working Group was charged with the task of examining issues related to diversity in the biomedical research workforce in the United States. Its recommendations will include ways to improve the retention of underrepresented minorities, persons with disabilities, and persons from disadvantaged backgrounds through critical transition periods in the career pipeline.

To help inform the development of recommendations, the Working Group announced a Request for Information (RFI) to gather input from various sources, including extramural and intramural researchers, academic institutions, industry, and the public. For the RFI, the Working Group asked for feedback on the following issues and sub-issues that fall under the two primary categories of the biomedical research workforce pipeline and factors in the review process:

- Biomedical Research Workforce Pipeline
    - The appropriate transition points where NIH's training, career development and research grant programs could most effectively cultivate diversity in the biomedical research workforce
        - Entry into graduate degree programs
        - Transition from graduate degree to postdoctoral fellowships
        - Appointment from a postdoctoral position to the first independent scientific position

[28] http://acd.od.nih.gov/dbr.htm

        - Award of the first independent research grant from NIH or equivalent in industry
        - Award of tenure in an academic position, at the NIH, or the equivalent in an industrial setting
    - The role of mentorship in the training and success of biomedical researchers throughout their careers
        - Development of relationships between professional societies, institutions, and individuals to develop mentoring programs
        - Creation and expansion of institutional mentoring programs
        - Mentoring of applicants and preparation of applications prior to submission
    - The influence of role models whose qualities and characteristics can positively affect the training and success of underrepresented biomedical researchers through their careers
    - The role of NIH messaging in encouraging underrepresented researchers to apply for NIH fellowships and grants
    - The role of institutional infrastructure support and climate as a factor in the success of underrepresented researchers
- Factors in the Review Process
    - The potential role of institutional affiliation, academic pedigree, and various conscious and unconscious factors on review outcomes
        - Exploration of the possible influences of racial, ethnic, gender, affinity, or other biases
        - Research on the NIH Peer Review system to determine appropriate methods or interventions to identify and if necessary redress bias, including efforts to anonymize applications or test the effects of unconscious bias training on outcomes

Respondents were asked to consider the identified issues as they responded to the following three questions:

1. For any of the areas identified above and any other specific areas you believe are worthy of consideration by the Working Group, please identify the critical issues(s) and impact(s) on institutions, scientists, or both.
2. Please identify and explain which of the issues you identified are, in your opinion, the most important for the Working Group to address and why.
3. Please comment on any specific ways you feel these issues would or should affect NIH policies or processes.

The online submission process was open from January 10 through February 24, 2012. This report is an analysis and summary of the public comments and will serve as a tool for the Working Group to use as part of its process for making concrete recommendations to the NIH Director on ways to improve diversity of the biomedical workforce.

The Role of Ripple Effect Communications, Inc.

Ripple Effect Communications, Inc. was engaged by the NIH Office of the Director to perform an analysis of the data received through the RFI. As an independent contractor, Ripple Effect staff is not invested in the ACD committee deliberations and therefore has no bias toward the outcomes of the assessment; however, Ripple Effect is uniquely positioned to bring a continuum of working knowledge and expertise about NIH to the analysis process. Our staff's diverse levels of knowledge about NIH allow an open interpretation of respondents' thoughts and ideas, which ensures full expression but also provides context for understanding potentially complicated messages.

Ripple Effect was established in 2006 to provide "Intelligent Project Management"™ to the Federal government and is often called upon to provide support in one or more of the following areas: Communications; Program & Policy; Technology; Conference & Events Management; Organization & Process Improvement; Research & Analysis; and Project Management. We assess, plan, manage, and execute projects that aid the government (with the current focus on increasing transparency) in transforming into a "people-centric, results-driven and forward-thinking" organization.

Methods

We engaged both quantitative and qualitative research methods as part of the analysis process. While focusing on and maintaining the integrity and structure of the issues identified by the Working Group, we remained open to the data. We used grounded theory data analysis methods to capture the ideas that were either pervasive enough to warrant their own code or went beyond the issues identified by the Working Group.

About the Data

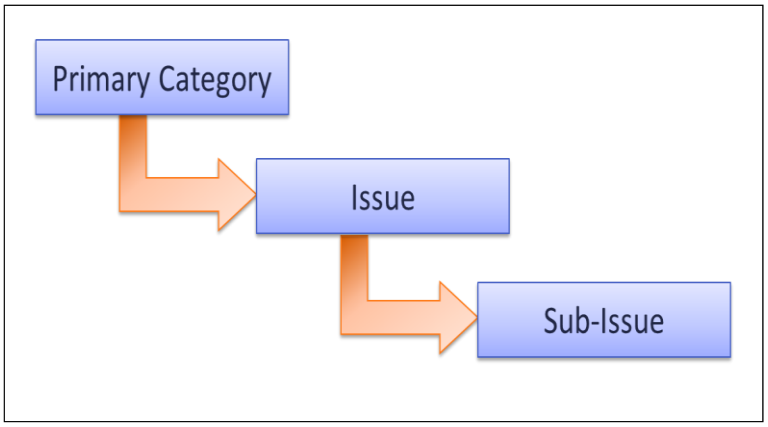
A total of 140 respondents provided feedback to the RFI; 134 through the online submission process (open January 10 through February 24, 2012) and 6 via email (late submissions that were included in the analysis). Most respondents, including 7 respondents with an NIH email or NIH identified organization, provided feedback from a self-reported individual perspective (self: n=96; 69%); others identified an organizational affiliation and were verified as responding on behalf of an organization (organization: n=44; 31%).

Analysis Process

All submissions were uploaded and organized into a central SharePoint database. The contents of a single respondent's submission (individual or organization) were parsed into multiple comments. The result was a data set of 547 comments, coded according to the Working Group issues and others that emerged from the data, and then analyzed using both SharePoint and Excel.

Code Development

Code development began using the two primary categories, six issues, and ten sub-issues identified by NIH as the conceptual foundation of the coding scheme. Team members further developed the coding scheme using an iterative, grounded theory approach, which involved studying the data, suggesting themes for inclusion, reviewing each other's code application, and resolving disagreements.



Conceptually, the codes that emerged from the data were all at the sub-issue level. In addition to the ten sub-issues identified by NIH, 14 others, referred to as "data-driven" codes, were developed and applied to the data. The final coding scheme included two primary categories, six Issues, and 24 sub-issues. Responses to one issue, *Influence of Role Models*, did not warrant

the development of sub-issues; those comments were coded at the issue level. In total, 25 "codes" were applied to the data (one issue and 24 sub-issues). The full coding scheme (including code descriptions) can be found in Appendix A; below is a table illustrating the conceptual levels and code names used throughout this report.

Primary Category	Issue	Sub-Issue
Biomedical Research Workforce Pipeline	Transition Points	Prior to Graduate School*
		Entry to Graduate School
		Postdoctoral Training
		First Independent Position
		First Funding Award
		Award of Tenure
		Leadership Appointments*
		Retention/Career Sustainability*
	Mentorship	Strengthen Relationships
		Create/Expand Programs
		Application Preparation
		Quality Mentorship Unavailable*
		Incentivize Mentoring*
		Alternative Mentoring Models*
	Influence of Role Models	None
	NIH Messaging	Improve/Enhance Communications*
		Improve Biomedical Career Image*
		Promote Value of Diversity*
	Institutional Support and Climate	Leadership Commitment and Education*
		Identify and Address Barriers*
		Minority Scientists Overburdened*
		Accessing Institutional Support*

Primary Category	Issue	Sub-Issue
Factors in the Review Process	Conscious and Unconscious Factors	Bias Against Applicants
		Review System Bias/Redress
		Diversify Study Sections*

*Data-driven sub-issues

Priority

To assess the priority of issues identified by each respondent, we created a sub-group of comments that met at least one of the following criteria:

1) The comment was included in response to Question 2, "Please identify and explain which of the issues you identified are, in your opinion, the *most important* for the Working Group to address and why."
2) The commenter explicitly expressed priority by using priority language, such as "critical," "important," or "essential," etc.

If no priority was indicated or if the commenter explicitly expressed that the item was NOT a priority, the comment was not included as part of the priority analysis.

Analysis was a straightforward count of the number of people who identified each issue and sub-issue as a priority. From the individual perspective, priority is presented as an order based on the frequency with which each person identified a code, not as a mathematical rank. Analysis of this sub-group is presented in Section Two of the Findings.

NIH Responsibility

To assess the role that respondents believed NIH should play in response to the issues identified in the RFI, we created a sub-group of all comments where individuals explicitly suggested an NIH responsibility or indicated that the issue fell under the purview of the NIH. Specifically, we included comments when at least one of the following criteria was met:

1) The comment was located in response to Question 3, "Please comment on any specific ways you believe these or other issues would or should affect NIH policies or processes."
2) The commenter specifically stated that NIH should be responsible.
3) The comment addressed an existing NIH program.

If the respondent explicitly expressed that the item should NOT be the responsibility or purview of NIH or the comment was general and did not explicitly state NIH responsibility, it was not included in the NIH responsibility analysis.

Analysis occurred in two steps. First, we compared the frequency distribution of all sub-issues identified as an NIH responsibility with the overall data set. Second, we reviewed all data for overarching themes that informed explicit recommendations for NIH. Analysis of this sub-group is presented in Section Three of the Findings.

Findings

Findings are divided into three sections that reflect different conceptual levels of analysis and respond to the questions posed in the RFI. The first section includes analysis in response to Question 1: "For any of the areas identified above and any other specific areas you believe are worthy of consideration by the Working Group, please identify the critical issues(s) and impact(s) on institutions, scientists, or both." This section provides a quantitative overview of the primary categories and issues, along with a quantitative distribution and a qualitative analysis of the 25 sub-issues.

The second section addresses Question 2: "Please identify and explain which of the issues you identified are, in your opinion, the most important for the Working Group to address and why." We coded and quantified the data for respondents that explicitly identified priority issues.

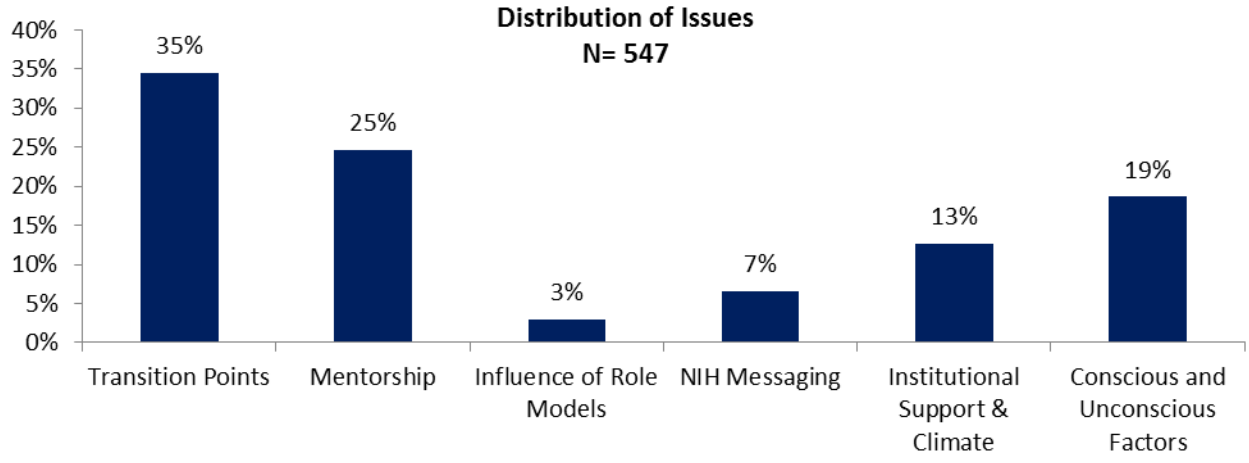
The third section includes a descriptive summary of the ideas commenters presented as relevant to Question 3: "Please comment on any specific ways you believe these or other issues would or should affect NIH policies or processes." We coded and quantified the comments that referred to specific recommendations for NIH.

Section ONE: Quantitative and Qualitative Analysis of critical issues

A total of 140 submissions were received and parsed into 547 comments; each comment received one code and was analyzed for frequency and content.

A Quantitative Overview of Primary Categories and Issues

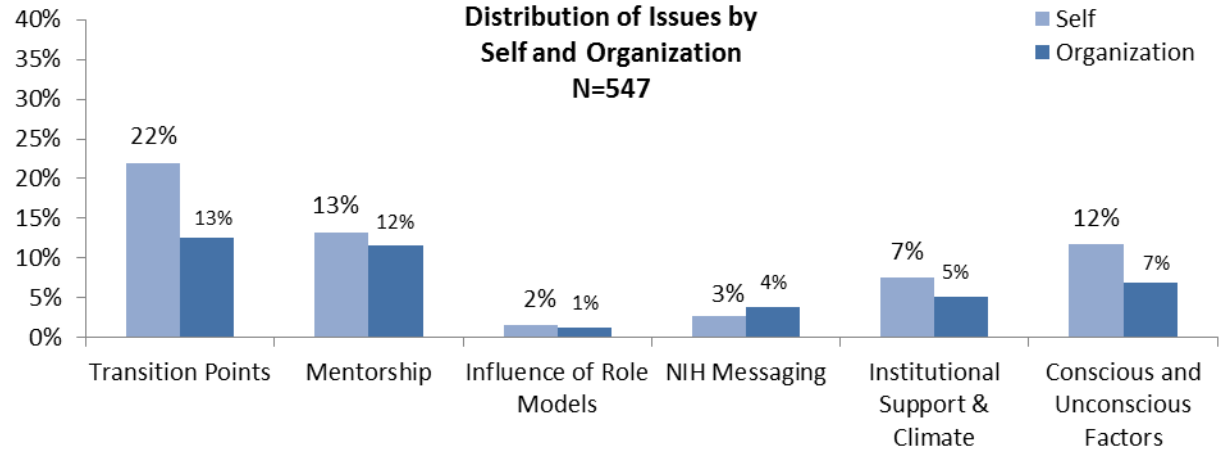
Of the two primary categories identified by NIH, respondents most frequently commented about the *Biomedical Research Workforce Pipeline* (81%). Across the board, *Transition Points* was the issue most frequently commented on (35%), followed by *Mentorship* (25%) and *Conscious and Unconscious Factors* (19%).



Biomedical Research Workforce Pipeline *Review Process*

Issues by Respondent Affiliation

Respondents were identified with one of two types of affiliation: as an independent individual (self) or on behalf of an organization (organization). Those who responded from a personal perspective commented more frequently than organizations about *Transition Points*, *Institutional Support and Climate*, and *Conscious and Unconscious Factors* in the review process. Those responding on behalf of an organization commented most frequently on *Transition Points* and *Mentorship*, and also provided more suggestions about *NIH Messaging* compared to those responding on their own behalf.

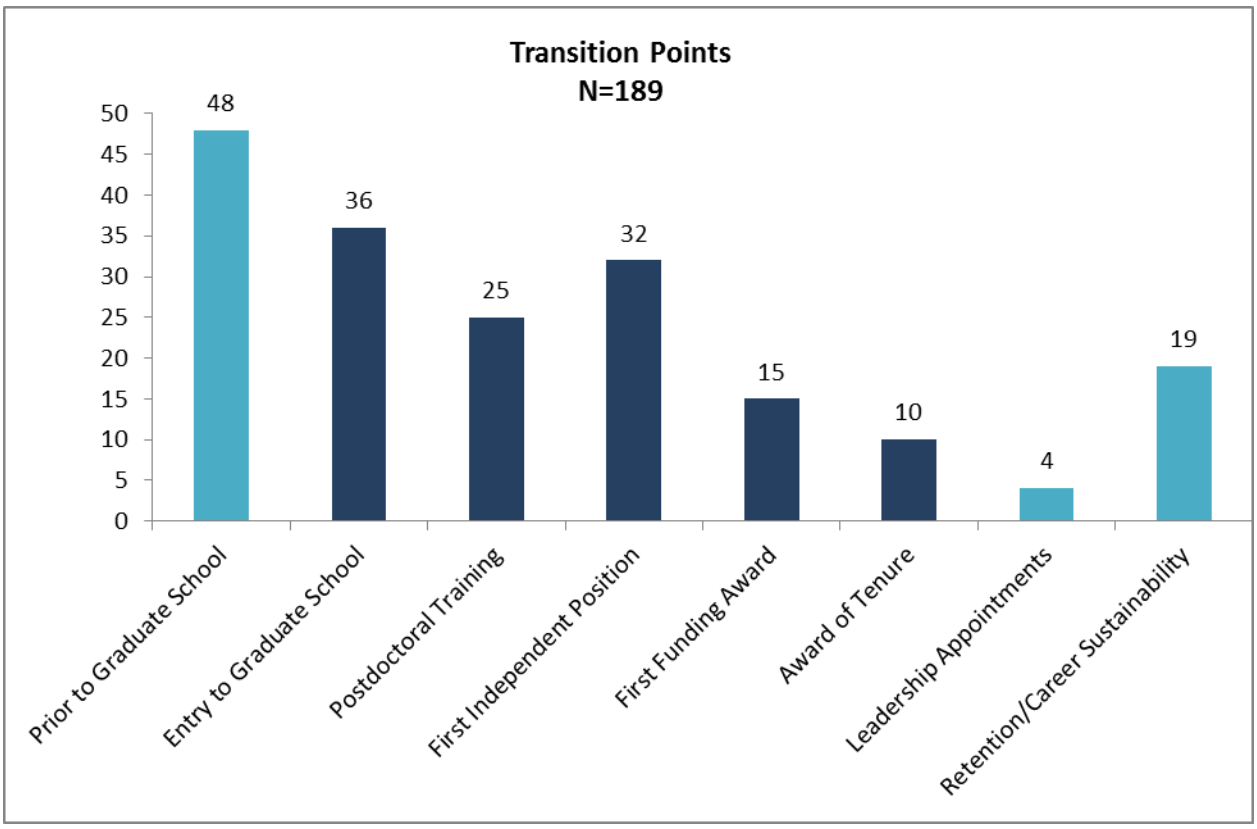


A Quantitative and Qualitative Analysis of Sub-Issues

The six issues and 24 sub-issues, as identified by NIH and derived from the data, are illustrated and discussed here in detail. A graph that summarizes the frequency distribution across all sub-issue is provided in Appendix B. Where relevant, the NIH-identified sub-issues are shown in blue, while data-driven sub-issues are shown in orange.

Issue One: Transition Points

The issue most salient to respondents was pipeline *Transition Points*. In addition to the five transition points outlined in the RFI, respondents noted three other important points related to priming the pump and maintaining the pipeline: *Prior to Graduate School* (K-12 and undergraduate); *Leadership Appointments*; and *Retention/Career Sustainability*. The majority of comments were concerned with the earlier points in the pipeline, up to and including the point of *First Independent Position*.



Prior to Graduate School

This sub-issue was most frequently coded within the Transition Points issue, accounting for approximately 25% of all comments on this issue. Prior to Graduate School captured comments about the importance of priming the pump before entry to graduate school. We divided this code into three categories: K-12, undergraduate, and both. Of the 48 comments that suggested early intervention, 14 believed that K-12 interventions were essential, 13 believed undergraduate interventions were sufficient, and 21 expressed that both stages required attention.

Respondents who highlighted K-12 voiced a critical need to not only strengthen K-12 Science, Technology, Engineering, and Mathematics (STEM) curricula, but also to enrich the early education experience with funded outreach programs and hands-on, mentored research experiences. Such programs were believed to energize younger students' passion for science and related careers. Respondents identified barriers for students in K-12, including fear, poor career guidance, and insufficient support systems. More attention and stronger instruction toward developing communication and critical thinking skills were noted as paramount for success.

A similar pattern was observed for those respondents that identified a need only for undergraduate interventions. Enhancing curricula was considered important; however, enrichment, mentoring, and external research opportunities, such as summer research

internships, were perceived as critical components to encourage more interest in the sciences at this stage. Increased awareness of the needs of first-generation college applicants and student members of minority and underserved groups was a common concern.

It was frequently suggested that enhancing relationships between minority-serving schools and larger research-intensive institutions would open doors for educators who have the potential to serve as early mentors. It was believed that efforts to "broaden the net" would help recruit students in educationally underserved or remote areas where college matriculation levels are low and college retention rates are even lower.

Entry to Graduate School

A disparate range of ideas were expressed about how to improve *Entry to Graduate School*, the second most frequently cited transition point. Overall, respondents agreed that there were many barriers to recruiting minorities into biomedical graduate programs. From a cultural perspective, racism was cited as a concern; several commenters worried that recent research findings, such as findings in Ginther et al.,[29] were deterring students at the earliest stages of the pipeline.
Individual barriers involved the perceived requirements and rewards of a career in science. Respondents described minority students as being family-oriented (which a career in science would interrupt) and financially burdened (which could both prevent and deter a career in science) in comparison to their non-minority peers. Also, some respondents suggested that many students believed careers in science were too difficult. An effort toward better educating underrepresented minorities at the undergraduate level regarding degree and career options, especially dual-degree programs, would help recruitment at this stage.

At the institutional level, respondents suggested that undergraduates who would bring diversity to programs needed greater mentoring and guidance to promote their matriculation into a graduate program. Providing underrepresented students with more active assistance, such as finding a graduate school, assisting with the application process, and helping to prepare for entrance exams, was considered another means to increasing the number of diverse students entering graduate programs. Successful admission to graduate school was also linked to extra-curricular research experiences, such as summer research programs and research fellowships. Respondents believed that if minorities and other groups underrepresented in science are to be competitive applicants for graduate school, they would need assistance locating, applying to, and successfully entering such enrichment experiences.

Postdoctoral Training

[29] Ginther DK, Schaffer WT, Schnell J, Masimore B, Liu F, Haak LL, Kington R. Race, ethnicity, and NIH research awards. Science. 2011 Aug 19;333(6045):1015-9. PubMed PMID: 21852498.

Comments regarding the transition to *Postdoctoral Training* varied, with different barriers and remedies identified. Some suggested an increase in the number of training grants awarded, others recommended that NIH should alter institutional requirements for new applications to allow less research-intensive institutions and minority-serving institutions access to these funds (potentially through collaborations). There was also a call for a significant shift away from institutional training grants to more individual-oriented funding structures, such as fellowship awards.

Again, career attraction was identified as a problem. Respondents suggested that postdoctoral researchers who would bring diversity to programs are in need of professional skills development, career guidance, and information outreach that would educate them on the postdoctoral application process and encourage retention in the field of research. Specifically, comments included suggestions for education on "soft skills," such as grant administration, lab set up, developing a teaching philosophy, mock interviews, and negotiating hiring contracts. Minority students were again characterized as being family-oriented, with strong geographical ties that made finding postdoctoral training positions challenging.

First Independent Position

In a job market where increased competition for fewer faculty appointments defines the environment, it was suggested that individuals who would bring diversity to an organization were either moving from one postdoctoral position to another and another, or busy seeking more secure or higher paying jobs in other related fields. To keep the pipeline flowing at the point of *First Independent Position*, respondents suggested that increases in early career and start-up funding would be needed to improve hiring for minority scientists. This was viewed as especially important in a competitive hiring environment that favors applicants who can bring their own funding to a new institution.

> *It might tip the balance in favor of interviewing someone who does not look like the rest of their faculty, and encourage a search committee to be a little more adventurous. NIH has supportive mechanisms for those under-represented in life science or STEM areas for undergraduate, graduates and postdocs. If one does not help in the next critical step, getting a job, it makes the preparative steps less than effective in changing the life sciences or STEM workforce. (#93)*

Loan forgiveness, higher salaries, and increased institutional support and resources (e.g., career guidance) were mentioned as possible methods or incentives to keep struggling trainees in the biomedical research workforce.

First Funding Award

A lack of available funding was perceived as part of the problem with achieving the *First Funding Award* stage (and the next stage) of the pipeline. One respondent described how

intricate the situation was and placed a lack of funding as the central problem that transcends a particular point along the pipeline.

> *For the majority of scientists of color that I know, we have become a group of migrant workers floating from institution to institution being "mentored" in temporary teaching/research programs where the host institution really has no intention of making a tenure track position available. After a while it becomes a catch-22, in my case my last NIH review said "We don't want to fund you because we would rather that you were in a tenure track position" and the institution said "we won't put you on the tenure track without funding." (#86)*

It was noted that diversity hiring initiatives have not been met with adequate mentoring and professional development; as such, hiring increases have not resulted in increased funding success for minority faculty. Giving these new researchers access to resources, such as further training (e.g., writing and grantsmanship skills) was cited as one way institutions could compensate for inadequate mentoring.
NIH programs, such as the Early Career Reviewer Program,[30] were touted as a quality resource. While respondents encouraged more programs that would provide first-hand experience with the grants process, they also called for investigating the grant preparation process (time spent, number of internal reviewers, type of mentorship) as a way to determine if institutional support may account for some of the bias affecting minority funding at this career stage.

Award of Tenure

Respondents generally agreed that traditional tenure policies are not in sync with the professional and personal lives of minority and underrepresented researchers. Consistently described as family-focused and service-oriented, minority and underrepresented researchers were perceived as having many commitments outside of their research and academic careers, which interfered with their ability to meet traditional definitions of success that would lead to *Award of Tenure*. Respondents believed that if the challenges of earning tenure are not addressed, improvements in diversity early in the pipeline will continue to be met with an insufficient pool of mentors. This paucity of mentors would remain an impediment to the success of future researchers entering the field.

Attainment of Leadership Appointments

A few respondents expressed concern that a lack of diversity at the level of *Leadership Appointments* was having an adverse trickle-down effect. Respondents agreed that a low numbers of minorities in leadership positions influenced the distribution of institutional resources and opportunities.

[30] http://public.csr.nih.gov/reviewerresources/becomeareviewer/pages/overview-of-ecr-program.aspx

> *The challenge at the senior scientist level is tremendously important as AA, women, etc. are not represented at the level of department chairs, society presidents, etc., so not only mentoring but distribution of resources and opportunities are often controlled by people from a narrow gender/ethnic background set. (#11)*

One respondent suggested that executive coaching and leadership training should be increased to support efforts to diversify the upper ranks.

Retention/Career Sustainability

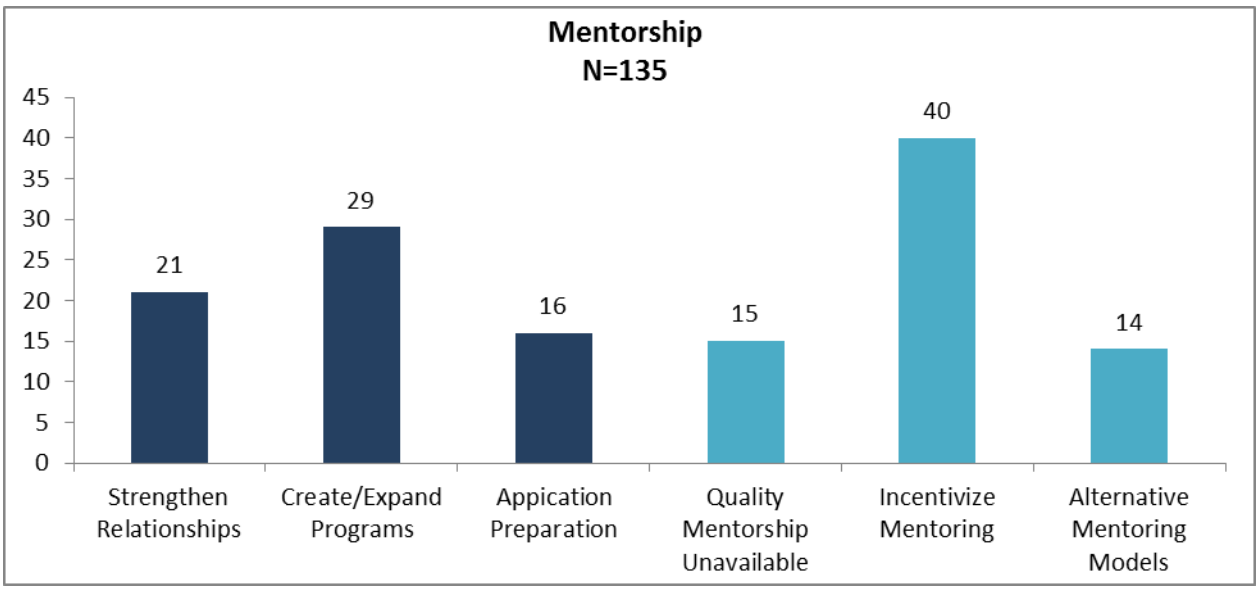
Attrition and long-term career sustainability emerged as an independent sub-issue. Respondents voiced concern for the sustainability of all current mid-career scientists, who often becomes disenfranchised in an increasingly competitive funding environment. Noting that competition may be tougher due to barriers facing investigators who would bring diversity to the field, respondents believed that improvements for all would result in positive change across the board.

> *Something has to be done to help people who are in the latter stage of their career but have lost funding. Young investigators are given a break. But if you do not have funding you are looked down upon because you lost your grant. It's a prejudice. (#40)*

Respondents were concerned that young minority or disadvantaged students were dissuaded by the funding environment and were opting for other career trajectories with better compensation and stability. A change in funding structures (e.g., more R01s and fewer institutional training grants) was suggested, as was more long-term funding stability. A few individuals commented that improvements to the funding environment as a whole would translate to improvements for all and would begin to attract and retain quality scientists of all backgrounds.

Issue Two: Mentorship

Mentorship was the second most frequently commented upon issue. Consensus emerged that effective and consistent mentorship was a key component for navigating the path toward success as a biomedical scientist, especially for members of underrepresented groups. In addition to the three sub-issues identified in the RFI, three other specific sub-issues were derived from the data: *Quality Mentorship Unavailable*, *Incentivize Mentoring*, and *Alternative Mentoring Models*.



Strengthen Relationships

In support of increasing the quality and amount of available mentors, respondents suggested that strengthening relationships between organizations would help in the development of more effective mentoring programs. Many of these comments requested that NIH improve its relationships with professional societies and other minority-serving organizations, specifically identifying many programs that might be valuable templates for future efforts. Respondents suggested that organizations were an excellent medium for pairing minority researchers with minority mentors.

> *Quality mentoring is essential to the advancement of a researcher's career. Researchers may not, however, be aware of specific needs or concerns of underrepresented minority or women scientists. NIH can help by identifying these concerns and challenges, providing guidance and resources tailored to these needs, and supporting society and institutional programs/efforts to address such concerns, potentially through grants or grant supplements to support programs which mentor underrepresented minority or women scientists at various stages of their career. (#90)*

There was also a call for increased collaborative mentoring between smaller and minority-serving institutions and major research institutions. One respondent elaborated on how such partnerships, if produced thoughtfully, could be symbiotic.

> *Clearly students benefit from their active participation in research and MSI faculty benefit from a higher level of professional activity, networking and access to state of the art facilities. This can ultimately help them secure independent funding. Equally important, scientists at major institutions benefit from the research skills of MSI faculty who are already highly trained in their fields. (#91)*

Such institutional collaborations could simultaneously bolster mentoring efforts for minority faculty and students at smaller and minority-serving institutions, while providing diversity of thought and training to larger institutions.

Create and Expand Programs

Dovetailing as a means to address how NIH might incentivize mentoring, respondents commented on the general need for the creation or expansion of mentoring programs at all academic levels, from K-12 to tenure track. Existing programs were described as having a positive, but minimal influence; restructuring and expanding was suggested as a means to increase a program's maximum potential for mentoring new scientists who can bring diversity to their field.

Respondents suggested that plans for creating or expanding mentoring programs should take into account three very important needs:

- Training of mentors, especially with respect to the needs of underrepresented and minority mentees
- Setting up long-term mentoring relationships
- Ensuring continuous evaluation of individual mentor/mentee relationships

Most comments favored increased NIH involvement, such as an expansion of diversity supplements, extensions on time limitedaward mechanisms such as the K24, or new funding mechanisms. NIH influence was also requested as a means for providing critical structure and monitoring that could lead to improvements in existing mentoring programs at research institutions.

> *Skilled mentors augment networking opportunities, steer mentees to opportunities for visible engagement with scientific colleagues, and advocate for a mentee's career advancement. The ACD working group should therefore consider a larger role for NIH in promoting, guiding and monitoring mentoring activities in NIH-supported research and programs with training components. This should include efforts to foster institutional mentorship training programs that embody institutional commitment to quality mentoring and emphasize the importance of workforce diversity. (#102)*

Overall, respondents agreed that the biomedical field needed more mentoring programs and that there was a critical need to restructure and refocus the programs that exist today.

Application Preparation

Although it was one of the less frequently identified sub-issues, mentoring through the *Application Preparation* process was believed to be a crucial provision by those respondents who mentioned it. At all application junctures, including initial applications, resubmissions, and renewal, it was believed that mentoring would improve the likelihood of persistence toward funding success. One respondent echoed the call for pre-submission mentoring programs that match new investigators with mentors who have proven grant writing experience.

> *Early critiques to potential applicants can mean the difference between receiving a career-altering grant and a discouraging denial that does not result in resubmission. Professional contacts and experienced advisors are a critical source of feedback at this juncture. Individuals underrepresented in the biomedical research workforce often lack the appropriate mentorship networks which provide a valuable leg-up in the application process. (#101)*

Interpreting summary statements and crafting application resubmissions was perceived as particularly important. Respondents believed that once underrepresented and minority researchers had transitioned to independent funding mechanisms, there would be less need for opportunities designed to enhance diversity.

Quality Mentorship Not Available

Respondents emphasized the lack of quality mentoring available to minorities and other underrepresented groups. Some pointed to the low number of minority mentors, while others complained about how inadequate available mentors were. A few offered personal stories about how a lack of quality mentorship continued to affect them.

> *There is a lack of properly mentoring minority Ph.D.s by their advisors. Many postdocs and junior faculty do not "learn the ropes" from their immediate supervisor, and they are not pointed in the right direction. My dissertation advisor was useless in helping locate a good lab and as a junior faculty member, no one took the time to introduce me to the inner workings of NIH, nor did anyone suggest I be a reviewer. Therein lies the difference in my career path and ability to obtain funding. (#18)*

Consensus among respondents was that minorities, already at a disadvantage, were more negatively affected by the lack of quality mentoring than were members of the majority group. Some respondents emphasized the importance of increasing the number of quality mentors from minority and underrepresented groups; others felt that this was less important than improving the quality of all mentors and ensuring sensitivity to the needs of minority and underrepresented mentees. Most respondents agreed that any attempts to improve mentoring would likely have a broad, positive effect on the workforce, which would not be limited to improving diversity.

Incentivize Mentoring

Mentorship is an important activity. The most frequently offered solutions for improving the number and quality of mentors available was to *Incentivize Mentoring* and to increase accountability. Respondents suggested that efforts should be made to ensure institutions and training programs are adequately investing in the success of their trainees. One respondent explained that in the absence of institutional oversight, mentoring had become "an individually-driven ad hoc activity that relies on the readiness and interest of the trainee," rather than a reliably supportive environment. The suggestion was made that NIH should provide a mentoring rubric at major funding milestones, including initial applications as well as competitive and non-competitive renewals.

> *NIH should be asking and mandating the Federally-funded investigators to train and mentor young impressionable budding scientists from all racial/ethnic/geopolitical/ disadvantaged/vulnerable populations/groups as a requirement for their R01 projects and it should be made a review criteria. (#13)*

Equally as important, however, respondents encouraged NIH to reward quality mentoring and provide mentors, especially those who are minorities themselves, with adequate support to carry out mentoring activities.

Alternative Mentorship Models

Several respondents noted the value of *Alternative Mentoring Models*, which they believed could either replace or augment more traditional one-on-one mentoring relationships. Mentoring groups were commonly recommended, such as peer group mentoring or multi-institutional faculty mentoring teams. In either case, respondents believed that team-based mentoring would provide depth and breadth for the mentee experience, while alleviating mentoring burdens for minority mentors who are in high demand. Another high-impact model suggested was the continuation and expansion of mentoring seminars. Respondents supported seminars for their potential to provide excellent mentoring without extensive long-term commitments or burdens on invited mentors.

Issue Three: Influence of Role Models

The lowest number of comments came in reference to the issue of *Influence of Role Models*. Just 16 comments (3% of the overall number of comments coded) referred to the paucity of diversity in those who hold positions of senior leadership. Those who commented on this issue stressed the need to build a critical mass of role models who could inspire young members of disadvantaged groups at all stages of their educational and career development. As a pipeline issue, one respondent suggested a shift in funding priorities away from earlier stages.

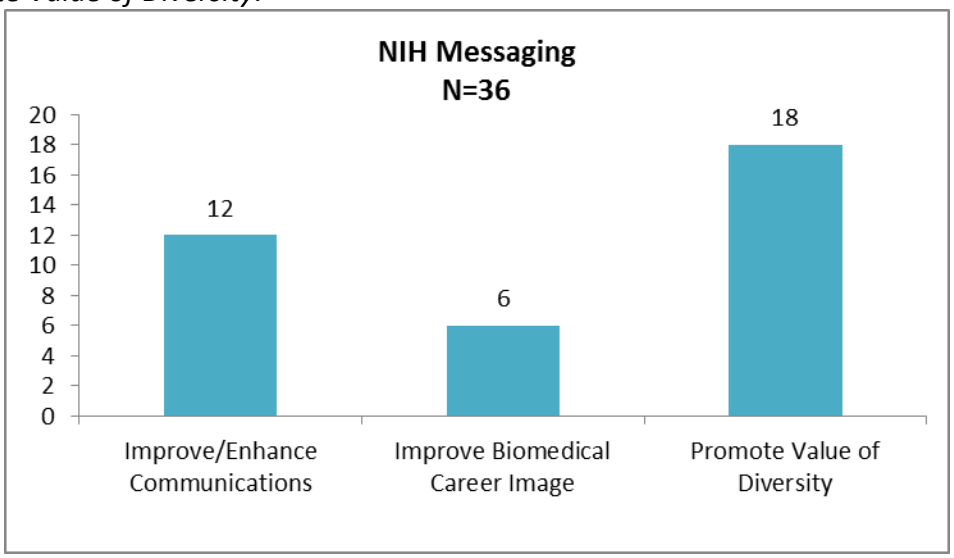
> *Supporting minorities at the postdoctoral levels and beyond is likely to have a greater impact than the current strategy for pre-doctoral training because it would maximize the chance that senior minority faculty would be generated to serve as role models for younger scientists. (#53)*

Role models from underrepresented groups were valued by respondents for their potential to demonstrate to aspiring young people from various walks of life that a career as a scientist was not only possible but rewarding.

Issue Four: NIH Messaging

In order to encourage underrepresented researchers to apply for NIH fellowships and grants, respondents believed a continuum of efforts was required. Comments generally related to the broader idea that NIH should use its voice to demonstrate commitment to diversity. Through NIH policies and communications, the message should be clear that contributions from minority

investigators are valued and an integral part of the overall whole. *NIH Messaging* includes three data-driven sub-issues: *Improve/Enhance Communications*, *Improve Biomedical Career Image,* and *Promote Value of Diversity.*



Improve/Enhance Communications

Respondents had several ideas about how NIH could improve or enhance existing communications efforts. Not only did respondents ask NIH to improve the lines of communication through more targeted messaging to reach intended groups, they also suggested NIH start asking for direct input from members of diverse groups. Several respondents from racial and ethnic minority groups mentioned they were disappointed that they had not been asked for their thoughts or opinions about their experiences with NIH programs or their ideas for improving the system.

> *One thing disappointingly absent from the NIH's deliberations and comments on this matter is the thought that perhaps interviews with successful and unsuccessful applicants from underrepresented groups would lead to new insights. Not just findings from the most successful and established people who happen to be African-American, but those who have struggled to get funded…or may never have been able to acquire funding. Ask them what they have been doing. How many applications submitted? How many revisions? What breadth of proposals have they made? Etc. And to then see how those behaviors compare to the more successful applicants. (#8)*

In reference to improving communications related to the review process, one respondent pointed to the importance of considering the sociocultural context of the recipient when providing feedback to grant applicants.

> *It may be possible to cushion the emotional and psychological blow of receiving a summary statement by providing less experienced investigators with guidance on how to receive, interpret, and react to scores and summary statements. This*

> *could be provided in the form of (1) an email message from SROs that is sent to all minority, new and early stage applicants ahead of the posting of their summary statements, (2) creation of a video similar to the "NIH Tips for Applicants" on the NIH website that features more experienced and/or minority researchers who have been successful in securing NIH funding, and/or (3) presentations and discussion at national meetings attended by minority, new, and early stage researchers. (#96)*

Improving the content of what is communicated, the style with which it is communicated, and the method of dissemination were all identified as crucial elements of NIH diversity efforts.

Improve Biomedical Career Image

A handful of respondents suggested that NIH should extoll the advantages of a biomedical research career to show those who are considering this life path that the benefits outweigh the obstacles.

> *Execute a national public awareness campaign that highlights the appeal of becoming a biomedical scientist and the importance of diversity in the research workforce. Several institutions suggested NIH could increase publicity regarding their workforce diversity programs, including profiles of successful and diverse graduates. The positive attention may help to combat the cynicism regarding a career in biomedical research that leads many high-ability undergraduate students to choose other options. (#110)*

While improving the image of biomedical careers was important, there was also some caution voiced by the few respondents whose comments were assigned this code: Efforts to promote biomedical careers should not undermine realistic expectations of the challenges presented by a successful research career.

Promote Value of Diversity

Half of the respondent comments on this issue suggested that NIH actively promote the value of a diversified biomedical workforce. Respondents suggested that progress toward creating a diversified workforce required that NIH use its considerable voice to demonstrate that diversity is highly valued and has tangible benefits. It was suggested that NIH promote the value of diversity by engaging in general awareness campaigns.

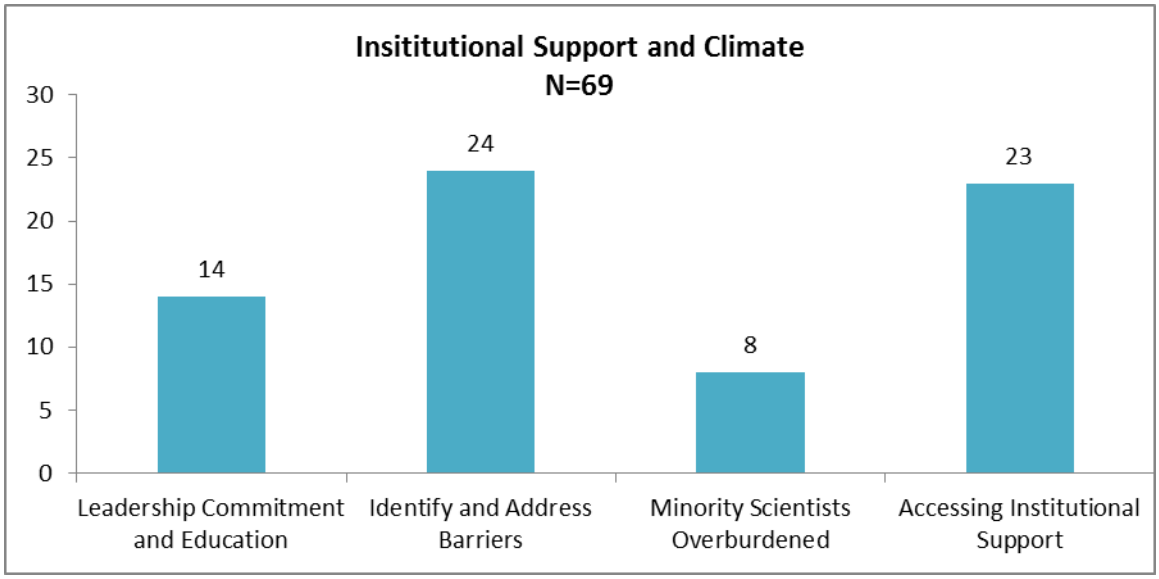
> *If individuals perceive that their own ethnic backgrounds are underrepresented, they may interpret this as a sign of exclusion, and this could deter them from pursuing a research career. NIH should strive to represent a diverse research training environment and workforce that includes ethic and racial minorities, women, and people with disabilities in all of its public outreach materials as well as on NIH committees and panels. (#204)*

One specific idea suggested that NIH develop a campaign to encourage major research institutions and undergraduate minority-serving institutions to forge partnerships that would ideally result in an increased number of minority supplements awarded to R01 investigators. Also, in order to build trust with members of groups that had been mistreated in the past (e.g., Tuskegee and Guatemala experiments), another respondent suggested NIH demonstrate that it is an ethical and compassionate organization that is redressing bias.

Issue Five: Institutional Support and Climate

The majority of comments on *Institutional Support and Climate* referred specifically to university environments. Comments included remarks related to departmental structure and support, resource allocation, and institutional culture and climate. Recurring themes related to the importance of inclusion, creating a safe environment for researchers who would bring diversity to their institution, and providing adequate access to resources and support. Respondents called for greater commitment to diversity from university leadership with a commitment to institutional reform.

Four data-driven sub-issues in the *Institutional Support and Climate* issue include *Identify and Address Barriers*, *Accessing Institutional Support*, *Leadership Commitment and Education*, and *Minority Scientists Overburdened.*



Leadership Commitment and Education

Respondents called on NIH to use its considerable influence and encourage increased *Leadership Commitment and Education* at the institutional level. Responding on behalf of an organization, this individual highlighted the importance of leadership and suggested collaboration as a means to achieve institutional leadership commitment.

> *Engage more deeply with university presidents, provosts, and research leaders in supporting efforts to create a more diverse biomedical workforce. Presidential leadership and institutional commitment is an essential precondition for NIH programs to be effective. Institutional leaders play a pivotal role in prioritizing diversity, and establishing an environment that is conducive for mentoring and the success of under-represented students and junior faculty on their campuses. Associations like USU and APLU can be key resources in working with NIH to foster greater awareness and implementation of best practices. (#110)*

Respondents suggested NIH could either lead by example or provide incentives and resources, such as diversity training and cultural competence education. The end result was hoped to be improved communication among groups, the fostering of collaboration over competition, and the creation of less hostile, more understanding environments that would then reflect that diversity is valued and understood. Respondents described campus and workplace environments where prejudice, slurs, and other conscious and unconscious biases persisted in the teaching materials, methods, and dominant culture. Education and training were perceived as an integral part of the solution toward removing experiences that would be insulting to diverse populations.

Identify and Address Barriers

Identifying, evaluating, and addressing environmental barriers to success was the most frequently coded sub-issue, accounting for 35% of comments on this issue. Respondents voiced concern about harsh working environments, which they described in terms of institutionalized prejudice, exclusion and isolation of minorities, and nepotism. Such displays of insensitivity, hostility, and ignorance toward minorities were perceived as barriers not experienced or, in some cases even recognized, by the dominant culture. One respondent noted that "daily insults, emotional stress, and distractions that non-minority students never have to face" had the potential to limit personal career aspirations and negatively impacted the success of diverse researchers.

Acknowledging the challenges of effecting change at the institutional level, this respondent emphasized that such efforts were greatly needed to promote diversity in the biomedical workforce.

> *It will be very tempting for the Working Group to spend most of its effort on the "pipeline" and "mentoring" aspects of this important U.S. scientific workforce issue. These focus areas are important, and they are easier to address in many social and political respects; but they tend to focus the solutions on perceived deficiencies in minority scientists instead of on the barriers they face as a consequence of racism in America. If the Working Group will balance their attention to strategies for identifying and reducing barriers due to racism, unfair conscious discrimination, and unfair bias, which minority scientists face at their home institutions and in the NIH review process, they will do America a great service.(#64)*

Isolation and exclusion were dominant themes in comments on this sub-issue. Respondents referred to the research environment as "chilly" and unwelcoming to minority trainees and

researchers. In the absence of a critical mass of underrepresented individuals, a sense of vulnerability to discrimination was described. Some respondents shared experiences in which their concerns were left unaddressed or disregarded, even after being brought to the attention of institutional leadership. As a result, respondents believed that it was not enough to simply increase quantifiable markers of diversity; real change could only occur when inclusion of minorities became a top priority.

Minority Scientists Overburdened

A common concern of both self-identified underrepresented researchers and other respondents was the demand for underrepresented researchers' time toward institutional efforts at improving diversity, i.e., *Minority Scientists Overburdened*. Institutional obligations, such as mentoring, participating on committees, and presenting at non-scientific meetings, take time away from research and thus can adversely influence career advancement. Respondents suggested protected time for institutional activities, especially those where minority representation was highly valued, or rewards so their participation would not impede their professional career.

Accessing Institutional Support

Identified almost as frequently as identifying and addressing barriers was *Accessing Institutional Support*, i.e., resources to support research, such as grant writing workshops, administrative support, and protected time. Some respondents highlighted the value of institutional "bridge funding" or "seed funding" – funding that would alleviate some of the financial stress or pressure felt as a result of the current funding environment. One respondent highlighted the importance of departmental support, particularly financial assistance.

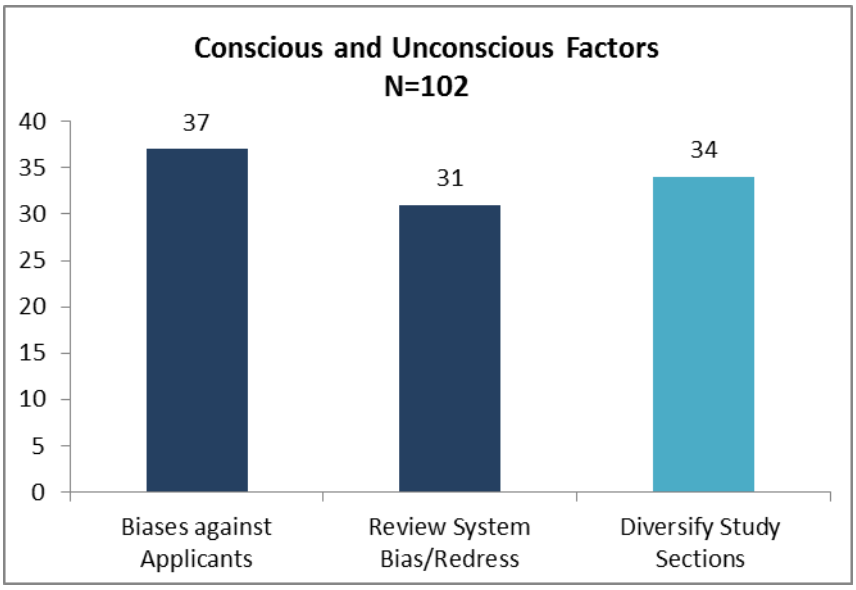
> *Support from the faculty member's department chair and research chair is critical. This support may take the form of providing episodic bridge funding to cover research time until grant monies pay for all of the protected time for research, sharing examples of successful grant applications, and supporting time to attend professional development conferences. (#58)*

Respondents noted that while institutions may provide ample support to underrepresented researchers, they still may fail to produce results because of poor institutional structure and organization. Respondents described overlapping or duplicative programs that targeted and recruited the same group of underrepresented individuals. It was suggested that NIH could help to identify and eliminate this overlap.

As a more specific institutional issue, respondents described an "uneven playing field" between minority-serving institutions and other small, less well-funded institutes compared to larger, well-funded research-intensive institutions. While dealing with reduced infrastructure and higher teaching workloads, faculty struggle to get access to resources. As a means to achieve better equity among institutions, respondents suggested that NIH recognize, encourage, and reward cross-institutional resource sharing and collaboration.

Issue Six: Conscious and Unconscious Factors

In order to adequately capture the nuances identified by *Conscious and Unconscious Factors*: "The potential role of institutional affiliation, academic pedigree, and various conscious and unconscious factors on review outcomes," we reorganized the language of the original RFI. Due to the frequency with which institutional affiliation and academic pedigree appeared concurrently with concerns about race and gender, we removed those biases from the broader definition of the issue and included them at the sub-issue level with all of the other potential biases identified in the RFI. In total, there were three sub-issues identified as part of the issue, *Conscious and Unconscious Factors*: *Bias Against Applicants*, *Review System Bias/Redress*, and *Diversify Study Sections*.



Biases Against Applicants

Respondents relayed concerns that conscious and unconscious *Bias Against Applicants* were influencing the success rates of diverse grant applicants. The table below provides tallies (the number in parenthesis) for the specific biases that were mentioned as concerns. Biases listed on the left were identified as part of the RFI; biases listed in the right hand column were additional biases identified by respondents.

Biases identified in RFI	Biases identified by respondents
• Race (15) • Ethnicity (6) • Gender (8) • Affinity (0) • Institutional affiliation (9) • Academic pedigree* (14)	• Age (2) • Research focus/discipline (6) • Communication style (2) • Professional/social network (8)

**Academic pedigree included education, professional credentialing, and productivity.*

Race, academic pedigree, and institutional affiliation were the most frequently identified biases of concern. One respondent referred to academic pedigree and institutional affiliation as creating "invisible endorsements" that result in a "halo effect."

Review System Bias/Redress

Review System Bias captured comments that identified ways in which the review system itself may be resulting in funding disparities. For example, respondents requested further exploration of the following aspects of the review process:

- Availability of information that identifies applicant characteristics (e.g., the biosketch)
- Evaluation criteria
- Determinations of which applications will be discussed or not discussed
- Recent policy change decreasing the allowed number of resubmissions

Respondents were divided on the suggestion to improve applicant anonymity. Biosketches and similar applicant descriptions provide many contextual clues about applicant demographics (e.g., race and gender); some respondents felt this type of information must be unavailable to reviewers, while others believed academic and institutional information were essential for determining the applicant's fitness to conduct the proposed research. A two-stage or two-tier system was suggested as a compromise, where scientific merit would be assessed first, *without* knowledge of applicant history or characteristics.

To redress bias, three main ideas emerged from respondents: greater transparency and accountability in the review process, training, and post-review support. To provide greater transparency and accountability, respondents called for increased monitoring of the review process to expose disparities in applicant scoring and funding success; as part of the process, respondents asked for the data to be distributed to study section members and the public. Another suggestion was to provide scoring advantages, based on diversity-related criteria, to address scoring disparities.

Training efforts were a frequently suggested means for redressing bias in the review process. The most common suggestion was reviewer training related to the influence of conscious and unconscious bias. There was also a call for training efforts that would include guidance to SROs and reviewers on how to address bias when it becomes apparent during a review. Other types of suggested training included: diversity training that would sensitize reviewers to different communication styles, and training that would facilitate legitimate evaluation of scientific approaches or methods unfamiliar to reviewers.

Post-review support for minority and underrepresented applicants was another means reviewers suggested for redressing bias. Respondents noted that researchers from underrepresented groups are more likely to internalize negative comments from reviewers as personal shortcomings, which could deter resubmissions.

> *While the structure of summary statements must remain uniform across investigators, perhaps targeted supplemental messages can be sent to minority, new, and early stage investigators to (1) prepare them for the experience of receiving a summary statement and (2) to help investigators to digest their summary statements in a way that increases the likelihood that they will revise and resubmit their applications. (#96)*

While respondents offered different ideas about which aspects of the review process produced the most disparity in funding success, there was consensus that the process itself was not designed to promote diversity.

Diversify Study Sections

The need to *Diversify Study Sections* was an idea that warranted individual coding and independent analysis. Several respondents expressed dissatisfaction with the reviewer selection process, noting that the current criteria for becoming a peer reviewer overemphasize funding success, publication productivity, academic rank, and the influence of a researcher's social and professional network. Combined, the outcome of these factors was low diversity among peer reviewers and a reinforcement of barriers for researchers to reach these traditional markers of professional achievement. Citing the documented success related to becoming an NIH reviewer, respondents suggested that increased diversity among peer reviewers could increase the overall success rates of scientists belonging to underrepresented groups.

Another concern resulting from low study section diversity included voice imbalance between senior and junior reviewers. This imbalance of power was explained as senior scientists exerting authority and power over the review discussion, giving little regard to the views of minority and junior reviewers. Referred to as "low diversity of thought," respondents believed this could create a collective bias.

> *A more diverse group may prioritize disease prevention over drug development or collaboration over competition. They might value steady progress towards addressing neglected health problems and community impact over perceived "great leaps" on the "hot topics" of the moment. The benefits of cultivating diversity include, presumably, diversification of what science is done, who benefits, and what impact it brings to the American public. (#77)*

Collectively, respondents believed that low diversity among peer reviewers was resulting in low funding rates for diverse researchers and minority health-related research.

Section TWO: Priority Issues

Respondents generally recognized the challenges inherent with diversifying the biomedical workforce. While it was rare for respondents to rank the order of the issues and sub-issues they identified as priorities, a few respondents articulated a reluctance to suggest priority, noting that all issues were important, with some easier to correct. Most commonly, respondents provided a short paragraph or two identifying the issues they felt were most important.

The frequencies presented in this section are different than the numbers represented throughout the rest of this report. To give the Working Group an idea of how many people identified which issues and sub-issues were a priority, we have presented this data from the individual perspective (as opposed to code application frequencies, which represent the total number of comments that received a particular code). Of the 140 respondents who provided feedback to this RFI, 105 (75%) identified at least one priority sub-issue.

Priority of Issues

The distribution of issues based on priority criteria matches the distribution of issues found in the overall comment analysis in Section One. *Transition Points*, *Mentorship*, and *Conscious and Unconscious Factors* were identified as the three most important issues, followed by *Institutional Support and Climate*, *NIH Messaging*, and the *Influence of Role Models*.

Order of Priority by Issue	Number of Respondents (n=105)
Transition Points	60

Order of Priority by Issue	Number of Respondents (n=105)
Mentorship	47
Conscious and Unconscious Factors	32
Institutional Support and Climate	25
NIH Messaging	12
Influence of Role Models	8

When comparing the order of priority issues by respondent affiliation (e.g., self or organization), the issues followed the same order, but at the sub-issue level, affiliation made a difference.

Priority of Sub-Issues

A breakdown of the top ten sub-issues for self and organization is provided below; a complete list of prioritized sub-issues by affiliation is provided in Appendix C. Priority order was established based on the total number of respondents that expressed priority for each sub-issue.

Priority of Sub-Issues: Self

Those who reported from their own individual perspective expressed greatest priority for two transition points: *Prior to Graduate School* and transition to *First Independent Position*. *Biases Against Applicants* was prioritized third in the order of sub-issues; *Create/Expand Programs*, *Incentivize Mentoring,* and *Quality Mentorship Unavailable* were also top priorities for individuals. This group next assigned priority to the pipeline points of *Entry to Graduate School* and *Retention/Career Sustainability*.

Self (n=76)

Issue	Order of Priority by Sub-issue	Number of Respondents	Priority
Transition Points	Prior to Graduate School	20	1
	First Independent Position	14	2
Conscious and Unconscious Factors	Biases against Applicants	13	3
Mentorship	Create/Expand Programs	11	4
	Incentivize Mentoring	9	5
	Quality Mentorship Unavailable	9	6
Transition Points	Entry to Graduate School	8	7
	Retention/Career Sustainability	8	8
Institutional Support and Climate	Accessing Institutional Support	8	9
Conscious and Unconscious Factors	Diversify Study Sections	8	10

Individuals prioritized three sub-issues that were not identified in the top-ten priority order for organizations: *First Independent Position*, *Entry to Graduate School*, and *Retention/Career Sustainability*.

Priority of Sub-Issues: Organization

Individuals who provided feedback from their organizational perspective also placed greatest priority on the *Prior to Graduate School* sub-issue within *Transition Points*. However, the next four sub-issues came from the *Mentorship* issue; specifically, organizations prioritized in descending order the following sub-issues: *Strengthen Relationships*, *Create/Expand Programs*, *Incentivize Mentoring*, and *Quality Mentorship Unavailable*. Organizations prioritized *Influence of Role Models* and *Promote Value of Diversity* next; neither of these sub-issues was a top-ten priority for individual respondents. Finally, respondents providing an organizational perspective prioritized two *Conscious and Unconscious Factors* sub-issues: *Bias against Applicants* and *Diversify Study Sections*.

Organization (N=29)

Issue	Order of Priority by Sub-issue	Number of Respondents	Priority
Transition Points	Prior to Graduate School	7	1
Mentorship	Strengthen Relationships	6	2
	Create/Expand Programs	6	3
	Incentivize Mentoring	6	4
	Quality Mentorship Unavailable	5	5
Influence of Role Models	Influence of Role Models	5	6
NIH Messaging	Promote Value of Diversity	5	7
Institutional Support and Climate	Accessing Institutional Support	5	8
Conscious and Unconscious Factors	Biases against Applicants	5	9
	Diversify Study Sections	5	10

Organizations prioritized three sub-issues that were not identified in the top-ten priority order for individuals: *Strengthen Relationships* (*Mentorship*), *Influence of Role Models*, and *Promote Value of Diversity.*

Section THREE: Respondent Recommendations

Our analysis for this section involved two approaches. The first approach was to compare code frequency distributions across the entire dataset with the subset of data created to represent specific ideas for NIH. The second approach involved qualitative analysis of the subset of data to identify common themes that permeated across respondent suggestions.

Code Frequency Comparison

Comparing the distribution of issues between the total data set and the subset of NIH Responsibility revealed subtle differences. *Transition Points* was identified most frequently across both data sets and the *Influence of Role Models* was least identified, but the order of frequency distribution of the middle four issues differed. The *Conscious and Unconscious Factors in the Review Process* was the second most frequently-identified issue for NIH to address, followed by *Mentorship*, *NIH Messaging*, and then *Institutional Support and Climate*. The table below illustrates the overall order of frequencies for both groups.

NIH Responsibility Sub-Set	Total Data Set
Transition Points	Transition Points
Conscious and Unconscious Factors	Mentorship
Mentorship	Conscious and Unconscious Factors
NIH Messaging	Institutional Support and Climate
Institutional Support and Climate	NIH Messaging
Influence of Role Models	Influence of Role Models

Qualitative Themes

A number of specific suggestions were presented throughout Section One; in this section, we analyze the subset of NIH Responsibility data to present a more holistic view of respondent recommendations.

Accurate Understanding

To adequately address diversity-related challenges, respondents suggested that NIH must better understand the current situation and the issues preventing diversification of the biomedical workforce.

Conduct More Research

Findings from the previously-cited Ginther et al. (2011) article were criticized, with respondents describing the approach and data as limited in scope and inadequate for capturing an accurate picture of the current situation. Comments included suggestions for more granular analyses. For example, there was concern that data claiming to represent women may not be indicative of the challenges faced by women of ethnic minorities. Similarly, data claiming to provide insight into the Latino community was criticized, with a call for further disaggregated data to allow a better understanding of the differences between smaller groups within that community.

Research was also called for as a way to better understand where the “bottlenecks in the pipeline” actually are and to better understand the sources that create barriers to success. Armed with a more accurate understanding of the situation, respondents believed NIH would be better able to make meaningful improvements to diversity efforts.

Evaluation and Continued Monitoring

Respondents urged NIH to embark on a series of self-evaluations, suggesting that NIH conduct investigations to determine where the NIH systems, programs, or funding criteria may be preventing diversity candidates from entering the field. For example, the biosketch was perceived as a structural impediment to success even before the grant application was received by the Center for Scientific Review. While it was common for respondents to call for more program support or more funding, the deeper message was to provide more support and funding only to those programs and funding mechanisms that are working.

Respondents also suggested carefully monitoring NIH efforts toward creating diversity in the biomedical workforce. Noting that programs should have measurable indices for success,

respondents asked that NIH ensure consistent and meaningful monitoring to ensure program goals are met.

> *The success of these NIH programs should be reevaluated and redefined to ensure that the measurement of achievement includes quantifiable outcomes such as how many URM research applicants actually receive grant funding at the next level and the period of time taken to do so. (#203)*

Some respondents suggested NIH require institutes and centers, grantee institutions, and independent awardees to track, report, and improve success rates for underrepresented investigators; others suggested the NIH Office of the Director should be responsible for monitoring. A small group felt the National Institute on Minority Health and Health Disparities should be expanded, giving it oversight and monitoring authority with respect to diversity initiatives.

A specific idea related to monitoring and ensuring quality training outcomes was for NIH to develop and require a set of core competencies that all postdoctoral researchers would be expected to achieve. Respondents believed that requiring skills that go beyond the traditional expectations, especially "soft skills," e.g., grantsmanship, would level the playing field by strengthening the postdoctoral experience and adequately preparing them to compete at higher career levels.

Respondents were concerned that if NIH continued to fund programs without an accurate understanding of the problems and possible solutions, and without raising the bar and setting new standards for excellence, then students and trainees would be pushed along the pipeline into situations where they would be unable to meet new challenges. Without adequate training, mentoring, and professional development, respondents expected that the pipeline will remain leaky.

Improve, Expand, and Add New Diversity Funding Opportunities

The struggle to acquire funding was perceived as greater for individuals that would bring diversity to the field, resulting in attrition at all career stages. At the front end of the pipeline, students and trainees were described as reticent to begin scientific careers, particularly in light of evidence that suggested minorities fight an uphill battle. Further along the pipeline, severe competition and little support were blamed for junior and mid-career investigators' choices to seek alternative careers. To combat attrition, respondents suggested better support for individual grantees and institutions through improvements and expansion of current efforts and the creation of new diversity initiatives.

Support Individuals

At the individual level, respondents suggested that NIH improve current funding awards and expand or create new ones. Unhappy with the current balance between individual and institutional awards, some respondents suggested that NIH shift some of the institutional funding in favor of individual awards, such as individual fellowships, K-awards, and R01s. Respondents also voiced favor for the diversity supplements and called for their expansion; however, several noted the application process should be streamlined so the program could be more effective.

> *From my experience and that of other investigators, obtaining these supplements can take 9 months-one year, such that the term of support is usually greatly reduced by the time it is awarded. Moreover, one cannot get a supplement if you*

> *happen to already have that minority student in your lab being supported by your NIH grant. The impracticality of not being able to support a minority student off of your research grants while you wait one year for the supplement makes this type of mechanism of limited utility. (#33)*

Other changes included a call for increased funding for protected time to cover clinical and teaching responsibilities. This was especially important when respondents expressed concern about finding ways to compensate faculty for time spent mentoring minority and underrepresented trainees. Respondents also suggested that protected time was more important for faculty at institutions with the greatest likelihood of impacting diversity, such as minority-serving institutions where teaching loads are high. Also for that group, there was a call for an expansion of smaller, short-term forms of funding, such as funds to hire summer research assistants or interns.

Further, suggestions for encouraging more applications from individual minority and underrepresented scientists included: 1) providing incentives, such as score advantages to minority applicants, 2) extending privileges, such as involvement with the Early Stage Investigator program, and 3) requiring ICs to adopt minimum quotas or proportions for funding investigators that would bring diversity to the ranks of NIH-funded scientists.

Support Institutions

Overall, respondents indicated that institutions needed more funding and support to successfully execute diversity initiatives. To address the early pipeline issues, respondents called for increased funding for hands-on research experiences for K-12 and undergraduate students interested in pursuing science careers. At the upper levels, student recruitment, enrichment activities and programs, professional development, and mentoring were most frequently mentioned as efforts in need of financial support. The following respondent suggested that NIH help fund a "diversity center."

> *Institutions with strong NIH support and training records could become centers for diversity where the focus is broad education about overt bias and passive racial micro aggression that involve students, faculty, and even staff of the grantee institutions. I think this will increase the number of minority students in scientifically rich training environments and will facilitate structural changes to those environments that remove the kind of racial bias and microaggression that makes it difficult for minority students to focus on their scientific learning and to remain interested in joining the scientific workforce (#30).*

At institutions with training programs, some respondents described a struggle to make their Diversity Recruitment and Retention Plans practicable and successful. Expanding funding and providing flexibility with the allocation of training funds was a recurring request that, if satisfied, would enable programs to provide full tuition support to trainees and cover salaries for program support staff. Respondents agreed that the absence of funds in these areas makes it difficult for training programs to reach diversity goals and support quality trainees.

Many respondents called for increased funds for mentoring and professional development programs, either from NIH or from the institution. Some respondents suggested funds for enhancing or creating new postdoctoral research support centers; others highlighted the need to create better professional development resources that would specifically address the needs of those who can increase diversity in the workforce, regardless of their career stage.

Encourage Collaboration and Continuity

Increased collaboration and coordination were consistently identified as important for improving the biomedical pipeline. Respondents called for collaboration on a variety of levels and emphasized that involving all stakeholders in a discussion about the needs of trainees and scientists will improve recruitment and retention of a diverse workforce.

Collaboration within NIH and between Federal Agencies

Beyond NIH, respondents suggested greater efficiency by streamlining Federal efforts. Citing a recent Government Accountability Office report, one respondent noted the Federal government has over two hundred programs designed to increase knowledge of careers in STEM fields with "overlapping target populations and objectives." Respondents did not identify specific programs or efforts which they believed could be consolidated, but recommended a full evaluation of all Federal biomedical workforce diversity programs to align program goals and decrease overlap.

Similarly, respondents urged NIH to examine its own efforts and consider ways to reduce duplication and maximize the potential of its constrained budget. Within NIH, respondents were eager to see a unified diversity mission for all Institutes and Centers, and they were also interested in seeing successful programs, such as collaborative training and career development programs, as models for "trans-IC initiatives." Within NIH, collaboration was seen as a key element toward building committed, coordinated, long-range efforts that would address all stages of the pipeline, thus reducing segregation of efforts that target specific stages. Respondents advocated for a coordinated effort within NIH in order to create continuity of support and potentially address some of the leaks that occur in later stages of the pipeline.

Collaboration with Institutions and Organizations

Several respondents called on NIH to partner with professional societies that are making inroads toward enhancing and supporting minority and underrepresented scientists in the biomedical workforce. Some organizations are responding to research development needs, such as research question and design development and feedback on works in progress. Still others are providing greatly needed mentoring programs to their membership. NIH support of and involvement with these efforts could broaden the programs' impact on the workforce. Specific suggestions for NIH included collaboration with appropriate partner organizations to 1) develop training webinars addressing diversity in the workforce, and 2) develop a centralized database of resources for minority researchers and students. Such resources could then be available to the extramural community.

Collaboration between Institutions

Respondents believed NIH could use its considerable influence to promote and improve collaboration within and between institutions. With respect to diversity, respondents suggested that NIH encourage and reward synergies between top tier institutions and smaller ones. Repeatedly, respondents suggested that NIH support mentoring and resource sharing (e.g., one-on-one relationships or programmatic cooperatives) between minority-serving institutions, such as Historically Black Colleges and Universities, and research-intensive universities. The outcome of these collaborations was expected to include benefits for both students and faculty

at both institutions. Smaller institutions would have increased exposure to top-tier research and access to infrastructure; top-tier institutes would gain knowledge and a better understanding of non-dominant perspectives and potentially new research ideas.

Collaborations were believed to be a crucial element of a successful plan for addressing the needs of a diverse workforce. Some respondents noted the success of NIH Clinical Translational Science Awards (CTSAs) and pointed to this mechanism as an obvious method for rewarding collaboration that has potential for increasing diversity in the workforce.

Diversify Requests for Proposals

This theme often accompanied concern about the review process and emerged as a method for addressing funding inequities. A large number of respondents called for increased focus on health disparities and minority health. By virtue of their affinity and commitment to research relevant their communities, increasing support for health disparities research was perceived as a means for increasing the number of funded investigators from racial or ethnic minority groups.

In developing new requests for proposals, respondents suggested that NIH work with representatives of diverse populations to ensure new programs accounted for the limitations of traditional methods in minority health and health disparities research. For example, unique challenges presented by smaller sample sizes and recruitment of participants could be discussed and addressed through meaningful dialogue. When it came time for review, respondents urged that non-traditional research methods had to be given greater consideration; ideally, review panels should include representation from disciplines such as social and behavioral sciences. One respondent suggested that any proposal designed to study a specific population should have at least one investigator from that target population on the review panel.

A handful of respondents suggested funding that would not only create ethnic diversity in the workforce, but also diversity by profession. It was suggested that physician-investigators need funding opportunities that accommodate their clinical responsibilities and that support cross-disciplinary efforts to encourage bedside-to-bench innovation. Respondents also highlighted the importance of specifically supporting minority physicians in their efforts to engage in research.

Redefine NIH Paradigms

The final recommendation is conceptually less tangible than previous recommendations; however, top of mind for several respondents was the need for NIH to reframe how it defines both success and diversity. Current definitions were believed to be limiting; broadening what NIH considers as “success” and “diverse” was suggested as a means for achieving greater diversity in the biomedical workforce.

Reconsider NIH Definition of Success

In light of a growing population and shrinking budgets, respondents questioned how NIH ultimately measured success. R01 status is difficult to achieve, and arguably more difficult to retain. Respondents suggested that NIH should allocate some funding to diversity efforts that valued contributions beyond traditional scientific discovery via an R01.

> *In previous times, the URM pipeline was the pathway to success for the URM trainee. Today, the pipeline for all scientists has evolved into several pathways, any of which a URM trainee may choose to follow successfully. However, there*

> *are more pitfalls for URMs, and perhaps focus should shift to defining programs better suited to meet these changes. (#137)*

In addition to NIH efforts to diversify the pool of funded investigators, NIH was encouraged to reconsider independent funding as the only career milestone worth targeting. Using a marker of success that is difficult to achieve for all scientists, and more difficult for minority and underrepresented groups of scientists, respondents asked that NIH invest in mentoring and institutional supports that would help pave new pathways toward equally valued career alternatives and definitions of success.

Reconsider NIH Diversity Definition and Criteria

Although not frequently mentioned, some respondents challenged the NIH to reevaluate its definition of diversity, raising a complex and politically sensitive issue. Those who identified this issue as important viewed the current definition as too narrow.

> *Diversity doesn't fit into a check box. Our program has people from many walks of life, but we get marks only for people who can be fit into a category. Where do I put the Japanese-Brazilian dermatologist? The gay steel-town football star who joins our program to become molecular biologist? I have one student whose father is a goat herder in Africa and the student is the first generation to live in a building with a basement. Our program mixes Mormons with Muslims, and both are better for the experience. But there are no boxes or forms to illustrate how our program gains strength from our diversity. (#14)*

Respondents suggested that definitions of diversity should be broadened to allow for characteristics such as socioeconomic status, field of study, religion, and geographic location. The few respondents who suggested NIH should tackle this issue believed that evaluating how NIH defines and determines diversity would eventually promote the type of diversity of thought that would benefit the scientific community and, subsequently, the nation's health.

RFI Appendix

A. Full Coding Scheme: Description of Issues and Sub-Issues

Primary Category: Biomedical Research Workforce Pipeline

Issue 1: Transition Points

The appropriate transition points where NIH's training, career development, and research grant programs could most effectively cultivate diversity in the biomedical research workforce

NIH Sub-Issue	Description
Entry to Graduate School	Entry into graduate degree programs (Biomedical research is not an attractive career regardless of diversity markers; other factors that prevent minority scientists from entering grad programs; and solutions to get those in graduate school to stay, e.g., with better access to high quality training, i.e., level the playing field)
Postdoctoral Training	Transition from graduate degree to postdoctoral fellowships
First Independent Position	Appointment from a postdoctoral position to the first independent scientific position
First Funding Award	Award of the first independent research grant from NIH or equivalent in industry
Award of Tenure	Award of tenure in an academic position, at the NIH, or the equivalent in an industrial setting (support for mid-career scientist)

Data-Driven Sub-Issue	Description
Prior to Graduate School	Priming the pump; cultivating diversity begins before Graduate School (K-12; Undergraduate; Both)
Leadership Appointments	Attainment of executive and/or leadership level position (Department chair, NIH study section chair)
Retention/Career Sustainability	General comment about the loss of trainees/faculty already in the pipeline due to various barriers (lack of job opportunities, difficulty obtaining funding, difficulty obtaining membership on NIH research teams, competition, etc.); the volatility of being a mid-career scientist.

Issue 2: Mentorship

The role of mentorship in the training and success of biomedical researchers throughout their careers

NIH Sub-Issue	Description
Strengthen Relationships	Development of relationships between professional societies, institutions, and individuals to develop mentoring programs
Create/Expand Programs	Creation and expansion of institutional mentoring programs (including NIH)
Application Preparation	Mentoring of applicants and preparation of applications prior to submission

Data-Driven Sub-Issue	Description
Quality Mentorship Unavailable	URMs have difficulty finding mentors (not enough); mentors are not effective (don't provide quality mentoring).
Incentivize Mentoring	Build accountability (evaluation tied to funding) and reward (funding, protected time, recognition) into mentoring activities to motivate potential mentors to devote time and effort to mentoring.
Alternative Mentoring Models	Acknowledge/encourage alternative mentoring models (peer mentoring, mentor groups, etc.), in addition to the traditional one-on-one model.

Issue 3: Influence of Role Models

The influence of role models whose qualities and characteristics can positively affect the training and success of underrepresented biomedical researchers through their careers

NIH Sub-Issue	Description
None	

Data-Driven Sub-Issue	Description
None	

Issue 4: NIH Messaging

The role of NIH messaging in encouraging underrepresented researchers to apply for NIH fellowships and grants

NIH Sub-Issue	Description
None	

Data-Driven Sub-Issue	Description
Improve/Enhance Communications	Build on what NIH is currently doing. Improve the content of what you communicate (e.g., gather input from minority scientists), but also how it is communicated (e.g. sensitivity to language) and how to improve the channels of communication so the messages reach the intended audience (e.g., use targeted communications strategies).
Improve Biomedical Career Image	Promote a positive view of biomedical research careers.
Promote Value of Diversity	Progress toward creating a diversified biomedical research workforce requires that diversity is valued; the research and educational communities need to buy in and support the efforts. Leadership is essential to meeting this goal.

Issue 5: Institutional Support and Climate

The role of institutional infrastructure support and climate as a factor in the success of underrepresented researchers

NIH Sub-Issue	Description

NIH Sub-Issue	Description
None	

Data-Driven Sub-Issue	Description
Leadership Commitment and Education	Leadership commitment to diversity efforts is required; should lead to education and training that address a variety of discriminatory issues, e.g., racism/sexism.
Identify and Address Barriers	Institutionalized prejudice, stereotypes, and nepotism create hostile environments (e.g., learning tools illustrate racial bias or stereotypes, existing faculty and staff vocalize prejudice); an active display of insensitivity toward underrepresented groups [URGs]).
Minority Scientists Overburdened	Minority scientists are overburdened with institutional service duties that are not rewarded and do not count toward research success (e.g., ensuring there is one minority on every committee requires a disproportionate commitment from that group compared to their peers).
Accessing Institutional Support	Inequity exists in relationship to the availability of, and equal access to, research support and resources at one's home institution (i.e., the existence of and knowledge about resources, such as grant writing workshops, administrative support, bridge/seed funding, etc.).

Primary Category: Factors in the Review Process

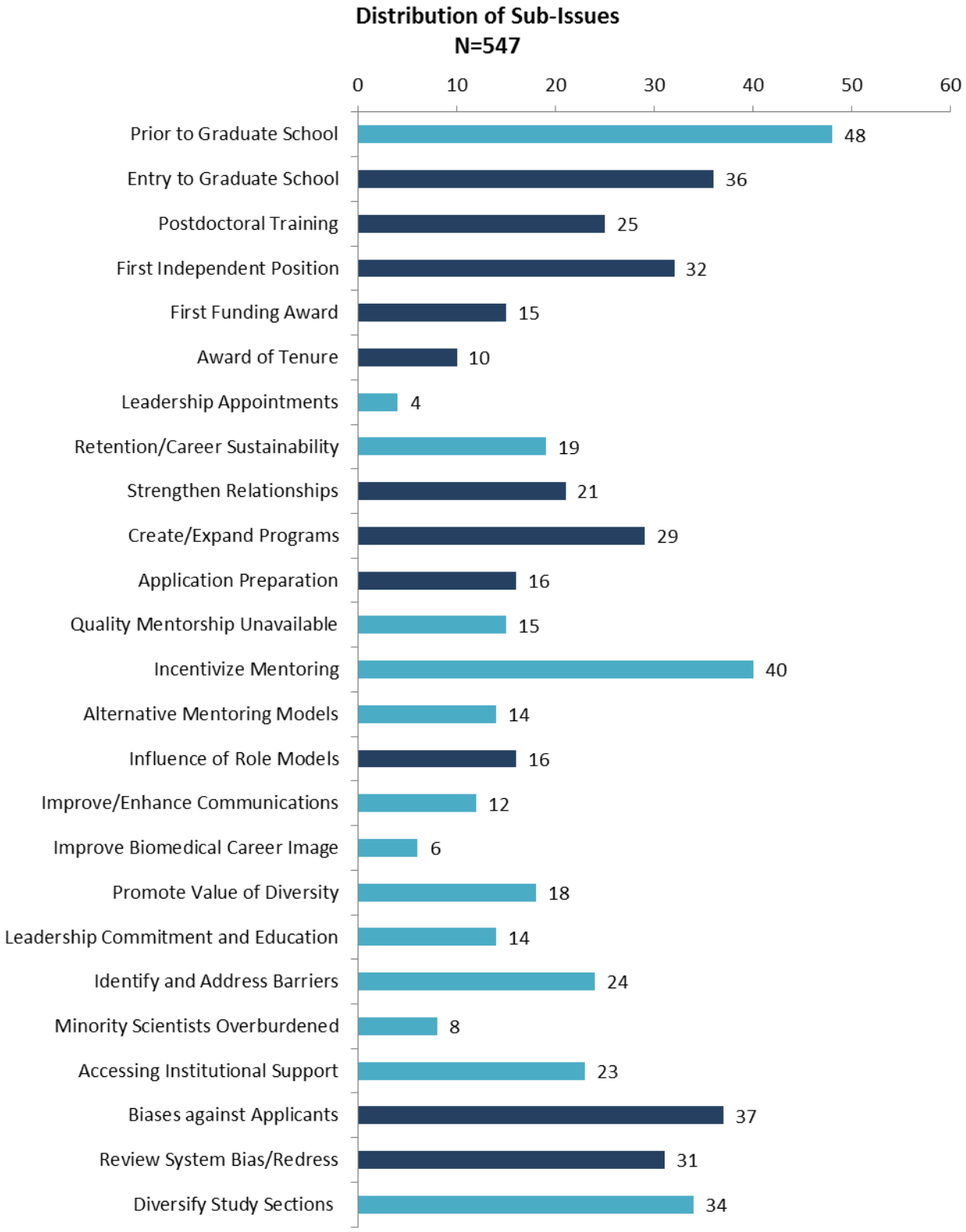
Issue 6: Conscious and Unconscious Factors

The potential role of institutional affiliation, academic pedigree, and various conscious and unconscious factors on review outcomes

NIH Sub-Issue	Description
Biases Against Applicants	Exploration of the possible influences of racial, ethnic, gender, affinity, institutional affiliation, academic pedigree, or other biases on review outcomes. Additional biases: research focus, age, experience, network status.
Review System Bias/Redress	Research on the NIH Peer Review system to determine appropriate methods or interventions to identify and if necessary redress bias, including efforts to anonymize applications or test the effects of unconscious bias training on outcomes.

Data-Driven Sub-Issue	Description
Diversify Study Sections	Diversify the composition of study sections to reduce conscious or unconscious bias of members; not always necessarily a bias against, but favoritism toward.

B. Summary of Frequency Distribution across All Sub-Issues


Distribution of Sub-Issues
N=547
0
10
20
30
40
50
60
Prior to Graduate School
48
Entry to Graduate School
36
Postdoctoral Training
25
First Independent Position
32
First Funding Award
15
Award of Tenure
10
Leadership Appointments
4
Retention/Career Sustainability
19
Strengthen Relationships
21
Create/Expand Programs
29
Application Preparation
16
Quality Mentorship Unavailable
15
Incentivize Mentoring
40
Alternative Mentoring Models
14
Influence of Role Models
16
Improve/Enhance Communications
12
Improve Biomedical Career Image
6
Promote Value of Diversity
18
Leadership Commitment and Education
14
Identify and Address Barriers
24
Minority Scientists Overburdened
8
Accessing Institutional Support
23
Biases against Applicants
37
Review System Bias/Redress
31
Diversify Study Sections
34

C. Order of Priority: all Sub-Issues by Affiliation
Order of Priority: Self (N=76)

Issue	Sub-Issue	Number of Respondents
Transition Points	Prior to Graduate School	20
Transition Points	First Independent Position	14
Conscious and Unconscious Factors	Biases against Applicants	13
Mentorship	Create/Expand Programs	11
Mentorship	Incentivize Mentoring	9
Mentorship	Quality Mentorship Unavailable	9
Transition Points	Entry to Graduate School	8
Transition Points	Retention/Career Sustainability	8
Institutional Support and Climate	Accessing Institutional Support	8
Conscious and Unconscious Factors	Diversify Study Sections	8
Institutional Support and Climate	Identify and Address Barriers	7
Conscious and Unconscious Factors	Review System Bias/Redress	7
Transition Points	Postdoctoral Training	6
Transition Points	First Funding Award	6
Transition Points	Award of Tenure	5
Mentorship	Strengthen Relationships	3
Influence of Role Models	Influence of Role Models	3
Institutional Support and Climate	Leadership Commitment and Education	3
NIH Messaging	Promote Value of Diversity	3
Transition Points	Leadership Appointments	2
Mentorship	Application Preparation	2
NIH Messaging	Improve/Enhance Communications	2
Institutional Support and Climate	Minority Scientists Overburdened	2
Mentorship	Alternative Mentoring Models	1
NIH Messaging	Improve Biomedical Career Image	0

Order of Priority: Organization (N=29)

Issue	Sub-Issue	Number of Respondents
Transition Points	Prior to Graduate School	7
Mentorship	Strengthen Relationships	6
Mentorship	Create/Expand Programs	6
Mentorship	Incentivize Mentoring	6
Mentorship	Quality Mentorship Unavailable	5
Influence of Role Models	Influence of Role Models	5
NIH Messaging	Promote Value of Diversity	5
Institutional Support and Climate	Accessing Institutional Support	5
Conscious and Unconscious Factors	Biases against Applicants	5
Conscious and Unconscious Factors	Diversify Study Sections	5
Transition Points	Award of Tenure	4
Transition Points	Retention/Career Sustainability	4
Transition Points	First Independent Position	3
Conscious and Unconscious Factors	Review System Bias/Redress	3
Transition Points	Entry to Graduate School	2
Transition Points	Postdoctoral Training	2
Mentorship	Application Preparation	2
Mentorship	Alternative Mentoring Models	2
NIH Messaging	Improve/Enhance Communications	2
Institutional Support and Climate	Identify and Address Barriers	2
Transition Points	First Funding Award	1
NIH Messaging	Improve Biomedical Career Image	1
Institutional Support and Climate	Leadership Commitment and Education	1
Institutional Support and Climate	Minority Scientists Overburdened	1
Transition Points	Leadership Appointments	0

Appendix 2: Public Meeting Summary

Advisory Committee to the Director (ACD) Working Group
on Diversity in the Biomedical Research Workforce
Public Meeting
Tuesday, February 14, 2012
10:00 a.m. to 3:45 p.m. EST
National Institutes of Health
Building 31, C Wing, 6th Floor, Room 6C6

Members Present:
Reed Tuckson, M.D., *Co-Chair*
John Ruffin, Ph.D., *Co-Chair*
Lawrence Tabak, D.D.S., Ph.D., *Co-Chair*
Ann Bonham, Ph.D.
Jordan Cohen, M.D.
Jose Florez, M.D., Ph.D.
Gary Gibbons, M.D.
Renee Jenkins, M.D.
M. Roy Wilson, M.D., M.S.
Clyde Yancy, M.D.

Invited Speakers:
Karen Chaves
Glorimar Maldonado
William Mendoza
John Silvanus Wilson, Jr.

Welcome and Opening Remarks

The Co-Chairs of the Advisory Committee to the Director (ACD) Working Group on Diversity in the Biomedical Research Workforce, Drs. Reed Tuckson, John Ruffin, and Lawrence Tabak, welcomed the committee members and guests in attendance and presented opening remarks to the committee. Dr. Tuckson said that some members are attending by phone and webcast, and noted that the day's public meeting/hearing will be in the public record.

Dr. Tuckson said that the committee is in the process of data review, hypothesis formulation, and hypothesis testing in an attempt to better understand and address their charge. The day's meeting will provide the committee with input to assist in its understanding of critical and pertinent issues. The committee had not reached a decision on its position regarding any recommendations, he said, and the purpose of the meeting was not to discuss the perspective of the committee, but rather to inform the committee.

Presentation by the White House Initiative on Historically Black Colleges and Universities (HBCUs)

The committee welcomed the first speaker, Dr. John Silvanus Wilson, Jr., Executive Director of the White House Initiative on Historically Black Colleges and Universities (HBCUs). Dr. J. Wilson presented an overview of the initiative, including the work, ideas, perspectives, recommendations, and key problems and challenges the initiative has identified.

Dr. J. Wilson said that the work of the White House Initiative on HBCUs is under Executive Order (EO) 13532 (Promoting Excellence, Innovation, and Sustainability at Historically Black Colleges and Universities). The three factors of the EO include capital enlargement (permits work with agencies and the private sector), strategy development, and campus enrichment. These factors are united by perception enhancement, such as through messaging and informing, he said.

Dr. J. Wilson said the baseline problem that needs to be addressed is that African Americans are underrepresented in the biomedical research workforce. He said that key challenge areas that need to be addressed include pluralism versus diversity; institutional infrastructure disadvantages that may lead to individual disadvantages; and bias, including both review bias and perceptions of bias by applicants. He proposed a competitive grant program "Race to the Biomedical Top (RTTBT)," with considerations that parallel the U.S. Department of Education (DOE)'s "Race to the Top (RTTT)." RTTBT would lead to several benefits: the NIH would obtain innovative ideas from a wide-variety of applicants; less research intense institutions would receive the direct benefits; and a clear opportunity to shift student and faculty lifestyles to research..

Dr. J. Wilson said that in order to improve ideas and perspectives, some important areas of concern include potential bias on review panels, increasing HBCU faculty on review committees, and reexamining resubmission policies to ensure similarity among grant application resubmission requirements of HBCUs and non-HBCUs. He finally noted that the problems of diversity in the biomedical workforce cannot be solved quickly and will require vigilance in order to develop permanent solutions.

Dr. Jose Florez asked whether Dr. J. Wilson envisioned the competitive grant program that he proposed to be limited to HBCUs, or a parallel expansion to institutions that are not HCBUs, but that show the same level of commitment to improve their infrastructure, support, and training of minorities. Dr. J. Wilson said that the competitive preferences under the program he proposed would not be limited to HBCUs, and this could in fact help drive competition among grant applicants.

Dr. Ann Bonham asked whether Dr. J. Wilson had any thoughts on a national strategy to address the disparities in the biomedical research workforce, so that funding would be shared by several organizations. Dr. J. Wilson said that this type of program could certainly have shared

funding. He noted that not only would a program to attract applications from a more diverse population stimulate competition, it could also drive applications from unexpected applicants.

Dr. M. Roy Wilson asked Dr. J. Wilson to expand on his comment about bridging funding programs to the private sector, so that the private sector is involved in funding. Dr. J. Wilson said that a lot of individuals in the private sector have been waiting for game-changing ideas. He said, perhaps due to the Department of Education's (DOE) revised approaches, the private sector has been much more willing to invest in the DOE's initiatives. Dr. Renee Jenkins asked if there was a study from the perspective of the DOE of strategies that lead to the strongest positive impact on the DOE's RTTT grant program. Dr. J. Wilson said that the DOE is prepared to gather this type of data, but they have not yet. There is evidence, he said, that the RTTT program is working and morale has improved. Excitement has built up within communities and, as an added benefit, the states have been able to engage communities that they have not engaged previously, so a wider population became involved, he said.

Dr. Jordan Cohen asked which department would provide budgetary support to the proposed RTTBT program—would it be the DOE or did Dr. J. Wilson see it as some type of collaborative effort? Dr. J. Wilson said that he had two responses. The first response, he said, is that a number of agencies are investing in science, technology, engineering, and math (STEM) education. He proposed that the committee inform potential stakeholders of the workforce diversity goals of the NIH and seek out a multi-agency approach to support the RTTBT grant program. The second response, he said, is that HBCUs get roughly $225 million per year from the NIH approximately 1 percent of the money that the NIH invests in biomedical research. He said that another 1 percent contributed to HBCUs would be another $225 million per year. The competitive grant that he proposed would provide funding of $100 million per year a 50 percent increase in funding to HBCUs by the NIH alone. In other words, this would actually be a much smaller increase (0.5 percent) than what DOE is doing in terms of higher education programs.

Dr. Gary Gibbons wondered if Dr. J. Wilson's office could assist the committee by providing an evaluation or assessment of the NIH's existing investments of 1 percent, and whether there is a misalignment with what is needed and what is being provided. It would also be helpful, he said, for the committee to know more about the strategic plan of HBCUs as a consortium, and whether they are already doing planning such that if they received part of the funding, this would help reach preexisting targets. He also thought it was critical to involve the private sector from the beginning and asked Dr. J. Wilson for clarification on the point in time when he thought the private sector would become engaged. Dr. J. Wilson said he thought the private sector should be involved immediately so that they have sufficient time for preparation; he said the agencies could provide the initial support with funding from the private sector coming later.

Dr. Tuckson said that the committee is trying to determine the appropriate emphasis on the pipeline versus once an R01 grant application comes to the NIH. He said that while he cannot share where the committee stands at this time on the grant review process, it would be useful for Dr. J. Wilson to provide the committee with a specific assessment of what is currently

known and not known on necessary steps to prepare young African Americans to engage in a career in STEM. He said the committee would like to be able to reference the work of Dr. J. Wilson and others familiar with the topic, not just to save some time, but also to lend additional credibility to the committee and their decisions. Dr. J. Wilson agreed and said that he would also like to involve other people that he works closely with on these issues. Dr. Tuckson said he would like Dr. J. Wilson to review the summary of the meeting, in order to ensure accuracy and precision regarding his discussions and recommendations.

Presentation by the White House Initiative on Educational Excellence for Hispanics

The committee welcomed the next speaker, Ms. Glorimar Maldonado, Chief of Staff of the White House Initiative on Educational Excellence for Hispanics. Ms. Maldonado said that her initiative's office has recently begun to address workforce issues, although her office was not historically involved in these issues. She said the nature of the office's work was not strictly focused on Hispanic-Serving Institutions (HSIs), but also covers the entire educational spectrum, from cradle to career. This wide coverage makes the initiative unique from some of the other initiatives (e.g., HBCUs).

The work of the office, she said, is focused on engaging the community, and it is particularly interested in early learning. Using the most recent census data, the office examined communities with the highest concentrations of Latinos and solicited feedback on educational needs, she said. The majority of the feedback indicated that communities did not know what resources are available to them, particularly for kindergarten through high school (K–12). The initiative's office works to engage communities, strengthen the infrastructure of educational facilities, and gain trust.

Ms. Maldonado said that there are 70 to 80 DOE designated l HSIs, but some Web sites, such as that of the Hispanic Association of Colleges and Universities (HACU), list several hundred. The reason for the disparity is that the DOE's HSI list is a grantee list of institutions that have met HSI criteria and receive Federal funding. The work of her office focuses on a longer list, she said, which incorporates all universities that have self-identified as emerging HSIs. The office reaches out to the universities through visiting the campuses and recruiting interns. Some programs, such as the Viva Technology Program, she said, reach out and interact with students in high schools to teach them about STEM. The office invites community members to participate in the initiative's meetings, she said, and several members on the President's Advisory Commission come from HSIs and have provided valuable feedback. She said her office recommends that the committee engage HSIs that are already focused on STEM education and are already utilizing STEM-focused educational approaches.

Dr. Yancy said that what he originally expected to hear from the White House Initiative speakers was that efforts should cast a broad net, be inclusive, and attempt to re-engineer culture, but these directions are low-yield from his perspective. He said it is important to consider the number of HSIs that have the "academic scaffolding" for increasing diversity in the biomedical sciences and STEM, which will narrow down the field and may provide better

returns on investment. He would prefer to use those with existing infrastructures and ramp up what is already there rather than introduce a new construction in a culture that has not been receptive to STEM in the past. He said it would be useful to have a list of institutions with existing infrastructure for addressing diversity issues, along with a list of the mentors at the institutions and the history of the investigators that have come from the institutions.

Dr. R. Wilson asked Ms. Maldonado to expand on the DOE's definition of HSIs. He asked whether the DOE's definition of HSIs gets around some of the legal constraints, such as how many Latino students are served by the university. She said that there are three criteria that the schools must meet to be an HSI, including (1) being a not-for-profit university/college, (2) having two-year programs leading to a degree, and (3) having at least 25 percent of full-time students that are Hispanic. Once institutions meet these three criteria, they are eligible to apply for accreditation status to be designated as an HSI by the DOE, she said. Once an institution passes the accreditation, it can apply for funding. Institutions that actually receive funding are considered HSIs. The Department of Education website describes HSI funding for the past few fiscal years: http://www2.ed.gov/programs/idueshsi/funding.htmlDr. Florez asked how many are considered HSIs but do not receive funding, but Ms. Maldonado did not know the answer to this question.

Dr. J. Wilson said that there are trust issues with many of these institutions and he suggested that the committee identify these institutions and speak with them one-on-one. With regard to the educational pipeline for biomedical research careers, Dr. J. Wilson said that the 2020 goal of once again being the most educated, competitive, and diverse workforce will require 8 million more Americans, with 2 million of these being African American, graduating from college. HBCUs need to graduate another 167,000 graduates over the current pace to meet this goal. HBCUs currently graduate 35,500 per year now, and this rate needs to increase to 57,000 per year to meet the 2020 goal. He said that only 40 percent of those that enter undergraduate college programs intending to major in STEM actually finish in a STEM program at HBCUs. This data points to a major problem in the low numbers of African Americans in the biomedical research workforce: retention in the STEM educational pipeline.

Ms. Maldonado said that assistance to institutions during the application process will help tremendously. When grant applications submitted by HSIs/HBCUs are rejected, many of the applicants do not resubmit because they do not believe that they have a chance for funding. When assistance or encouragement for reapplication is provided to HSIs by her office, she said, many will reapply; reapplication assistance is one way to foster the reapplication process.

Dr. Gibbons asked which HSIs are awarding the highest percentage of graduates with Ph.D. degrees, to provide a sense of the HSIs with a proven track record. With this information, the committee might have an idea of HSIs with a proven track record that they could contact and ask for feedback on how they are successful. Ms. Maldonado said that she did not know, but that the percentage with advanced degrees in those institutions is about 4 percent.

Dr. Florez said that the focus of the presentations during the day's meeting was on education, from K–12, undergraduate, and graduate students. He asked what is known about Hispanic representation of faculty at HSIs and their ability to serve as role models to STEM students. Ms. Maldonado said that her office does not currently know, and the only way to find out is to ask the HSIs themselves.

Dr. R. Wilson said heterogeneity is vast in HSIs, from two-year schools up to research institutions. The entire set of HSIs should not be considered, but rather representation for each set (e.g., two-year institutions; four-year institutions), and this would correspond to the denominator. Dr. Yancy said that the denominator informs about the landscape, but he would like information on the numerator, which are those institutions are already serving as successful pipelines and sources of STEM graduates.

Dr. Tuckson said that selectivity is important because everyone cannot be experts in all areas, so there will be some segmentation in expertise. He said the solution to this problem could be directing resources to areas of competence. He asked Dr. J. Wilson for his views beyond HBCUs. Dr. J. Wilson said that he serves under an EO, and so does not have the liberty to go beyond fulfillment of the EO. He said a different EO will be coming out addressing issues dealing with African American education beyond HBCU topics. The Hispanic, Tribal, and Asian American Pacific Islander Initiatives cover the entire educational pipeline for these populations. He said that there is a subset of HBCUs that drive graduation of African Americans with STEM degrees and it is important to identify such biomedical hotspots, which can be areas of focus for funding.

Dr. Tuckson said that retention is a key consideration for the committee. The pedagogy of how these programs work and what are the best practices should be considered by the committee—for example, reaching out to students in middle school, and later in high school, and whether this is enough for stimulating their interest in pursuing a college degree.

Dr. J. Wilson said that the White House initiatives do not provide funds. He said when he spoke of "winners," he meant winners in the sense that institutions are selected for funding by the private sector. He said that his office works with the private sector to help them decide which institutions and potential grantees are good investments.

Dr. Tuckson said that if you are going to make recommendations, particularly to the private sector, in order to gain trust, you must be credible, and have clear, ample evidence that certain programs work and are good investments. He said the more information and support that is provided from experts in these areas and initiatives, the more success the committee will have in gaining trust with the private sector.

Dr. Bonham said that the definition of biomedical hotspots may not be clear-cut, and asked whether the committee would be missing the "unusual suspects" by looking primarily at institutions with a proven record of success. She wondered whether this would be adding

institutional bias on top of institutional bias. She asked whether Dr. J. Wilson and his office have considered these issues in their RTT plan. He said that he has considered, but not as exhaustively as the committee will need to consider. He said the competitive preferences do not cordon off the competition in any way because there needs to be room for anyone to apply, either the usual suspects or the unusual suspects. He said the reason that a competition is good is that you can hear from institutions that will speak in their own terms of why they are doing a good job. This approach is better, he said, than outlining criteria and having people come to the criteria.

Presentation by the White House Initiative on Asian American and Pacific Islanders

The committee welcomed the next speaker, Ms. Karen Chaves from the White House Initiative on Asian American and Pacific Islanders (AAPIs). Ms. Chaves said that the focus of the initiative is on several areas, including healthy communities, economic and community development, educational opportunities, and immigrant and civil rights; the office's work is much broader than purely educational initiatives. She said the focus of the initiative has been on community engagement, including efforts to reach overlooked and underserved AAPIs, work to support post-secondary institutions that serve AAPIs, and outreach to increase opportunities for AAPI-relevant research. AAPIs are very diverse, she said, but are often lumped together, so their true diversity is not realized. Many AAPIs are enrolled in community colleges but retention is problematic and a high percentage of them (30 percent to 55 percent depending on the group) do not receive a college degree. She said it is also important to ensure that freshman-bridging programs and new student programs are in place to improve retention.

Compared with HSIs, AAPI institutions are still in early development, she said, and many institutions are not even aware that funding is available for minority institutions. There has also been some confusion as to whether an institution that is an HSI can also be an AAPI. She said that it is important to partner with communities to help develop the research agenda, engage the community in the research areas of interest, and ensure that the research meets the needs of the specific populations.

Ms. Chaves also relayed concerns that one of the initiative's commissioners from the University of California, San Francisco (UCSF) asked her to pass on to the committee. The commissioner said that the Ginther et al., 2011, article from the journal *Science* reported evidence of disparities for African American researchers, but there is also evidence for disparities for Asian American researchers. The commissioner noted that a very high percentage of the Asian scientists in the paper were foreign-born: 16 percent of the researchers were Asian and 87 percent of these were noncitizens. The commissioner said that these findings raised questions of whether U.S.-born Asians are adequately represented in the biomedical workforce. Another concern was that there may have been too few Asians in the category to give adequate power to detect statistical significance.

Dr. Tuckson said that Ms. Chaves brought up an important issue and a potential new line of inquiry. The committee should start considering research priorities, he said, and identify ways that research can be relevant to solving problems within communities of minority populations.

Dr. R. Wilson was curious about the definition of an Asian American Native American Pacific Islander Serving Institution (AANAPISI). He said that the percentage of Asians at certain AANAPISIs should take into account the different proportions of the subpopulations (e.g., Japanese, Korean, and Chinese) because educational backgrounds can be very different. Ms. Chaves said that the percentage is not just the percentage of students that are AAPIs, but also the proportion that meet the poverty threshold. Socioeconomic status is, therefore, also included in criteria that define AANAPISIs.

Dr. Florez said that one point to remember about the Ginther paper is that only researchers holding Ph.D. degrees were included; it is an easier process for a foreign-born Ph.D. to take a position in the United States than a foreign-born medical doctor.

Dr. Yancy asked if there was a consistent theme as to why many AANAPISIs do not receive Federally supported assistance. She said that some of the reasons include confusion by the institutions as to whether or not they are eligible.

Dr. Gibbons asked whether any risk prediction models have been developed to evaluate the low retention rates at AANAPISIs. Ms. Chaves said that she will take this question to her colleagues and will get back to the committee with an answer. Ms. Chaves agreed to have the letter regarding her colleague's concerns about the Ginther paper introduced into the meeting's deliverables.

Presentation by the White House Initiative on American Indian and Alaska Native Education

The committee welcomed the next speaker, Mr. William Mendoza, from the White House Initiative on American Indian and Alaska Native Education. The role of their initiative, he said, is to be the voice for American Indian and Alaska Native populations. The initiative would like to work with the committee to seek ways to best interact with the communities to address educational disparities. Twenty-five percent of degrees, he said, are life sciences and biological degrees at tribal colleges and universities (TCUs), most of which are two-year schools. When students attend TCUs and later attend four-year schools, their experiences at the four-year schools are greatly improved, he said. The initiative would like institutions to expand their degree offerings and restructure STEM courses. Faculty development (e.g., exchange programs, sabbaticals, and professional development steps) is also an important focus of the. EO 13592 is involved with increasing the percentage of American Indian and Alaska Native students that are engaged in STEM curricula, he said. Dr. Tuckson asked Mr. Mendoza to provide the committee with a summary of his organization's view of the educational pipeline and its recommendations for improving the pipeline for American Indian and Alaska Native students and communities.

Dr. Florez said that when he presented the results of the Ginther (2011) paper at a workshop in Boston a participant asked about Native American success rate. The paper did not address Native Americans since only 41 grant applications were submitted by Native Americans. He said that there is an imbalance in the body of work due to lack of information for Native American and Alaska Native groups. Dr. Florez said that filling in this knowledge gap will help ensure that Native Americans and Alaska Natives are not neglected due to lack of data. Even knowing where data gaps are and then calling for information to fill the data gaps is important, said Dr. Tuckson. Dr. Cohen asked whether any TCUs have graduate degree programs. There are 11 or 12 graduate degree programs and these are concentrated at two or three universities. Dr. Cohen said that these are examples of institutions that may have existing infrastructures to support biomedical education initiatives.

Dr. Ruffin said that the Department of Health and Human Services developed a tribal consultation policy, which could help in terms of filling the data gaps. The NIH also has a robust loan repayment program, he said, and a number of Native Americans have had their loans repaid through that program. The success of those individuals must be considered by the committee and the committee must determine if steps need to be taken by the NIH to ensure that these individuals remain successful. Dr. Bonham said the committee also needs to learn about the retention of students that enter TCUs as a stepping stone prior to matriculation at four-year institutions. She would also like the committee to find out about the usefulness of cross-cultural mentors to these students.

Dr. Jenkins said that an area that helped in getting the STEM educational pipeline moving for HBCUs was private sector support. She asked Mr. Mendoza to expand on whether there have been any similar successes in engaging the private sector for American Indian and Alaska Native efforts in the educational pipeline. He said the American Indian Higher Education Consortium leads the way for private, non-profit funding of TCUs, but private funding through the initiative's efforts has been largely absent. He said now the initiative would like to take a more active role in working with private funding and TCUs, and develop a national network of groups that are involved with TCUs.

Dr. Florez asked to what extent AANAPISIs overlap with the American Indian and Alaska Native communities. Mr. Mendoza said there is some overlap with respect to the Native Hawaiian community, and he works with Karen Chaves of the AAPI initiative to address this; however, there no overlap in funding in terms of the initiative's efforts.

Dr. Tuckson asked what role the TCUs serve primarily: is the role of TCUs to prepare students in the biomedical sciences, or is it to prepare them for subsequent matriculation at major research institutions and to thrive in those environments, after having been trained locally at TCUs? These considerations, he said, are important for deciding where NIH should concentrate training of students for careers in the biomedical sciences. The closer that these efforts are to the communities and reservations, said Mr. Mendoza, the more benefit the students from these communities will have. The TCUs seek to train students in the biomedical sciences, although they also serve as preparatory centers for the students. Dr. Tuckson asked whether

there is any information on the barriers that block movement of students from TCUs to state-based universities, and whether there are any initiatives to motivate locally trained students to attend state universities. Mr. Mendoza said studies through the National Science Foundation have been done to answer some of these questions, but he does not currently have the information to answer Dr. Tuckson. Generally speaking, however, he said, these students are 60 percent more likely to complete their undergraduate program at a state-based university if they first attended a TCU than if they did not.

Dr. Tuckson asked Mr. Mendoza to send the committee information on barriers that exist in the pipeline, retention, and the success of efforts to bridge from TCUs to state-based universities. Dr. Ruffin suggested that Mr. Mendoza look at some of the programs that are based in the National Institute of General Medical Sciences, including the Bridges to the Future Program, which will provide some of the information that Dr. Tuckson requested.

Public Comments

The committee next welcomed comments from the public.

The first presenter for the public comments session was Dr. Alika Maunakea, a postdoctoral fellow with the National Heart, Lung, and Blood Institute. He is a Native Hawaiian and felt there is an underrepresentation of Native Hawaiians in the biomedical workforce. He said he was speaking at the meeting in order to demonstrate the successes of his education and career, and as an example of a success story of recruitment and training by the NIH. After completion of his training, Dr. Maunakea plans to return to his Native community, enter academia, and guide STEM students to training for careers in the biomedical sciences. He said that he noticed in his training the importance of having effective training and retention programs that take into account the culture of the target communities. He said he first received training from the NIH as an undergraduate at Creighton University and was able to attend summer research training sessions at the NIH. He said that he learned of the NIH summer training programs on his own, without the guidance of a mentor or career center, through a Web site resource (fastweb.com). Dr. Maunakea said that he wanted to become an independent researcher and the NIH training program helped guide him on this path.

Dr. Bonham said that many of the themes discussed during the day's meeting involved engaging communities, engaging the youth in the communities, and performing culturally relevant research in the communities. She said the committee needs to prioritize efforts to ensure that research in the communities is relevant to the populations in the communities.

While Dr. Maunakea said that he would have benefited from a more culturally-sensitive program, he agreed that the classical lab training that he received at Creighton University was essential to his biomedical research training and education. He said that he would have benefited from having a biomedical science-based mentor in his community at a young age, but he ended up finding his own way to research from Hawaii to a position now with the NIH. Dr. Tuckson said that there is no real system that allows a researcher to capture the ability to be a

mentor, and asked Dr. Maunakea whether he thought that there was an adequate support system at the NIH that could lead a postdoctoral researcher to becoming an independent researcher. Dr. Maunakea said that the answer to this is both yes and no. He said that while the NIH did provide him with many training opportunities and collaborations immediately, there was very little guidance in terms of seeking out and planning for a future career path after one's time as a postdoctoral researcher at the NIH.

Dr. Ruffin asked how the committee might help to ensure that more underrepresented young people get the opportunities as he did early on that helped to guide him to a successful education and employment opportunities in biomedical research. Dr. Ruffin wondered what programs in the communities might be developed to help assist in a successful trajectory from education to career.

The next presenter for the public comments session was Ms. Marcela Gaitan, a senior policy advisor for the National Alliance for Hispanic Health. The organization she represents is a non-profit, public health organization. Her team works with a network of other community-based organizations around the country to provide services to Hispanic populations and find community-based solutions. A goal of the organization, she said, is to improve retention of Hispanics in biomedical professions and address health disparities. Hispanics currently comprise just over 3 percent of tenure-track investigators and are disproportionately represented in research. She said Hispanic investigators receive fewer Federal grants, even after accounting for their underrepresentation in the biomedical workforce. A way to increase their proportion in the biomedical workforce, she said, is to provide incentives and to increase the number of R01 grants that go to established and junior investigators. Hispanic researchers also resubmit grant applications at very low rates, she said, so a support system for following up and encouraging resubmission could improve the proportion of Hispanic researchers that are funded. Improvement of recruitment efforts might also increase the number of Hispanics in the biomedical research workforce. The alliance has a program to provide four years of academic support for STEM training, she said, and there are currently 30 students in the program.

The next presenter for the public comments session was Mr. Dale Dirks, President of the Association of Minority Health Professions Schools, Inc. (AMHPS). Mr. Dirks said that he was speaking on behalf of Drs. Sullivan and Wilson from the association. He brought with him a proposal to submit to the committee from his organization. The proposal addressed the topic of increasing the number of young minority researchers with R01 research grants from the NIH and was entitled *A Proposed Program to Increase the Number of Young Minority Researchers with Investigator-Initiated (R01) Research Grants from the NIH*. He said the association recognizes the shortage of minorities in the health and research workforce, and that African American investigators make up only 0.4 percent of R01 grants from the NIH, with the bulk of R01 grants awarded to Caucasian investigators. Dr. Tuckson thanked Mr. Dirks for bringing the proposal to the attention of the committee.

The next presenter for the public comments session was Ms. Michelle Quinteros, who is a program manager for Hispanic-Serving Health Professions Schools (HSHPS), an organization that

is composed of 26 schools of medicine and public health. The organization's mission is to improve the health of Hispanics through academic development, research initiatives, and training. The organization's training programs are geared toward graduate, medical, public health, and doctorate students, and its faculty development workshops are geared toward doctorate students and Hispanic junior faculty members. Training programs of HSHPS train 65 percent Hispanics, with 40 to 80 students placed during each summer (e.g., at UCSF/Centers for Disease Control [CDC] program). African Americans, Asian Americans, and Caucasian/non-Hispanic groups make up lower proportions of additional students in the training program. The training program greatly increases the scientific activities of supported students, including, for example, that they more frequently submit publications to peer-reviewed journals. Students in the HSHPS program are working on research as it relates to Hispanic communities. Since 2006, 12 students have been trained at USCF/CDC and most continued working at USCF after completion of the program. At least one student that was trained through the program has received NIH funding. The committee asked Ms. Quinteros to provide data on students in the HSHPS programs that have been successful in obtaining funding from the NIH, and she agreed.

The next presenter for the public comments session was Dr. Ernest Marquez, President of the Society for Advancement of Chicanos and Native Americans in Science (SACNAS).
The society is devoted to building a diverse STEM workforce. His organization recommended that the NIH develop more programs to encourage underrepresented minorities such as Chicanos and Native Americans to apply for fellowships and grants. Universities that are funded by the NIH should also be required to implement diversity training of its grantees and increase faculty diversity. In addition, the NIH should also release raw data for the Ginther (2011) paper. The NIH should encourage resubmission of R01 applications since resubmission is low among these populations. SACNAS holds regional meetings to bring scientists and students together on a yearly basis, he said, and mentors interact with the students by serving as role models. At the meetings, students can present their work and poster sessions are judged. These types of additional opportunities help the students develop skills and communication in STEM areas of research. He said SACNAS is holding a meeting soon and he invited an earlier public comment presenter, Dr. Maunakea, to attend. Besides the meetings, students also attend a one-week intensive leadership session, which includes preparation of a personal development plan. The SACNAS board is putting together a manuscript for a white paper on increasing workforce diversity.

Dr. Florez said that the committee heard during the day's meeting that increasing ethnic diversity of the review panel is a necessary step. The problem with the grant applications, he said, is that many do not get reviewed by the entire panel. Therefore, increasing the diversity may not help if there is not an opportunity for minority panelists to weigh in on applications from minorities. Dr. Marquez said that he also participated on review panels, so understands the grant process. In participating on review panels, he found that prejudices were not only against individuals, but against universities or organizations.

Dr. Tuckson requested that Dr. Marquez provide feedback on the report that Dr. Ruffin will prepare for the committee on lessons learned from the NIH funding programs to increase

diversity in the workplace. Dr. Jenkins said that it is also important for the committee to obtain data in parallel for people that have not received similar funding, so Dr. Ruffin should include this type of information in his report.

The next presenter for the public comments session was Ms. Evangelina Montoya, an advocacy liaison for the National Association of Hispanic Nurses, Washington, DC Chapter. The organization, she said, advocates for Hispanics Nurses across the U.S. and currently has about 3,000 members. The organization recognizes a commitment to mentoring nurses and assisting them in career development. The workforce of nurses is aging, she said, and there is not enough interest by younger Hispanics to enter the field of nursing. In order to reach the community, she said that her organization's chapters can assist the NIH in disseminating information on workforce issues. She said educational barriers are primary factors in preventing Hispanics from pursuing nursing careers. The organization, she said, has several recommendations for the NIH committee to increase workforce diversity in the biomedical sciences, including (1) informing educators and counselors about the rewarding nature of nursing careers, (2) establishing an improved system of dissemination of education information on career paths to younger individuals, (3) increasing funding to community colleges for nursing programs and health researchers, and (4) developing a private sector–based association of Hispanic nurses.

Dr. Tuckson said that another individual, Dr. Alberto Roca, submitted a comment to the committee. Dr. Roca founded the Post-doc Committee of SACNAS in 2003 and founded a Web site, MinorityPostdoc.org, to draw attention to underrepresented postdoctoral professionals. In his submitted comments, Dr. Roca said that many resources have been spent on the earlier aspects of the Ph.D. training pipeline (e.g., K–12 and undergraduate degree work) and very few resources have been focused on the needs of advanced Ph.D. graduate students and postdoctoral professionals. He proposed several suggestions for redirection of Federal funding to these individuals, including (1) scholarships to understand career preparation and outcomes of current minority postdoctoral professionals, (2) professional development to prepare postdoctoral professionals for the demands of careers in academia (e.g., developing writing skills for publications, fellowships, and grants), and (3) proactively recruiting for openings to assist postdoctoral professionals in finding jobs, particularly tenure-track positions. He said the lone mentorship model is not successful and the NIH needs to implement alternative methods of training, including a committee of mentors, career center access for postdoctoral professionals, and ensuring that departments are tracking their postdoctoral staff by holding departments accountable to produce publications on postdoctoral researchers' progress after leaving the institution.

Dr. Cohen said that the committee needs to know information on the percentage of postdoctoral professionals that enter faculty careers in academia and what type of disparity exists among minority populations for entering academia. Prior to the close of the meeting, Mr. Justin Hentges informed the committee that all of the handouts from the day would be electronically copied and distributed to the committee members by email.

Dr. Tuckson suggested that the committee hold a conference call to further discuss the issues of the committee. During the conference call, the committee would discuss pipeline issues, deliverables, data asked for during the day's meeting, and the R01 process. Dr. Bonham recommended that the committee discuss further the loan repayment program, and consider making a recommendation regarding loan repayment, possibly suggesting ongoing evaluations of loan repayment.

Dr. Tuckson said that proper control groups are missing with regard to institutions and other organizations that have not received funding. It is important also, he said, to know where money was spent and the lessons learned from those funding programs on the pipeline and workplace diversity, so that decisions can be based on those lessons. Dr. Tuckson asked Dr. R. Wilson to head a small subgroup of the committee to look at the MARC and MBRS programs with regard to evaluation. Dr. R. Wilson agreed. Drs. Ruffin, Bonham, and Jenkins will also be on the subcommittee.
The meeting was adjourned by Dr. Tuckson at 3:45 p.m.

Appendix 3: Peer Review Workshop Summary

Brainstorming Ideas for Conducting Studies with the Peer Review System Workshop: Strategies for Enhancing the Diversity of the Biomedical Research Workforce

Wednesday, March 28, 2012
9:15 a.m. to 3:30 p.m. ET

National Institutes of Health
Building 31, C Wing, 6th Floor, Room 6C6

I. Meeting Attendees

Advisory Committee to the Director (ACD) Working Group on Diversity in the Biomedical Research Workforce (WGDBRW) Members

Ann Bonham, Ph.D.
Renee Jenkins, M.D.
Tuajuanda Jordan, Ph.D.
John Ruffin, Ph.D., *Co-Chair*
Samuel Silverstein, M.D.
Dana Yasu Takagi, Ph.D.
Reed Tuckson, M.D., *Co-Chair*
Maria Teresa Velez, Ph.D.
M. Roy Wilson, M.D., M.S.
Keith Yamamoto, Ph.D.

Guest Speakers

Della Hann, Ph.D.
Molly Carnes, M.D.
Jennifer Crocker, Ph.D.
Irene Blair, Ph.D.
Monica Biernat, Ph.D.
Rachel Croson, Ph.D.
William Harbaugh, Ph.D.
Maggie Werner-Washburne, Ph.D., M.S.
Peter MacLeish, Ph.D.
Joan Reede, MD, MPH, MS, MBA
Irwin Arias, M.D.
Vivian Lewis, M.D.
Donna Ginther, Ph.D.

II. Welcome and Opening Remarks

Dr. Della Hann, Deputy Director of the Office of Extramural Research at NIH, and Dr. Dana Yasu Takagi, Professor in the Sociology Department at UC Santa Cruz, workshop co-chair and a

member of the Working Group on Diversity in the Biomedical Research Workforce (WGDBRW), opened the meeting.

Dr. Hann thanked those in attendance for coming and noted that the meeting would be videocast and archived.

Materials distributed for the meeting included two documents, one with short biographies for each of the speakers and the other titled "Unconscious Bias Panel Commentary Descriptions," which briefly summarized the topics that would be discussed by several of the speakers.

Dr. Takagi explained that the NIH is committed to the issue of diversity in the biomedical research workforce. Research by Ginther et al. (2011) has shown a set of racial disparities in R01 grants. Dr. Francis Collins, the Director of NIH, has formed the Advisory Committee to the Director (ACD) WGDBRW to examine these issues with respect to key transitions in the pipeline and develop recommendations that can eliminate the disparities. Topics of discussion at this workshop will include unconscious bias, above and beyond what is known in the literature, and will be led by presentations by experts in the field.

Dr. Takagi said that the working group is also interested in learning more about successful approaches to mentoring. The working group wants to hear more about the best practices for training and how trainees can be brought together. She said that the unconscious bias panel will discuss how to detect and address potential bias in review panels. She emphasized the importance of determining what works, how to measure bias, and how to evaluate approaches for effectiveness. In addition, there is a need to determine how to measure the outcomes of approaches to manipulate existing biases.

III. Session I: Studies on Unconscious Bias

Moderated by: Dr. Tuajuanda Jordan, Dean, College of Arts and Sciences, Lewis and Clark College

Dr. Tuajuanda Jordan provided opening remarks, and explained that the day's discussions will include issues of unconscious bias and include theoretical, observational, and practical issues. Lessons learned should be extended to all mentors to assist in diversifying the biomedical workforce.

A. Molly Carnes, University of Wisconsin-Madison

The premise of Dr. Carnes' research is that automatic cognitive processes are subject to error. Habits of mind can contribute to biases. Dr. Carnes illustrated this via using visual and interactive exercises.

Such habits could be influencing the review process, perhaps in terms of social stereotypes that unintentionally affect decision-making processes. Pertinent examples include studies that show

that leadership roles are linked more to men than women and that the field of science is linked more with men than women.

Dr. Carnes reviewed the results of a quantitative text analysis of R01 grant reviews for which differences were found between the letters of recommendation for men and women for faculty positions. The results of these analyses suggested that women are held to higher standards than men during the review process. Habit-breaking requires self-motivation, and two bias habit-reducing educational interventions that show promise and are used at the University of Wisconsin, Madison. Both were cluster randomized trials, one of which was a two-and-a-half hour bias literacy workshop as the intervention. Personal bias reduction strategies could also be used. The workshops have led to increased bias awareness and increased self-efficacy, and could potentially lead to actions that reduce bias.

B. Jennifer Crocker, Ohio State University

Dr. Jennifer Crocker's presentation included an explanation of interpersonal goals and the possible social dynamics of the grant review process. The implied presence of other people is known to shift behaviors, even when the person is not present. People tend to be unaware of the influence of their image-management issues (i.e., appearance to others) and the behaviors that drive them. When reviewers are already under a high cognitive load, image-management issues further affect a person and could influence the grant review process because reviewers want to appear competent. Likewise, these issues affect applicants and the way that they construct their applications.

Dr. Crocker has performed research on how interpersonal, self-image, and compassionate goals play out during social interactions. Her group studied these goals in ongoing relationships, including in college freshman roommate pairs. When there was a self-image goal, the pairs were more competitive on the following day and observed outcomes included increased fearfulness. For more compassionate goals, the pairs felt more cooperative on the following day. This suggests that goals affect whether people feel competitive or cooperative prior to or when they engage in a task.

Interpersonal goals are contagious and fluctuate over time, meaning that they can change. These findings, she said, suggest that a number of interventions could be tested on reviewers on grant review panels. Possible interventions include introducing these concepts to reviewers and reminding reviewers of self-transcendent goals.

Dr. Maria Teresa Velez noted that Dr. Crocker did not mention race/ethnicity or gender. Dr. Crocker said that this was intentional. She said these issues are empirical and wondered whether increasing the diversity of the workforce will be a helpful goal. In her experience, she said, some people are inspired by this, and some are annoyed. She said an intervention that focuses on race and/or gender explicitly may or may not be constructive.

Dr. Ann Bonham asked how these issues might be brought up to review panel members each time, so that the concerns for potential biases are not buried in the other materials that they receive. Dr. Crocker said that when review panels meet, the last step is when the review officer gives the members instructions, and this is the point where biases could be mentioned specifically.

Dr. Irwin Arias said that, in his belief, the increasing stress of the review itself accentuates the outlined principles. Another participant agreed and said that stereotype threats can undermine performance, so it is potentially true that there are increases in stress and competition in a roundtable situation. These will continue to increase without interventions.

C. Irene Blair, University of Colorado

The traditional model of discrimination, which is a more simplistic model, would involve applying a stereotype. In the review process, this could lead to a lower score. Implicit bias is more like a gut reaction. When outcomes are less controlled, biases are more likely to come into play. Explicit biases should not be dismissed, as these also matter. Dr. Blair's research has found that people are relatively accurate in predicting their own implicit biases. Therefore, people may be conscious of those negative feelings that arise. The real issue is how those feelings are applied.

Dr. Renee Jenkins asked whether there was another model to look at implicit bias for the affinity model as opposed to discrimination (the affinity model referring to the tendency of people to gravitate toward something that is more familiar, i.e., "this is what I like"). Dr. Blair agreed that affinity biases are important. Dr. Maggie Werner-Washburne said that a larger issue addresses stereotypes; the reason that these persist is often because of positive reinforcement for other characterizations, she said. Dr. Blair agreed that some implicit biases are thought of as a benefit, but the review process needs to acknowledge these and ensure that the review process is sound.

Dr. Samuel Silverstein said that it is important for the working group to realize what the Ginther 2011 paper found in terms of the number of applications. Dr. Donna Ginther said that her group looked at priority scores by race/ethnicity and funding conditional priority scores. She said that when there is a low score, race/ethnicity did matter. African American and Asian applicants were more likely to have higher scores and less likely to receive priority scores. Dr. Silverstein pointed out that in the top group, the information is not known. Dr. Ginther said that she can get these data for the top group if needed. Dr. Ginther said there is not as much bias at the top end of scoring. She said her group knows that African Americans had to submit applications more frequently to be successful. Dr. Silverstein said that the working group needs to know how many times they submitted and how many applications they submitted.

- Action item: Dr. Ginther will provide the WGDBRW with data for how many times applications were submitted and the number of applications submitted by race/ethnicity.

D. Monica Biernat, University of Kansas

Dr. Monica Biernat pointed out the differences between random error (e.g., disagreement with a person you know) and systematic error. It is the latter that is of the most concern in these discussions. She pointed out, as was noted previously, that it is on ambiguous ground that stereotypical attitudes are more likely to influence the process (i.e., not when there is a stellar application or a poor application). Some experiments have been conducted in the areas of stereotypes. One experiment surveyed people who remembered that an African American student had a lower grade point average than a Caucasian student 10 minutes after being told the information. She said there is the tendency to hold groups with lower expectations to higher standards. Common biases in evaluating merit include memory-based judgments and global judgments.

Dr. Biernat presented two ideas in terms of possible experiments: (1) conduct studies on grant review, to find out where bias is entering by editing the same grant to show different race/ethnicity; and (2) examine pre- and post-discussions to see if there is similarity for African American and Caucasian applications to examine whether bias is coming in during the discussion periods of the review process.

Dr. Biernat said that interventions could include race-blind reviews where reviewers could not determine the race. She also noted the difference in the potential level of bias against Hispanics vs. African Americans, in terms of R01 funding, based on the results of the Ginther 2011 paper. She asked whether the composition of the review panel matters and how this could be tested. She also wondered whether African American investigators are differentially responsive to feedback; some of her data indicated that this could be a possibility.

Dr. M. Roy Wilson said that, in looking at the scores from grant reviews, it seems that the pre- and post-discussions affect African American investigators more. Final scores were worse than individual scores, suggesting that discussions among review panel members led to lower final scores. This raised the possibility of bias entering the process during the discussion period. He asked Dr. Biernat what intervention she would suggest to address this possible bias. She answered that she would want to see if something was happening in terms of the lead evaluator on the application and whether they had a more negative attitude toward the application that led to a lower final score.

Dr. Vivian Lewis said that in the medical school admissions process, a holistic review is used, which allowed the school to weight scores for groups that tend to do worse on standardized tests. She pointed out that test scores do not accurately predict an African American or Hispanic student's ability to be a good physician. In this process, the school therefore weights applicants differently in terms of individual applications. She wondered if her definition of holistic was different than a term that Dr. Biernat used during her presentation. Dr. Biernat said that evaluators have a model in their mind of what is meritorious, and this may come from many different domains to form the perspective.

E. Rachel Croson, National Science Foundation

Dr. Croson discussed the results of binding of gender for applications for employment indicating that biases exist. For applicants for tenured and non-tenured positions using the same curriculum vitae with only the names changed, the males were more likely to be hired, and they were asked fewer questions about their abilities. She said there were similar results in these studies when the names were changed to Caucasian or underrepresented minorities. She said there is the possibility to do these types of studies with grant applications. Her ideas for these studies were as follows: (1) blind versus identified reviews, including a removal of all identifiers); (2) panel composition studies to see if the composition of the panel affects the likelihood of funding; and (3) training of panel members about possible biases and whether training affects outcomes. She said that program officers undergo this type of training at the National Science Foundation (NSF).

F. William Harbaugh, University of Oregon

Dr. William Harbaugh said that his research has looked at people choosing to enter competitive situations. He has examined whether they will enter a competitive situation if they have a chance of winning money, but must pay to enter. He said women are less likely to pay to enter the competition, and the question is whether they are less competitive or if men are more competitive. He said that the gender gap is eliminated when people are told where they stand in terms of their likelihood to win. He said the differences can be eliminated with feedback and noted that this may help in reducing the race/ethnic differences seen for R01 funding. Based on the Ginther 2011 paper, reapplication was reduced for minority applicants, and the issue, therefore, is how to keep them reapplying. He also noted that the differences in race/ethnicity and whether or not applicants receive funding are much less with the third reapplication.

Dr. Silverstein said that having normative data is important. He said that none of the study sections provide feedback for each panelist about the percentage of applications that he or she reviewed that received funding.

G. Questions to All Presenters in Section I

Dr. Velez said that people talk about diversity bringing different perspectives to the table. She wondered whether this could somehow be working against minorities and maybe women, on panels for their own grants. She said that when bilingual, bicultural faculty members teach classes at her institution, they receive lower evaluations. This could be due to having different points of view than other teachers, and the fact that students do not like the change. Maybe women and minorities are submitting applications with research ideas that are just a little different from the norm, and this penalizes them. She noted that changing the study section would not necessarily help.

Dr. Joan Reede suggested that in terms of a connected system and biases, maybe the answer is simpler—perhaps the biases are not against a person because of race/gender, but are against a department or institution. Dr. Ginther said that the Ginther 2011 paper found substantial evidence to support Dr. Reede's comments, including that the applicant's prior research record has a significant impact. It might also be useful to look at postdoctoral training and whether it impacts the funding probability.

Dr. Keith Yamamoto asked Dr. Croson about the framework for the NSF bias training of program officers and whether the training could be given to reviewers. Dr. Croson's colleague said that the training is voluntary, lasts for approximately 28 minutes, and is performed online. She said there were some discussions to show the video more consistently to all panels, but that has not been done regularly. She did not know how many of the program officers actually complete the training.

Dr. Silverstein said that the Ginther 2011 paper shows differences for race/ethnicity, but does not provide any insights into the cause. Other attendees agreed that there is nothing to support the idea that the differences were due to bias. Dr. Ginther said that bias is a loaded term and her team is made up of economists. Her group attempted to rule out as many explanations as possible, although some could not be ruled out because they were not tested. She said that she was not comfortable saying that the differences were due to bias.

Dr. Ginther said that because of the new review processes, if biases are playing a role, then the variance in scores received by an underrepresented group should be larger than for a majority group. She said this information should be available if the variance scores are examined.

Dr. Harbaugh said the first steps to take in approaching or planning experiments will be to show that there is evidence of bias.

Dr. Jordan summarized the ideas discussed so far, including verifying that bias exists, and then doing experiments to understand the causes and attempt interventions to eradicate the biases and effect of the biases on the review process. Another idea that came out of the discussions is to shift the dynamics of the grant review process so that being critical is not the ultimate goal or value, and examine whether the shift changes the outcome.

Dr. Jordan asked the Section I speakers to provide their ideas for next steps.

Dr. Blair said that it is important to continue performing observational data analyses with real data, and to perform studies to examine areas where bias may be more or less likely to occur, for example, with regard to the relationship of component scores to overall impact scores. Her third suggestion was to look at other dimensions, including gender and age, as well as institutions, and see if these are a factor.

Dr. Biernat said that it is important to understand what is happening and whether bias is present before planning interventions. She said that an experiment should be done to examine

for biases and stereotyping. She added that further data mining should be done to determine if there are any other patterns. She said she is hesitant to proceed with any interventions until it is known whether bias is present on the panel reviews.

Dr. Carnes said that, in terms of linguistic analysis, she would like to see the results for race. She pointed out that de-identifying applications is labor-intensive. She suggested a randomized study with the study sections to determine what is happening, with respect to bias.

Dr. Croson suggested a reanalysis of the data and to perform new experiments. She said it would be helpful to speak with other institutions and find out about their processes to address potential bias. People outside of NIH would be interested in these ideas, so perhaps plan a workshop where ideas could be discussed further.

Dr. Reed Tuckson asked if: (1) the speakers suggest some language that could be used to describe this issue of bias in a way that does not castigate or shed a negative light on the work that has been done?; and suggested that (2) because the studies will not give immediate results, many individuals will suffer in the interim; perhaps one approach, he said, is to do something more immediate, such as a conflict of interest form. People on study sections could be provided with the literature that demonstrates the differences in funding and that biases may exist and that they should be cognizant of it. The form would ask the reviewers to say that they have read the information and are aware of the possibility for biases.

Dr. Carnes said that that this approach of showing people is not enough. She said the approach needs to be more interactive. In such a case, a clustered randomized trial would be needed, but it's not clear what the value would be, since there is nothing to measure to see if the approach was successful. The outcome measure must be known before it can be determined if an intervention was successful, she said.

Dr. Jordan closed the session with a request to the speakers to send the working group suggested language to address bias and their ideas for experiments.

- Action item: Session I speakers will send the WGDBRW suggested language to address bias and their ideas for experiments.

IV. Session II: Grantsmanship Mentoring and Preparation of Applicants and Applications Prior to Submission

Moderated by: Dr. Ann Bonham, Chief Scientific Officer, Association of American Medical Colleges

Dr. Bonham provided opening remarks and introduced the first speaker of Session II, Dr. Maggie Werner-Washburne.

A. Maggie Werner-Washburne, University of New Mexico

Dr. Werner-Washburne discussed interdisciplinary approaches to grantsmanship mentoring. She suggested that existing data just need to be reanalyzed. It will be important to reach the human element and find out what is happening on the panels, and also with the writers/applicants from the institutions. In terms of problems with the pipeline, there is not enough power in the hands of the students and minority faculty, but the problem can be thought about in terms of the path that people are following. She said if there is no water, there will be no flow in the pipeline. The water needs to be energized, and this is the way that she approaches mentoring. She said in terms of grant applications, it is important to understand that different people have different ideas and beliefs, which will affect the way that they write grants. She said there should be an Apgar score assigned to the applications reviewed.

Dr. Silverstein said that the working group is seeking a new way of trying to solve or deal with a problem that no one has dealt with before. He said what Dr. Werner-Washburne has successfully relayed, at least to him, that this is new work and there are no precedents that fully describe this kind of problem.

Dr. Werner-Washburne said that it is possible to move people toward higher positions if they are empowered to do so, and this is her approach to mentoring.

B. Peter MacLeish, Morehouse School of Medicine

Dr. Peter MacLeish shared the history of investigators at Morehouse School of Medicine who have successfully received R01s, including the minorities that have done so. He said their method may be useful to NIH. The faculty at the institution develops research ideas and presents them during a mock review to paid reviewers, which is an important step in fine-tuning their ideas for the actual application. This, along with continuous support of the junior faculty, has been critical in minority investigators receiving R01s and other funding. He said that bias exists in many aspects and attempting to get answers will cause a waiting period. He said trying to fix the mentoring aspect of applicant submissions should improve the acceptance/funding of applications.

C. Joan Reede, Harvard Medical School

Dr. Reede has developed programs at Harvard for minorities and women for improving the pipeline. Some of the mentoring programs, she said, include mentoring investigators on their applications for grant proposals. The Ginther 2011 paper discussed people with Ph.D. degrees, but little is known about clinicians. She said 95 percent of the investigators at Harvard are clinicians. In terms of reviewing the grant applications, differences in the impact factors among published papers would play a role in the review process. For the mentoring program at Harvard (i.e., Harvard Medical School Faculty fellowship), several individuals, including the mentor, dean, and president, are involved in the process to prepare mentored faculty to reach R01 grant review.

Dr. Reede said that this program has been done several times, and it works in terms of the mentored faculty being successful in getting grants.

Dr. Werner-Washburne asked what happens to the faculty after the mentoring is finished. Dr. Reede said that there is a lot of connectivity and mentoring across different levels, including entry and exit. Dr. Reede said the connections do link to advancement. She said the approaches need to be done in a way that is evidence-based and hypothesis-driven if the mentoring system is to work for improving R01 funding to minorities.

D. Irwin "Win" Arias, NIH

Dr. Arias said in his observations that grants that were not pre-reviewed failed. In terms of reviewing, he said his group had manuscripts reviewed by people with different levels of understanding; one that did not know the science, and one that did know the science, but was not focused on the language used. He said the double review was methodical, not cursory. When this double-review process is used, the final product is understandable in terms of both perspectives, including the science and the words. With regard to the course at NIH, "Demystifying Medicine for Ph.D.s," he asked whether this type of learning could be incorporated at an earlier age, in order to increase interest in pursuing a biomedical career from an early age.

E. Keith Yamamoto, University of California, San Francisco

Dr. Yamamoto said the program is directed at increasing the probability of getting an R01, but is not directed at improving that for minorities. Outcomes research has not been done so he could not be certain of the effectiveness of the program. The program is called "feed forward grant mentoring." In this program, the applicant chooses a grant committee, and they first spend 90 minutes with the committee discussing goals, aims, and ideas for the research. The applicant then develops three to five aims and spends another 90 minutes with the committee to discuss. If a committee or other reviewers are not involved along the route of developing the application, there may be glaring problems that affect the soundness of the application. When a committee is involved along the way they will identify major problems early on. If guest reviewers only get a couple of days to review the application before it is submitted, they are not going to comment on the major detrimental issues of the application.

Dr. Bonham asked how many faculty members have gone through the mentoring program, but Dr. Yamamoto did not know exactly, although he said that there have been quite a few, and there is a lot of enthusiasm about the program at the university.

F. Vivian Lewis, University of Rochester

Dr. Lewis said that everyone can agree that mentoring is critical for minorities and others while establishing their careers. She said that applicants must be resilient in their applications if they are to be successful since not all will be funded. This is particularly true for minorities because

they get funded less frequently. Dr. Lewis introduced "self-determination theory" to develop two different types of mentoring interventions, including (1) working through a main mentor to help in feeling more related to the institution, and (2) peer mentoring to increase ties between researchers and the institution. She said experiments are being done to test in a randomized study the effectiveness of these interventions alone and together. The primary outcome is change over time, with career satisfaction and productivity being two important measures. She said that well-designed, large studies are needed to define scalable interventions.

Dr. Silverstein said that the educational literature states that about 50 to 100 hours of professional development are needed to change behavior. He asked Dr. Lewis how many hours are required to get the changes from her experience. Dr. Lewis said that she does not know, but it takes a long time. She said a short mentoring intervention is offered with follow-up interviews to see if the intervention was effective and to keep people accountable. She said the peer mentoring group will have a longer exposure and does include the "dose effect", rather than just one or two attempts. Dr. Lewis said that, in the design of the protocol, integral measures are collected every two months.

Dr. Carnes commented that 50 hours of training could be effective, but there is also evidence to show that a one-shot workshop is effective if time does not permit a longer period of training.

G. Donna Ginther, University of Kansas

Dr. Ginther's work in terms of mentoring includes one study to examine whether mentoring can help female assistant professors. She said an evaluation was done by randomized trial and was started in 1998. It was an ongoing study and did find that mentoring helps female assistant professors get grants. She said that prior to race/ethnicity studies on funding, she did gender studies.

Dr. Ginther said that gender may matter for student achievement. One example that she provided was that having a female dissertation advisor decreased completion rates, although it had no affect on getting a first job. Even when controlling for pretreatment publications, in the gender studies, mentoring improved the likelihood of being published and getting grants. She did not know what aspect of mentoring improved outcomes, but it seems to work for women.

H. Questions to All Presenters in Session II

Dr. Reede asked for further comment on the extent to which the training at NSF helped to eliminated bias during grant reviews. Dr. Croson said that the training sessions encouraged the program officers that participated in the training to be interactive. Although the training sessions were short, there was the potential to induce long-term change.

Dr. Bonham said that the committee is interested in looking at models that could be used and disseminated for mentorship and asked each speaker to provide two recommendations.

Dr. Werner-Washburne said that she would go back to grants that were not funded and try to examine the basis for not funding, such as language and wording. She said there is also a need to pull together the more successful programs and examine them to determine the reason that they are successful.

Dr. MacLeish said it is important to remain focused on institutional framework building. Institutions must be developed so that novel work can continue and important scientific questions can be solved, and also to attract underrepresented students.

Dr. Arias would like to see NIH be more concerned with what happens with younger students. He also said that NIH should play a more active role in influencing high school-level education and earlier, in terms of the biomedical sciences and fields of interest that are the basis of those, including biology. This would include introducing the very basics of medicine and disease much earlier in the educational pipeline to promote more interest in pursuing these careers from a younger age.

Dr. Lewis said that NIH is well-positioned to develop some pilot distance mentoring programs that some of the professional societies have tried to implement. NIH might also examine what works in terms of funding and success in receiving mentoring and implement a program using the same principles of training.

Dr. Yamamoto said that the chance to participate on study sections has helped many new investigators write their own grants. He said, while it is helpful, it can be detrimental, perhaps because it brings the focus and time away from their own work early on in their career. Maybe creating an early career reviewer program that would include putting a pre-tenure investigator in one review session, where they would review just a few grants, so they could see how the review process works very early in their careers would be helpful.

Dr. Croson said that at NSF reviews are conducted by the panel in study sessions and ad-hoc via email. She said that junior faculty is targeted to be reviewers on each proposal at the study section, often as ad-hoc reviewers. This is a way to get these researchers involved early on without as much of a time commitment.

Dr. Ginther suggested a simple randomized trial in which program officers could contact people that have had their proposals not funded. They could go over the proposals with the applicant and discuss strengths/weaknesses, which could perhaps lead to resubmission and a better chance of funding. Another approach, she said, is to randomly select applicants that were not funded and have them attend a one-day workshop at the NIH, where they would get direct feedback on their grant proposal. The NIH could then follow these researchers afterward. She does not believe in one intervention, and she said that policy changing will not work, because the mechanism is not known. Dr. Ginther agreed with Dr. Arias that diversifying the workforce and stimulating interest in these careers during or after college is too late and must be started in high school or earlier.

Dr. Reede said that the faculty fellowship program that she described is effective, and perhaps it can be scaled up by the NIH. A second idea is to develop a pilot program that mentors individuals that did not receive funding to improve the possibility of receiving funding with later applications. Institutions could also serve more active roles by providing mentors and helping young researchers move forward. The institutions should be held more accountable to do this type of mentor training.

Dr. Jenkins mentioned the possible utility of tracking the success of training programs and mentoring for improving funding. Meeting attendees agreed that this type of tracking information is scarce.

Dr. Tuckson asked the Session II speakers to submit their ideas for experiments to address mentoring for improving grant funding and also any ideas that they might have in reference to tracking funding, particularly people that are initially unsuccessful at getting their grant funded.

- Action item: Session II speakers will send the WGDBRW their ideas for experiments and for tracking grant applicants.

V. Action Items

- Dr. Ginther will provide the WGDBRW with data for how many times applications were submitted and the number of applications submitted by race/ethnicity.

- Session I speakers will send the WGDBRW suggested language to address bias and their ideas for experiments.

- Session II speakers will send the WGDBRW their ideas for experiments and for tracking grant applicants.

VI. Meeting Adjournment

The meeting was adjourned by Dr. Tuckson at 3:45 p.m.

Appendix 4: HBCU Workshop Summary

Department of Health and Human Services
National Institutes of Health

Efforts to Broaden HBCU Participation in Biomedical Research Meeting

April 16, 2012

Contents

HBCU Participants

Anne Osano, Ph.D., Bowie State University
Gail Orum-Alexander, Pharm.D., Charles Drew University of Medicine and Science
Christopher Reid, M.D., Ph.D., Charles Drew University of Medicine and Science
Chuma Okere, Ph.D., Clark Atlanta University
Marcus Shute, Ph.D., Clark Atlanta University
Tanaga A. Boozer, J.D., Ph.D., Florida Agricultural and Mechanical University
R. Renee Reams, Ph.D., Florida Agricultural and Mechanical University
K. Ken Redda, Ph.D., Florida Agricultural and Mechanical University
Michelle Claville, Ph.D., Hampton University
Joann Haysbert, Ph.D., Hampton University
Raymond Samuel, M.D., Ph.D., Hampton University
Wayne Frederick, M.D., Howard University
Matthew George, Jr., Ph.D., Howard University
Marinelle Payton, M.D., Ph.D., Jackson State University
Maria Fatima Lima, Ph.D., Meharry Medical College
Russell Poland, Ph.D., Meharry Medical College
Abigail Newsome, Ph.D., Mississippi Valley State University
Triscia Hendrickson, Ph.D., Morehouse College
Alexandra Peister, Ph.D., Morehouse College
Gloria E. Hoffman, Ph.D., Morgan State University
Michael Koban, Ph.D., Morgan State University
Arlene Maclin, Ph.D., Morgan State University
Camellia Okpodu, Ph.D., Norfolk State University
Shyam Aravamudhan, Ph.D., North Carolina A&T State University
Elimelda Ongeri, Ph.D., North Carolina A&T State University
Nora Shively, M.A., North Carolina A&T State University
Justin Zhan, Ph.D., North Carolina A&T State University
Antonio Baines, Ph.D., North Carolina Central University
Darlene Taylor, Ph.D., North Carolina Central University
Mark E. Lee, Ph.D., Spelman College
Mark Maloney, Ph.D., Spelman College
Sunny Ohia, Ph.D., Texas Southern University
Adebayo Oyekan, D.V.M., Ph.D., Texas Southern University
Shaik Jeelani, Ph.D., Tuskegee University
Gopal Reddy, Ph.D., Tuskegee University
Leonard Jack, Ph.D., Jr., Ph.D., Xavier University of Louisiana
Christopher Williams, Ph.D., Xavier University of Louisiana

Executive Summary

A meeting of representatives from historically black colleges and universities (HBCUs) and the National Institutes of Health took place on April 16, 2012, on the NIH campus in Bethesda Maryland.

NIH Director Francis Collins, M.D., Ph.D., welcomed HBCU representatives to this meeting, which would address ways to broaden HBCU participation in biomedical research**.** Additionally, Dr. Collins identified two high-level committees—the external Diversity in Biomedical Research Working Group and the internal Diversity Task Force—which will issue recommendations in June 2012 on ways to enhance the diversity of the biomedical research workforce.

John Wilson, Ed.D., Executive Director of the White House Initiative on HBCUs, explained that NIH and the Department of Health and Human Services will play a critical role in achieving the initiative's new goal—to ensure that the United States has the highest proportion of college graduates in the world by the year 2020.

Larry Tabak, D.D.S., Ph.D., Deputy Director of NIH, provided an overview of the NIH grant process and the challenges NIH faces in expanding the diversity of the biomedical workforce. Richard Nakamura, Ph.D., Director of the NIH Center for Scientific Review (CSR), described the NIH peer review process. Della Hann, Ph.D., Deputy Director of the Office of Extramural Research (OER), described the Academic Research Enhancement Award (AREA) and Biomedical/Biobehavioral Research Administration Development (BRAD) program.

John Ruffin, Ph.D., Director of the National Institute of Minority Health and Health Disparities (NIMHD), described his Institute's research and training programs. Sharon Milgram, Ph.D., Director of the Office of Intramural Training and Education (OITE), described some NIH training programs for high school, college, and graduate students, as well as postdoctoral fellows. Clif Poodry, Ph.D., Director of the Division of Training, Workforce Development, and Diversity at the National Institute of General Medical Sciences (NIGMS), discussed challenges in making the biomedical workforce more diverse.

During the open discussion led by Dr. Tabak, participants asked NIH to call another meeting of HBCU representatives focused on familiarizing NIH leaders with HBCUs. Other recommendations were to add a diversity-related criterion to the NIH peer review system for grant applications, establish a separate review program for grant applications from HBCUs, and create a new minority supplement program that provides mentored support for researchers during their postdoctoral training and first academic position. Participants also suggested longer funding periods for NIH-sponsored research grants at HBCUs and permission for HBCU investigators to resubmit unsuccessful grant applications more than once.

During the closing session, Meldon Hollis, Associate Director of the White House Initiative on HBCUs, said that investments in HBCUs can increase the number of African Americans with a

Ph.D. in biomedical science. Dr. Tabak reported that NIH would inform participants of the steps it plans to take as a result of this discussion.

Welcome and Introductions

NIH Director Francis Collins, M.D., Ph.D., welcomed HBCU representatives to this meeting. He hoped that this meeting would help people from diverse backgrounds participate in the biomedical workforce. NIH is deeply committed to enhancing the diversity of the biomedical workforce, ensuring that the best and brightest researchers address medical problems and identify solutions that benefit everyone.

NIH has established many training programs and other activities to expand the diversity of the biomedical workforce, but these programs have not achieved all of their goals. For example, in spite of much effort over many years, those who are black or African American, Hispanic or Latino, Native Hawaiian, or American Indian or Alaska Native are still underrepresented among principal investigators with NIH support. Also, an article by Donna Ginther of the University of Kansas, which was published in *Science,* showed that, even when underrepresented minority (URM) investigators complete advanced training in the biomedical sciences, they are less likely to obtain NIH grants than majority researchers.

Two high-level committees will issue recommendations to Dr. Collins on ways to enhance the diversity of the biomedical research workforce. The Advisory Committee to the Director, a major source of external advice to Dr. Collins, has formed the Diversity in Biomedical Research Working Group to develop recommendations on ways to enhance the diversity of the biomedical workforce throughout various career stages. The Diversity Task Force, part of the internal NIH Director's Steering Committee, is reviewing NIH activities related to diversity.

Some recent changes at NIH and new NIH leaders will help the agency expand its efforts to promote diversity:

- The National Center on Minority Health and Health Disparities is now the National Institute on Minority Health and Health Disparities (NIMHD).
- Dr. Roy Wilson, a distinguished African American physician-scientist, is the new deputy director of NIMHD.
- Dr. Gary H. Gibbons, Chairperson of the Department of Physiology at Morehouse School of Medicine, will become the new Director of the National Heart, Lung, and Blood Institute in the summer of 2012.

John Wilson, Ed.D., Executive Director of the White House Initiative on HBCUs, explained that in support of President Obama's 2020 plan, the White House initiative has a new goal: to ensure that the United States has the highest proportion of college graduates in the world by the year 2020. Achieving this goal will require that approximately 8 million more Americans obtain a college degree. Of these college graduates, 2 million will need to be African American, and 167,000 will need to graduate from HBCUs. As a result, the number of students who graduate

from HBCUs each year will need to increase from approximately 35,000 today to more than 57,000 by 2020.

NIH and the Department of Health and Human Services will play a critical role in achieving the 2020 goal, and the White House initiative will strengthen its relationship with NIH and the Department, as well as the relationship between NIH and HBCUs. The Department is the top funder of HBCUs, but this represents only 1% of all NIH funding for higher education. Doubling this support could truly transform HBCUs.

Dr. Wilson encouraged the HBCU representatives to provide bold and innovative feedback to NIH. This meeting would offer an opportunity for HBCUs to let NIH know of strategies that the agency's leaders should consider as they work with HBCUs to enhance the diversity of the biomedical workforce.

Overview of the NIH

Larry Tabak, D.D.S., Ph.D., Deputy Director of NIH, explained that NIH uses 83% of its fiscal year 2012 budget of $30.9 billion to support approximately 300,000 investigators at more than 2,500 institutions outside NIH. Although the NIH budget doubled in the early 2000s, budget increases have been much smaller ever since, giving NIH a purchasing power roughly equal to the one it had before the doubling period.

NIH Grant Process

Most of the research that NIH supports involves ideas from investigators, so the process of obtaining an NIH grant begins with a novel idea that will advance science. The investigator describes this idea in a grant application, and a scientific peer review panel evaluates the application's scientific merit. The national advisory council of the relevant NIH Institute or Center (IC) reviews the application, taking into consideration the scientific review in the context of its individual portfolio and mission. The council's recommendations inform the IC Director, who makes the final decision about whether to fund the application.

Dr. Tabak asked the HBCU representatives to encourage their peers to contact their program officers, who can help investigators determine whether or not to resubmit low-scoring applications. Because NIH's purchasing power has declined, very few investigators receive funding the first time they submit an application. As a result, most successful applications are resubmissions. Dr. Ginther's research showed that African American investigators are less likely to resubmit an unsuccessful application than white investigators.

Serving on a peer review panel increases an investigator's chance of obtaining NIH funding. Until recently, NIH only invited investigators who had previously received NIH funding to serve on peer review panels. Last year, the NIH Center for Scientific Review (CSR) created the Early Career Reviewer Program, which enables qualified scientists who do not have significant prior review experience to become well-trained reviewers. The program also helps emerging

researchers advance their careers by giving them review experience, which will help them prepare more competitive applications. The program also aims to enrich the existing pool of NIH reviewers by recruiting scientists from more institutions, including those that are less research-intensive. Dr. Tabak encouraged participants to nominate themselves or their colleagues for this program. In 2012, HBCUs sent NIH 19 nominations for the program. Of the 227 early-career investigators who participated in reviews through this program, 20% are African American.

Investigators should always ask colleagues to review their applications before submitting them, and they should give these individuals at least six weeks to finish their reviews. They should also learn about their target IC's missions and priorities by searching that IC's website.

In 2008, NIH awarded more than $115 million to HBCUs. This support grew to $151 million in 2009 and $154 million in 2010, partly as a result of the American Recovery and Reinvestment Act of 2009.

Challenges

In the late 1970s, NIH awarded grants to one-third of all applicants, but the success rate of NIH applicants has now dropped to below 20%. Between 2005 and 2010, HBCUs submitted 45 to 70 applications, and success rates were approximately 4% to 13%.

The proportions of NIH-supported investigators who are Hispanic or Latino, American Indian or Alaska Native, black or African American, or Native Hawaiian or other Pacific Islander are much smaller than the proportions of individuals from these backgrounds in the U.S. population. For example, although 16% of Americans are black or African American, only 11% of NIH principal investigators are black or African American.

Approximately 30% of college-age Americans are URMs. But in science and engineering, URMs comprise only 17% of students earning B.A.s and 7% of those earning Ph.D.s. URMs earn approximately 11,000 bachelor's degrees and 507 Ph.D.s per year.

Although 27% of predoctoral trainees in a non-URM NIH T32 or F31 training program undergo postdoctoral training, only 18% of predoctoral trainees in a URM T32 or F31 program receive this training. NIH needs to determine the reasons for this disparity.

According to Dr. Ginther's *Science* article, black investigators submitted only 1,149 of the more than 83,000 applications submitted to NIH between 2000 and 2006. Investigators from the 30 institutions that receive the most NIH funding have a better chance of receiving funding than investigators from other institutions, but black applicants have a lower likelihood of obtaining grants than white investigators in every group. For example, although black investigators from the top 30 institutions have a higher success rate than all investigators from lower-ranked institutions, they are less likely to receive funding than non-minority investigators at top 30 institutions.

Extraordinary Opportunities

Drs. Collins and Tabak have articulated a plan of action to address the challenges that Dr. Tabak described. The plan includes evaluating current NIH training programs, phasing out unsuccessful ones, and expanding successful ones. NIH will also increase the number of early-career reviewers, including those from underrepresented populations, will examine its grant review process for bias, and develop ant-bias interventions. Other components of the plan are to improve support for grant applicants and gather expert advice on additional action steps.

Overview of Peer Review at NIH

Richard Nakamura, Ph.D., Director of CSR, described CSR as one of the 27 NIH ICs. However, unlike most of the other ICs, CSR does not give grants; its sole mission is to review grant applications. CSR reviews approximately 70% of the grant applications received by NIH; ICs review the rest.

In general, NIH accepts applications three times a year. The time between a grant submission and receipt of the award is typically about a year.

When NIH receives a grant application, CSR assigns that application to an IC and peer review panel (known as an integrated review group or study section). NIH currently has 172 peer review panels, and many of the panels review 60–100 applications each round. The panels have almost 3,000 standing members. The head of the peer review panel assigns at least three reviewers to each application.

When these review panels meet, they rank each application and discuss only the 50% of applications with the highest scores, unless a reviewer asks the panel to discuss an application with a lower score. Reviewers consider five core review criteria: significance, investigator(s), innovation, approach, and environment. They also assign an overall impact score to each application based on the likelihood that the project will exert a sustained, powerful influence on the research field(s) involved.

The advisory committee of the relevant IC reviews the peer review panel's conclusions and makes a recommendation about funding the application based on the IC’s mission and priorities. The IC director then decides whether to fund the application.

The principal investigator receives a summary statement with scores for each review criterion; critiques from the assigned reviewers; and, if the panel discussed the proposal, the overall impact score (based on the average impact scores assigned by panel members), percentile ranking, and summary of the review discussion. If the IC director chooses to fund the application, the principal investigator receives money for his or her research, and the institution receives indirect funds to support the researcher. Successful applicants may apply for renewed funding every four or five years.

Discussion

During the discussion, a participant asked how applicants from liberal arts institutions and institutions that have traditionally served minority students can increase the environment criterion scores of their applications. Dr. Nakamura said that Dr. Tabak is leading a team that is trying to determine whether any aspects of the review process involve unconscious biases. In the meantime, NIH often recommends that scientists from institutions with less research experience find collaborators from other institutions for their grant applications.
A participant asked whether NIH has considered using a blinded review process, in which reviewers do not know the principal investigator's race or institution. Dr. Nakamura said that the Diversity in Biomedical Research Working Group is considering these options and will issue recommendations soon.

A participant pointed out that review panels often give high scores to researchers who have received NIH funding in the past, because these individuals have a good record. This approach does not permit researchers with less experience to enter the field. Review panels should be more interested in the quality of the science than whether an applicant has received previous grants. Dr. Nakamura said that NIH review panels now review applications from new investigators separately, and NIH has set aside a substantial amount of funding for these investigators. The Early Career Reviewer program also helps new investigators increase their likelihood of obtaining an NIH grant by teaching them about the review process and giving them opportunities to meet potential collaborators.

A participant suggested that NIH open its peer review panels to more faculty members from HBCUs, beyond simply inviting these institutions to nominate faculty members. The agency needs to actively recruit HBCU investigators. Panels must include reviewers who understand that the environments and infrastructures at HBCUs are different from those at other institutions, as misunderstandings about these unique features often lead to lower scores for HBCU applications. Including more reviewers from HBCUs would also increase the number of African American reviewers.

Overview of Extramural Research Opportunities

Della Hann, Ph.D., Deputy Director of OER, described the roles of the NIH scientific review administrators, program officers, and grants management specialists. The scientific review administrators assign each application to a peer review panel, and they summarize the results of its reviews. The program officers can help applicants identify the most appropriate type of grant (funding mechanism) for their project, provide advice on preparing an application, and offer feedback on the summary statement. The program officer to contact is listed in each NIH funding opportunity announcement. Grants management specialists oversee the business aspects of grants, including compliance with regulations.

Investigators who would like to submit a grant application to NIH should send a very short email to one or more program officers asking whether their research idea might be relevant to an IC's priorities. If the program officer indicates interest in the idea, the investigator should send the program officer a longer email with details on the project. Prior to submitting an NIH application, investigators should also talk to their institution's program staff about internal procedures and how to structure the grant budget. Investigators should also explore the application submission process on http://grants.gov in advance, so they know what to expect when they are ready to submit the application. Finally, investigators need to be persistent; if NIH does not fund their application, they should pursue other research ideas.

OER has a searchable website (http://grants.nih.gov) listing all of the NIH funding opportunities, as well as details on the NIH grants process. Dr. Hann listed some diversity-focused funding opportunities at NIH, including several initiatives targeted to HBCUs and other institutions serving a large proportion of underrepresented students. She highlighted two programs that are particularly relevant to the goals of this workshop:

> The **Academic Research Enhancement Award (AREA)** grants support small-scale research projects in biomedical and behavioral sciences conducted by faculty and students at educational institutions that have not been major recipients of NIH research grant funds. These grants provide up to $300,000 in direct costs for up to three years.
>
> The **Biomedical/Biobehavioral Research Administration Development (BRAD)** program promotes the establishment of rigorous and externally supported biomedical and biobehavioral research and/or research-related training programs by strengthening institutional research administration infrastructures. When an institution obtains a BRAD award, its research administration staff members receive training from NIH so that they can help their institutions become more competitive for NIH grants.

The NIH Research Portfolio Online Reporting Tools (RePORT) website, at http://report.nih.gov, provides a wealth of information on NIH grants. For example, users can find the strategic plans of each IC to determine whether a research project might fit an IC's priority. Users can also find many details on all of the grants that NIH has awarded in a given field, including which ICs have funded that type of research.

The Office of Extramural Research sponsors two NIH Regional Seminars on Program Funding and Grants every year. These seminars, which take place throughout the country, help demystify the grant application and review process, clarify Federal regulations and policies, and highlight current interests and concerns.

Discussion

In response to a question about page limits for grant applications, Dr. Hann explained that most NIH applications have a 10-page limit. The funding opportunity announcements indicate the application page limits.

Dr. Hann clarified that most BRAD programs have a principal investigator and a co-principal investigator. The co-principal investigator is usually a dean or other administrative leader.

A participant commented that the BRAD program resembles the NIH Extramural Associates Research Development Award (EARDA), except that EARDA provided pilot project funding and BRAD does not. HBCUs need funding from NIH for pilot projects, because their faculty members typically do not receive startup funding. Furthermore, many HBCUs do not have offices of research development, and EARDA funds could be used to train junior faculty members. For these reasons, BRAD is less useful to HBCUs than EARDA. Dr. Tabak promised to look into the reasons for the differences between BRAD and EARDA and to determine whether NIH could alter BRAD to offer pilot project support.

A participant asked which peer review panel is responsible for the AREA grant applications. Dr. Hann believes that a special emphasis panel reviews these applications, and Dr. Nakamura offered to verify this. Dr. Hann clarified that NIH has not set aside any funding for AREA, so ICs must consider whether to fund AREA grants in the context of their other funding priorities.

A participant asked how HBCU faculty members could join the peer review panels for the Support of Competitive Research (SCORE) program. Dr. Hann suggested that interested HBCU faculty members contact a program officer, who can then suggest that a scientific research officer include this faculty member in the review panel.

Dr. Wilson emphasized that NIH does not fully understand the reasons why so few URM researchers have received NIH funding or how to eliminate this disparity. The purpose of this meeting was to discuss these issues. One metric of success for this meeting would be for NIH to receive more grant applications, as well as more high-quality applications, from HBCUs.

National Institute of Minority Health and Health Disparities Update

John Ruffin, Ph.D., Director of NIMHD, explained that the mission of NIMHD is to lead scientific research to improve minority health and eliminate health disparities. Dr. Ruffin described some NIMHD programs that might be of interest to HBCUs:

> The **Loan Repayment Program** offers educational loan repayments of up to $35,000 per year to qualified health professionals with a doctorate degree who are working in non-Federal academic or research settings, and can conduct health disparities or clinical research for two years. Approximately one-third of program participants are African American, 19% are Latino, and 9% are Native American.
>
> The **Centers of Excellence Program** supports novel programs that are making significant advances and contributions to easing the health burden in underserved populations, as well as reducing and ultimately eliminating health disparities in several priority diseases and conditions.

The **Community-Based Participatory Research Initiative** promotes collaborative research between scientific researchers and members of their communities through the joint design and implementation of intervention research projects targeting health disparities in underserved populations. NIMHD sponsors 40 projects under this initiative. Eleven of these projects are led by community organizations.

The **Building Research Infrastructure and Capacity (BRIC)** program builds, strengthens, and/or enhances the research infrastructure and research training capacity of institutions.

The **Minority Health and Health Disparities International Research Training Program** offers short-term international training opportunities in health disparities research for undergraduate and graduate students in the health professions who are from health disparity populations and/or populations that are underrepresented in the career fields of basic science or biomedical, clinical, or behavioral health research.

The **Small Business Innovation Research/Small Business Technology Transfer Program** gives priority to research activities designed to empower health disparity communities to achieve health equity through health education, disease prevention, and partnering in community-based, problem-driven research.

NIMHD awards **R01 grants** for research on the social determinants of health related to health disparities and for basic and clinical research.

The **Science Education Initiative** supports educational, mentoring, and/or career development programs for individuals from underrepresented or health disparity populations.

Scientific meeting grants sponsor workshops and scientific meetings that are relevant to the scientific mission of NIMHD and the public health.

The **Disparities Research and Education Advancing Mission (DREAM)** program gives two years of support to postdoctoral fellows conducting research related to health in an NIH intramural laboratory, followed by up to three years of salary and mentored research support at an extramural institution.

Dr. Ruffin encouraged the HBCU representatives to read the NIH Health Disparities Strategic Plan and Budget (http://www.nimhd.nih.gov/about_ncmhd/index2.asp), which identifies the priorities related to minority health and health disparities of every NIH IC. He also invited participants to the 2012 Summit on the Science of Eliminating Health Disparities, which will take place in National Harbor, Maryland, on October 31 to November 3, 2012.

Discussion

In response to a question about the Loan Repayment Program, Dr. Ruffin explained that only people who have earned a terminal degree and are conducting research in health disparities are eligible for the program. Award recipients do not need to conduct their research at NIH and they can have a doctoral degree (including an M.D. or Ph.D.) in any discipline.

Dr. Ruffin reported that NIMHD is talking to representatives of the Howard Hughes Medical Institute and the Kellogg Foundation about potential collaborations.

Dr. Ruffin explained that almost every NIH IC offers grants for scientific meetings, but each IC has a different maximum grant award. NIMHD caps its meeting grants at $50,000, and NIMHD uses this grant mechanism to disseminate the results of the research it sponsors. In some cases, applicants can obtain $50,000 for a meeting from NIMHD and additional funding for the meeting from other ICs.

NIH Office of Intramural Research Update

Michael Gottesman, M.D., Deputy Director for Intramural Research, introduced Sharon Milgram, Ph.D., Director of the Office of Intramural Training and Education (OITE). Dr. Milgram explained that OITE offers a wide variety of training and education programs on the NIH campus. Students can begin training through the NIH intramural program while they are still in high school, and training through the NIH intramural program is also available for undergraduate, graduate, and medical students, as well as postdoctoral fellows. The OITE website (https://www.training.nih.gov/) offers videocasts or podcasts of many OITE workshops, a careers blog, a job board, and other job-related resources.

OITE's workshops help students at different training levels acquire skills in such areas as conducting scientific research, communicating about science, and writing grant applications. The office's annual events include a career symposium, graduate and professional school fair, and summer intern/postbac poster day.

Dr. Milgram highlighted a few OITE training programs:

> The **Summer Internship Program** offers a research experience lasting at least eight weeks to 1,200 high school, college, medical, dental, and graduate students each year. Interns participate in many workshops, journal clubs, and other educational opportunities during their time at NIH.
>
> The **Undergraduate Scholarship Program** provides up to $20,000 per year for college expenses. All scholars participate in the Summer Internship Program during the summer after their scholarship year and they must work for NIH for one year for each scholarship year. About 10% of scholars come from an HBCU.

The **NIH Postbac Program** offers a research experience to 700 recent college graduates. Half of these individuals subsequently enroll in graduate programs, and 45% enroll in professional programs. All of these trainees may participate in the NIH Academy health disparities training program.

The **Graduate Partnership Program** allows Ph.D. and M.D./Ph.D. students to do all or part of their dissertation research in the NIH intramural program.

The **NIH Medical Research Scholars Program** offers medical, dental, and veterinary students a yearlong experience working on a mentored basic, clinical, or translational research project.

Discussion

In response to a question about financial support for transportation and housing, Dr. Milgram clarified that NIH provides a stipend for its summer and postbac programs that takes into account the expenses of living in the Washington, DC, area. However, NIH does not provide funding for travel. Dr. Milgram and her colleagues have tried to find ways to help students who want to attend short NIH programs find free or low-cost housing during their stay, such as asking postbac and graduate students to host the visiting students.

A participant asked about accommodations for students with disabilities who participate in OITE programs. Dr. Milgram reported that OITE can provide accommodations for these students. For example, OITE provides sign language interpreters at many of its workshops.

In response to a question about videoconferencing for OITE workshops, Dr. Milgram said that she would like to allow students from around the country to participate remotely in OITE training programs. However, OITE does not currently have this capability.

A participant asked about the role of mentors from the home institution of students who participate in the Graduate Partnership Program. Dr. Milgram said that students, their NIH research mentor, and their home institution mentor need to jointly determine the roles of each party. The student, NIH investigator, a faculty member or graduate program director at the student's institution, and Dr. Milgram all sign an agreement before the student arrives at NIH.

National Institute of General Medical Sciences Update

Clif Poodry, Ph.D., Director of the Division of Training, Workforce Development, and Diversity at the National Institute of General Medical Sciences (NIGMS), described several recent changes at NIGMS. For example, Chris A. Kaiser, Ph.D., will become the new Director of NIGMS soon, and NIGMS has brought all of its training programs, including those focused on minority trainees, into the Division of Training, Workforce Development, and Diversity.

If the faculty members of the top 50 research institutions in the United States looked like their graduating classes, these institutions would need to hire 640 new URM faculty members. Even if these institutions had this many openings for new faculty members, the United States is not currently producing enough URM students with the appropriate training to fill these positions. The number of people who have completed a postdoctoral fellowship would need to be 10 times higher than it is now, for example. The biomedical workforce needs substantial changes and new ways of thinking.

Discussion

A participant whose institution has an NIGMS Minority Biomedical Research Support (MBRS) Research Initiative for Scientific Enhancement (RISE) grant commented that this institution has only one faculty member with an NIH research grant who can mentor students conducting research. Increasing the number of students supported by the RISE program would require NIH to support more research by faculty members at minority-serving institutions. Even a modest amount, such as $1,500 a semester for each faculty member, would help faculty members obtain the resources they need to conduct research.

A participant asked whether NIGMS might consider re-establishing the MBRS SCORE S06 program. This program was designed to increase the research competitiveness of investigators at minority-serving institutions, as well as the research capabilities of these institutions. Dr. Poodry said that NIGMS decided to provide SCORE grants only to institutions with laboratories that had NIH funding. This decision by NIGMS created difficulties for smaller institutions and for larger institutions that focus more on teaching than on research. Some experts criticized the program for providing neither good research nor good training. Therefore, NIH decided to separate support for students from support for research, allowing each component to be judged separately. Dr. Poodry added that, as with the SCORE S06 program, the number of students who can participate in RISE is limited by the number of faculty members who can mentor these students' research. NIGMS recognizes this problem and is trying to resolve it.

Discussion Session

Dr. Tabak led an open discussion of the issues raised during the earlier presentations and discussions.

Workshop Outcomes

A participant asked Dr. Tabak to identify the desired outcomes from this meeting. Dr. Tabak replied that the purposes of this meeting included familiarizing HBCUs with a new opportunity to engage more faculty members from institutions like theirs in the peer review process, which NIH staff members to contact with questions about grant applications, and a range of training programs that NIH provides. However, the most important message from the meeting might be that NIH does not have all the answers and does not even know all of the questions. Ideally, the conversation initiated at this meeting will continue, and NIH will learn from the HBCUs about

continuing gaps, what the agency could do better, and what new creative ideas might help NIH move forward.

A participant asked whether HBCUs would have an opportunity to provide feedback to the NIH Diversity in Biomedical Research Working Group before it finalizes its recommendations. Dr. Tabak explained that a summary of the current meeting would be shared with the working group.

A participant suggested that NIH report back to participants in this meeting on the priorities the agency has adopted as a result of this meeting, as well as steps NIH has taken to address these priorities. Dr. Tabak said that this was a good suggestion.

A participant commented that this meeting did not include representatives of all HBCUs, and NIH should distribute information on the presentations and discussions from this workshop to all HBCUs.

A participant suggested that NIH hold a follow-up meeting to give HBCUs an opportunity to tell the agency about their institutions' value and actions. Some NIH staff members might make assumptions about HBCUs that do not reflect reality, and NIH needs to understand how well HBCUs prepare undergraduate students and stretch their dollars. Once NIH staff members understand what HBCUs bring to the table, these staff members will think about HBCUs differently and will understand that they cannot treat HBCUs like other institutions. Dr. Tabak expressed support for this suggestion.

Partnerships

A participant commented that HBCUs produce high-quality recipients of undergraduate science degrees, but Association of American Universities (AAU) members do not accept these students into their graduate programs. AAU members need to form partnerships with HBCUs. Each AAU institution should agree, for example, to accept at least five minority Ph.D. students in the next five years.

A participant suggested that, in addition to seeking partnerships with majority institutions, HBCUs should consider forming partnerships with one another to develop collaborative grant applications to NIH.

A participant noted that funding for collaborations between research-intensive institutions and HBCUs have been very successful, and HBCUs need to expand their collaborations with these institutions. HBCUs have difficulty obtaining R01 grants on their own, but their chances of success rise when they submit applications jointly with large research institutions. NIH could require all large majority institutions to partner with minority-serving institutions in all of their grant applications. Dr. Tabak agreed that collaborations between research-intensive institutions and small, minority-serving institutions work well. He added that collaborations among HBCUs

could also be effective because different HBCUs have different—and potentially complementary—strengths.

Another participant suggested that a representative group from the participating HBCUs develop an R13 proposal to request funding for an HBCU Biomedical Research Symposium. This would facilitate developing inter-institutional research collaborations between HBCUs.

Peer Review

A participant suggested that NIH follow the lead of the National Science Foundation in implementing a diversity-related review criterion for grant applications. Dr. Tabak said that the NIH Diversity in Biomedical Research Working Group has discussed this option and will issue its recommendations in June.

A participant reported that faculty members in her institution have consistently received summary statements from NIH in which two reviewers gave the application a very high score and one reviewer gave the application a poor score. These discrepancies could reflect bias. In some cases, for example, reviewers clearly do not understand that an HBCU investigator who has not received previous NIH support is not the same thing as investigator with no research experience. This participant suggested that HBCUs send the summary statements that their investigators have received to NIH, so the agency can determine whether these statements show any evidence of bias on the part of reviewers.

Some NIH reviewers do not believe that research projects are feasible in the environments that HBCUs offer. Dr. Tabak reported that analyses of aggregate data on NIH review results have shown that reviewer scores of research environment do not affect the likelihood that a minority researcher's application will be funded. Instead, scores of the approach make a difference. However, Dr. Tabak cautioned that these analyses are based on aggregate data, and even if reviewers give a good score to an application's environment, their final impact score might reflect a bias against the institution's environment.

A participant suggested that NIH establish a separate peer review panel that would review only applications for AREA grants. Dr. Nakamura said that, to ensure that review panels give appropriate consideration to AREA grant applications, NIH is clustering these applications, so they are reviewed separately from R01 applications. In addition, the scientific review officer gives reviewers background information on AREA grants, so they think about these applications differently.

Training and Education

A participant suggested that NIH provide training in writing grant applications to HBCU students and faculty members.

Dr. Tabak reported that the Diversity in Biomedical Research Working Group is struggling with the role of NIH in science, technology, engineering, and math (STEM) education, because the NIH mandate does not cover this type of education. NIH spends approximately $30 million a year on STEM education. The U.S. Department of Education and the National Science Foundation play major roles in STEM education, and the working group is discussing whether NIH should offer programs in this area or focus more on the transition between the undergraduate and graduate degree and beyond.

A participant asked about the characteristics of a successful T32 training grant. Dr. Poodry replied that successful T32 grants typically support students only for a year or two, but can support these students for another three to four years on a faculty member's research grant. In general, faculty members in institutions with T32 grants have a substantial amount of research grant funding. T32 grants are designed to train cohorts, typically through workshops, seminars, courses, and other group activities.

A participant suggested that NIH create a new minority supplement program that, like the DREAM and R99/K00 programs, provides support for a URM researcher for a few years during the postdoctoral fellowship, followed by mentored research support when the investigator begins a tenure-track research career. Such a program would give junior faculty members access to the mentoring and scientific resources that could enhance or even redirect their research careers. Dr. Poodry said that NIGMS is addressing this need. He added that NIH provides workshops on writing grant applications. The participant argued, however, that HBCU investigators need mentoring and startup funds more than application-writing workshops.

A participant commented that many Ph.D. students in biomedical sciences are not considering academic careers. Dr. Tabak said that NIH is aware of this trend. Many undergraduate and graduate students are discouraged from entering a research career, because they know how hard their mentors struggle to secure consistent funding. This issue transcends race and ethnicity.

Research Challenges at HBCUs

According to a participant, faculty members at HBCUs cannot expand their efforts to obtain NIH research funds, unless their institutions reduce their other obligations, including teaching. Another participant suggested that NIH meet with the presidents and provosts of HBCUs to help them understand the importance of increasing their participation in biomedical research. Without support from the academic leaders of HBCUs, investigators at these institutions will not be able to expand their biomedical research activities. Dr. Tabak has spoken to the presidents and provosts of HBCUs at their national meeting and would welcome additional opportunities to talk to HBCUs leaders.

A participant said that, currently, reviewers consider an investigator's publication history the most important criterion for judging their record. Many HBCU faculty members do not have long publication records, and they do not get sufficient credit for their role in producing well-

qualified minority researchers. Dr. Tabak agreed that the biomedical research workforce is driven by publications. He added that NIH typically funds projects, not people.

HBCUs often have limited infrastructure to support research. As a result, processing grants can take a long time, and faculty members sometimes must submit progress reports to NIH before they have started working on the research. Grants management staff members at HBCUs need training. Dr. Tabak replied that NIH has offered training opportunities for grants management staff members in the past, and the agency should consider reviving these programs. These programs do not require many resources, but they can make a difference to HBCU investigators who want to focus on science, rather than grants' administrative requirements. A participant pointed out that the National Council of University Research Administrators offers many valuable resources for grants administrators and researchers.

A participant commented that the AREA grants do not provide enough funding for release time or for hiring technicians and postdoctoral fellows. Dr. Tabak said that NIH recently increased the size of the AREA awards and is unlikely to do so again in the near future. Dr. Nakamura added that Congress wants NIH to keep the average amount awarded for each of its mechanisms constant.

A participant suggested that NIH increase the duration of its research project grants. Another participant commented that, because some HBCUs need time to process grants, one year of pilot project funding is not sufficient. Three or four years of funding might be necessary for these institutions. Dr. Tabak said that NIH should consider increasing the average duration of the research projects it supports, if doing so would make a difference to URM investigators.

Funding Challenges at HBCUs

According to one participant, dwindling state funding is having a devastating effect on the work of HBCUs. In this environment, HBCUs can only expand their biomedical research training activities with funding from NIH. Dr. Poodry acknowledged the funding challenges that HBCUs face, and he noted that the NIH budget has not risen recently, either. NIH must strike a balance between supporting training and the research of faculty members who provide this training.

A participant commented on the need for funding to sustain the programs established through grants after the grant funding ends. Because continuation funding is rarely available, HBCUs often end successful programs that eliminate disparities when their grant funding ends, as they cannot replicate these programs elsewhere. Dr. Tabak said that sustainability is a “double-edged sword” for NIH. Because NIH has ongoing commitments to many projects, only 20% to 25% of the NIH budget is available to fund new projects each year. NIH tries to balance the need to turn over its grants portfolio, so the agency can invest in new projects. This is important in the fast-moving world of science, but can waste resources when it dismantles research teams created with NIH support. Whether NIH has achieved the right balance between these competing demands is not clear.

Given the funding constraints that NIH is facing, a participant suggested that NIH ensure that its funding closely matches the vision and mission of each IC. If NIH conducts a careful review of this sort, it might find that it needs to distribute more funding to HBCUs.

Special NIH Programs for HBCU Investigators

A participant expressed concern about NIH's policy that allows investigators to resubmit unsuccessful grant applications only once. Some HBCU investigators would benefit from the opportunity to resubmit an application a second time, because they need more time to ensure that their grant applications are worthy of approval by NIH. Dr. Tabak explained that, in the past, NIH allowed investigators to resubmit amended versions of unsuccessful applications twice. However, many peer review panels did not give high scores to new applications, knowing that their principal investigators would have two more chances to receive funding. As a result, funding for some of the best science was postponed. NIH instituted its new policy after a substantial amount of discussion, but this policy can put certain groups at a disadvantage. NIH plans to revisit its decision not to allow a second resubmission of unsuccessful grant applications based, in part, on the types of comments made at this workshop.

A participant pointed out that, in 2010, the overall NIH funding rate for HBCUs was about half the average rate overall. Like applications from new investigators, NIH should review applications from HBCU investigators separately. The agency could then fund the top 19% of applications from HBCUs, just as it currently funds the top 19% of all applications. Another participant suggested that NIH treat URM investigators in a separate pool only if they have not previously received an NIH grant. Once a URM investigator has received funding, he or she should no longer need special attention. Dr. Tabak said that other stakeholders have also suggested that NIH consider URM investigators separately from other investigators, just as the agency does for new investigators.

Meldon Hollis, Associate Director of the White House Initiative on HBCUs, pointed out that HBCU is a historic designation, and the student and faculty populations of all HBCUs are not necessarily predominantly African American. HBCUs have a different relationship with the Federal government than tribal colleges or Hispanic-serving institutions. Changing NIH policies in the ways that participants suggest would be very difficult. Furthermore, some of the programs that require HBCUs to compete against one another for a small pot of money do not necessarily benefit HBCUs or enable HBCUs to move into the mainstream environment. A better approach might be to build bridges that allow HBCUs to compete in broader programs.

NIH Committees

A participant asked about minority membership on NIH advisory councils, which play a critical role in determining which applicants receive grants. Dr. Tabak explained that NIH ICs nominate the members of its advisory councils and the Secretary of the Department of Health and Human Services makes the final appointments. These councils do include URM members. In addition to people with scientific expertise (who have typically reviewed grant applications for NIH in the

past), these committees often have members who are patients or representatives of patient advocacy groups. Just as HBCUs may submit the names of potential reviewers to NIH, they may also submit the names of potential committee members to Dr. Tabak or the IC directors.

Mr. Hollis explained that members of the public often contact his office when they are concerned that a Federal committee does not include HBCU representatives. When these situations arise, Dr. Wilson contacts the appropriate individuals at the relevant Federal agency.

Next Steps and Closing

Mr. Hollis said that the top 10 institutions for producing African American scientists and engineers are HBCUs, and investing in HBCUs is a good way to increase the number of African Americans with Ph.D.s in biomedical science. However, the Federal government cannot single-handedly ensure that HBCUs increase their production of minority biomedical scientists; reaching this goal will also require cultural changes in HBCUs, which HBCU leaders, including those at this meeting, can drive but the Federal government cannot. Furthermore, much of what happens in HBCUs is driven by state, not Federal, policy.

Instead of viewing themselves as competitors in a limited space, HBCUs need to consider how to engage the Federal government more forcefully and meaningfully. Room exists for creativity that could improve the relationship between HBCUs and the Federal government, and NIH is interested in exploring this possibility.

Mr. Hollis found the comments from Dr. Tabak and the other NIH leaders to be very encouraging. These individuals have clearly put time into thinking about the problems discussed at this workshop. This has been a useful conversation, and Mr. Hollis thanked the HBCU representatives for taking the time to participate in this conversation.

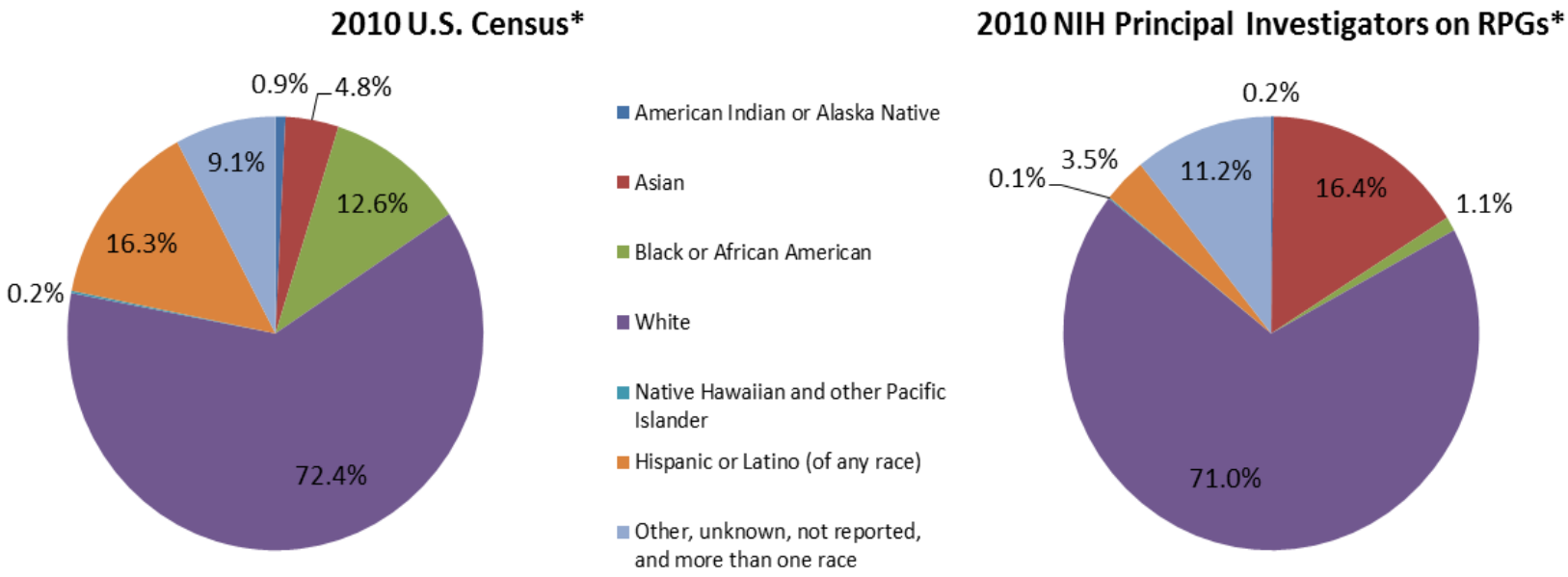
Dr. Tabak reported that the HBCU representatives would have an opportunity to comment on the summary of this workshop and NIH would inform them of the steps it plans to take a result of this discussion. He added that NIH will probably wait to identify its next steps until after the Diversity in Biomedical Research Working Group issues its recommendations in June.

ABBREVIATIONS AND ACRONYMS

AAU	Association of American Universities
AREA	Academic Research Enhancement Award
BRAD	Biomedical/Biobehavioral Research Administration Development
BRIC	Building Research Infrastructure and Capacity
CSR	Center for Scientific Review
DREAM	Disparities Research and Education Advancing Mission
EARDA	Extramural Associates Research Development Award
HBCUs	Historically black colleges and universities
IC	Institute or Center
MBRS	Minority Biomedical Research Support
NIH	National Institutes of Health
NIGMS	National Institute of General Medical Sciences
NIMHD	National Institute on Minority Health and Health Disparities
OITE	Office of Intramural Training and Education
RePORT	Research Portfolio Online Reporting Tool
RISE	Research Initiative for Scientific Enhancement
SCORE	Support of Competitive Research
STEM	Science, technology, engineering, and math
URM	Underrepresented minority

Appendix 5: NIH Additional Data and Analysis

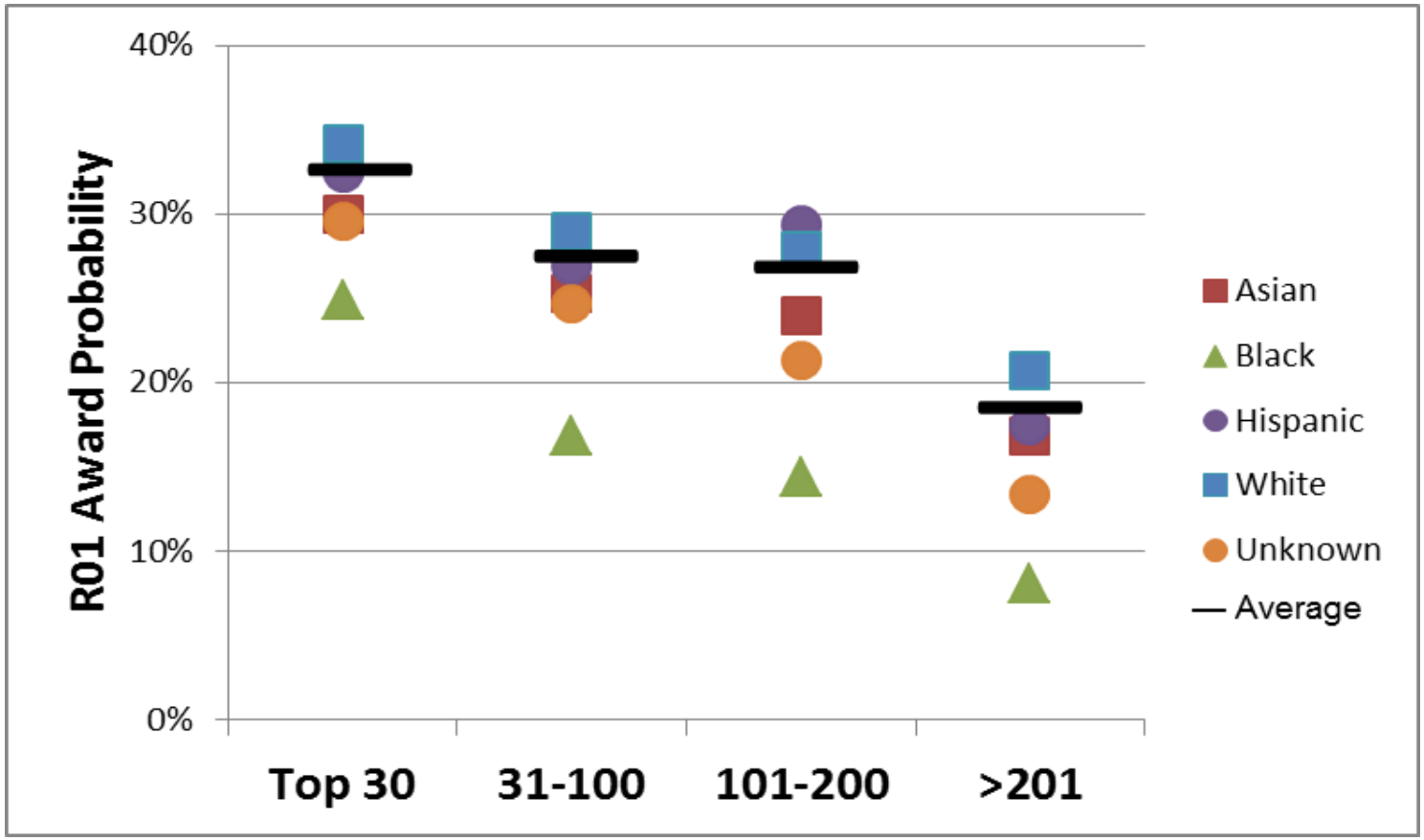
Figure 1: Race and Ethnicity of the 2010 U.S. Population and the 2010 NIH Principal Investigators on RPGS



2010 U.S. Census Bureau Report, http://2010.census.gov/2010census/data/2010 (left)
NIH Principal Investigators on RPGs, NIH IMPAC II (right)

*Total percentage is over 100 because those identified as Hispanic/Latino may also have identified as other races. PI information collected by NIH includes the option for an applicant to signify both race and ethnicity.

Figure 2: Award Probabilities by NIH Funding Rank and Race/Ethnicity



Source: Working Group communication with Dr. Donna Ginther

Figure 3: Distribution of Type 1 CSR Reviewed RPG Applications by Field of Science and Race of PI: Fiscal Years 2000 -2010

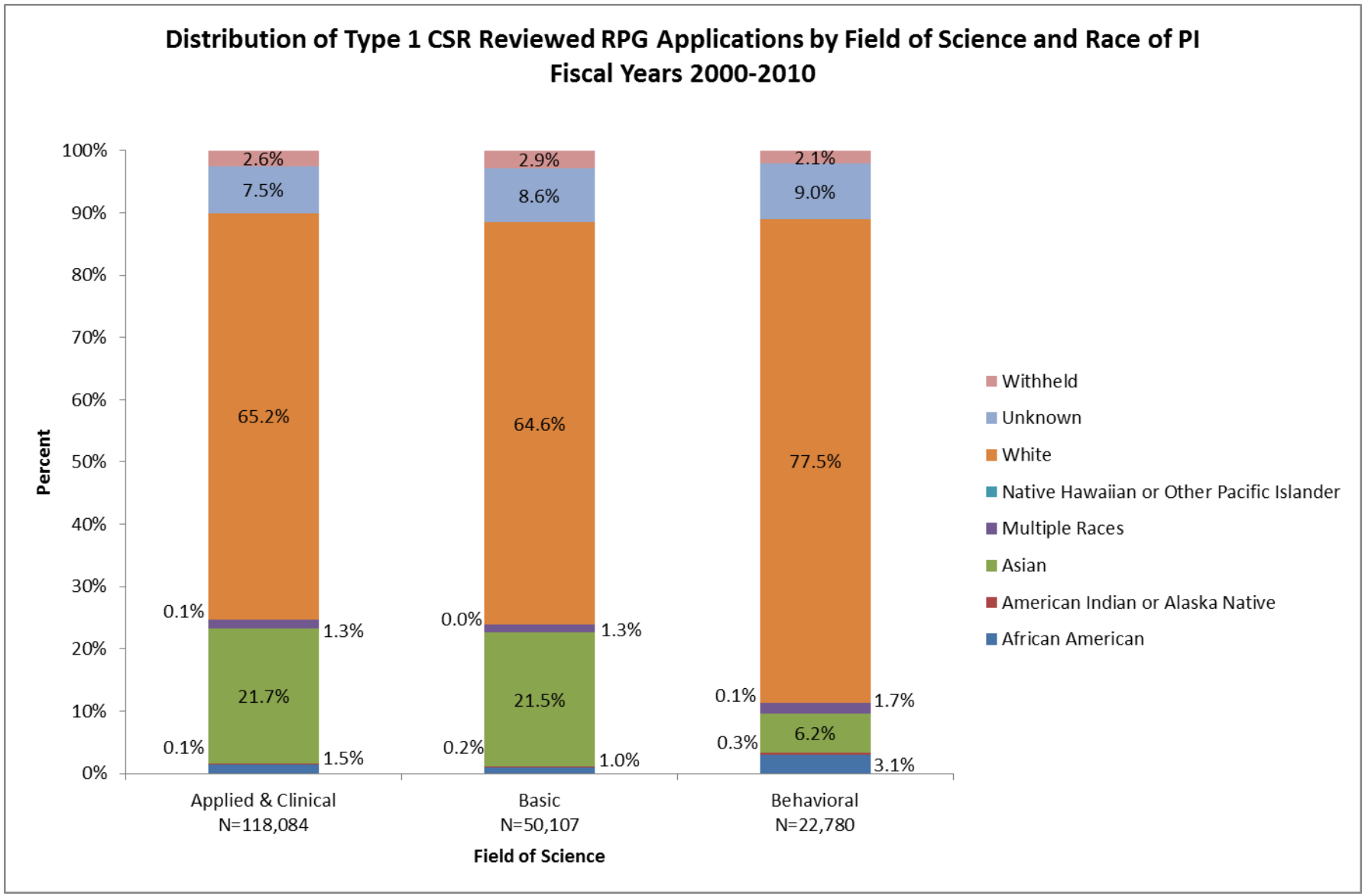


Figure 3A: Distribution of CSR Reviewers by Field of Science and Race of PI: Fiscal Years 2000 -2010

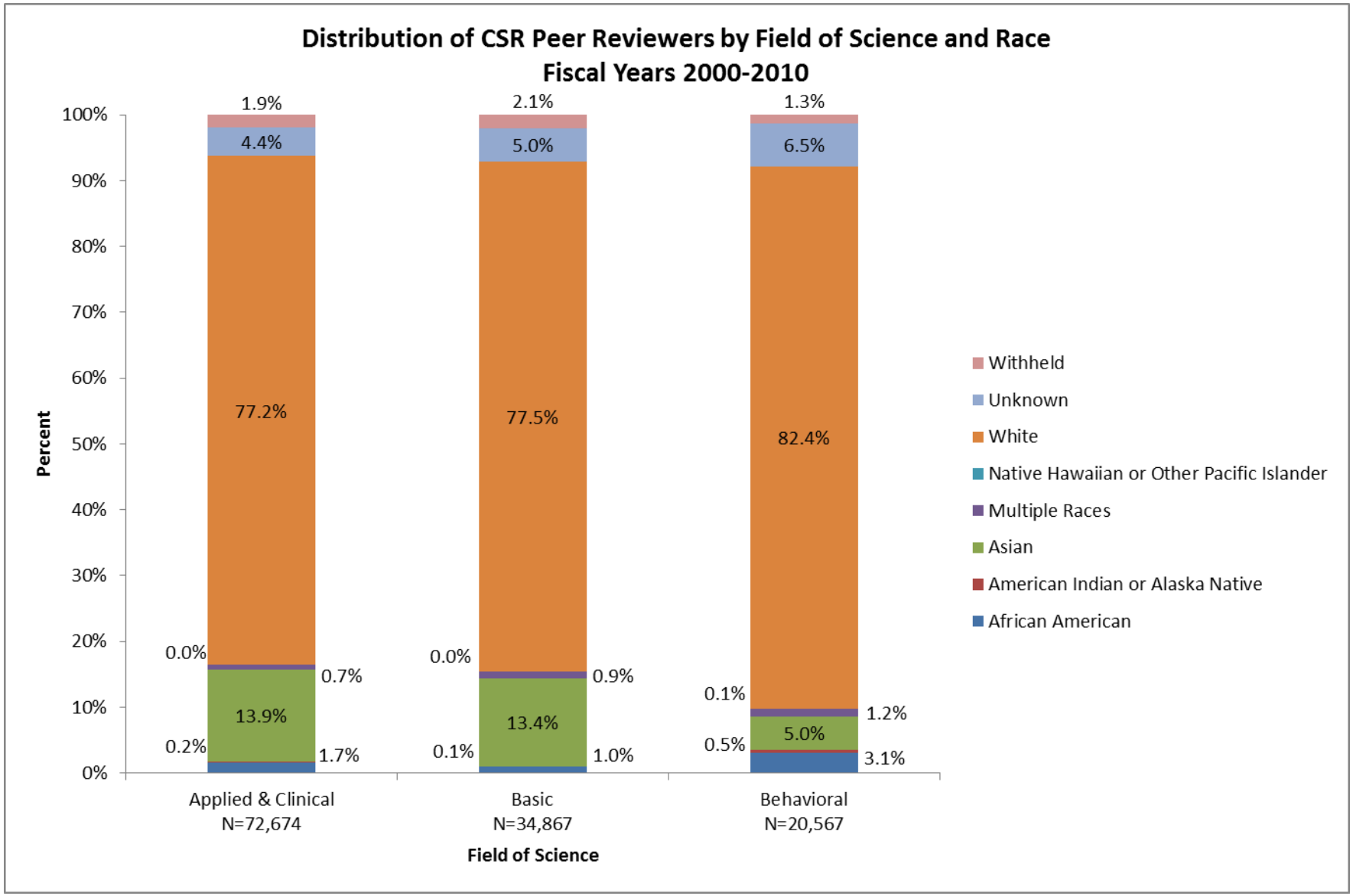


Figure 3B: Distribution of Type 1 CSR Reviewed Awards by Field of Science and Race of PI: Fiscal Years 2000 -2010

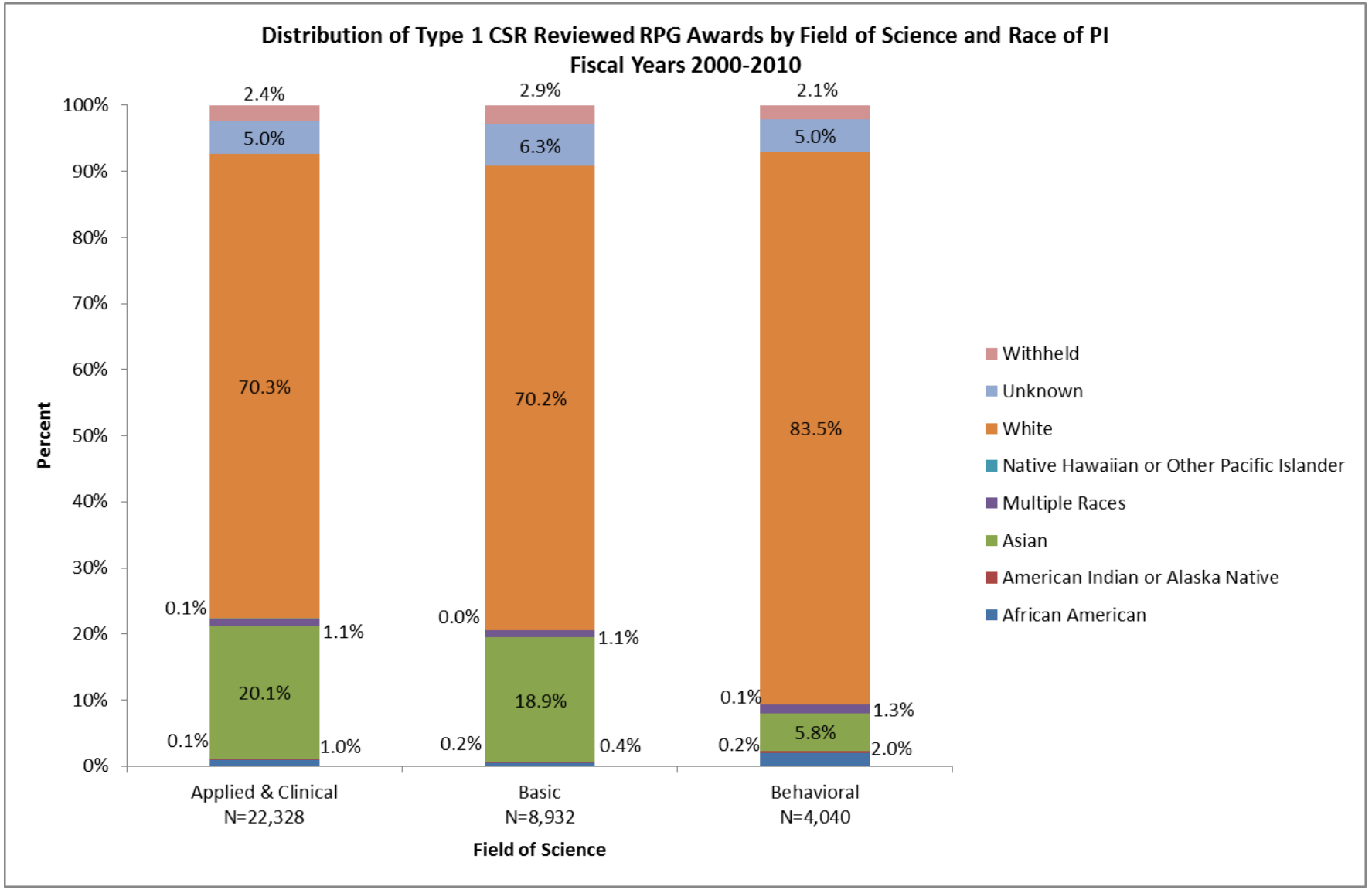


Figure 3C: Success Rates by Field of Science and Race – Clinical Sciences

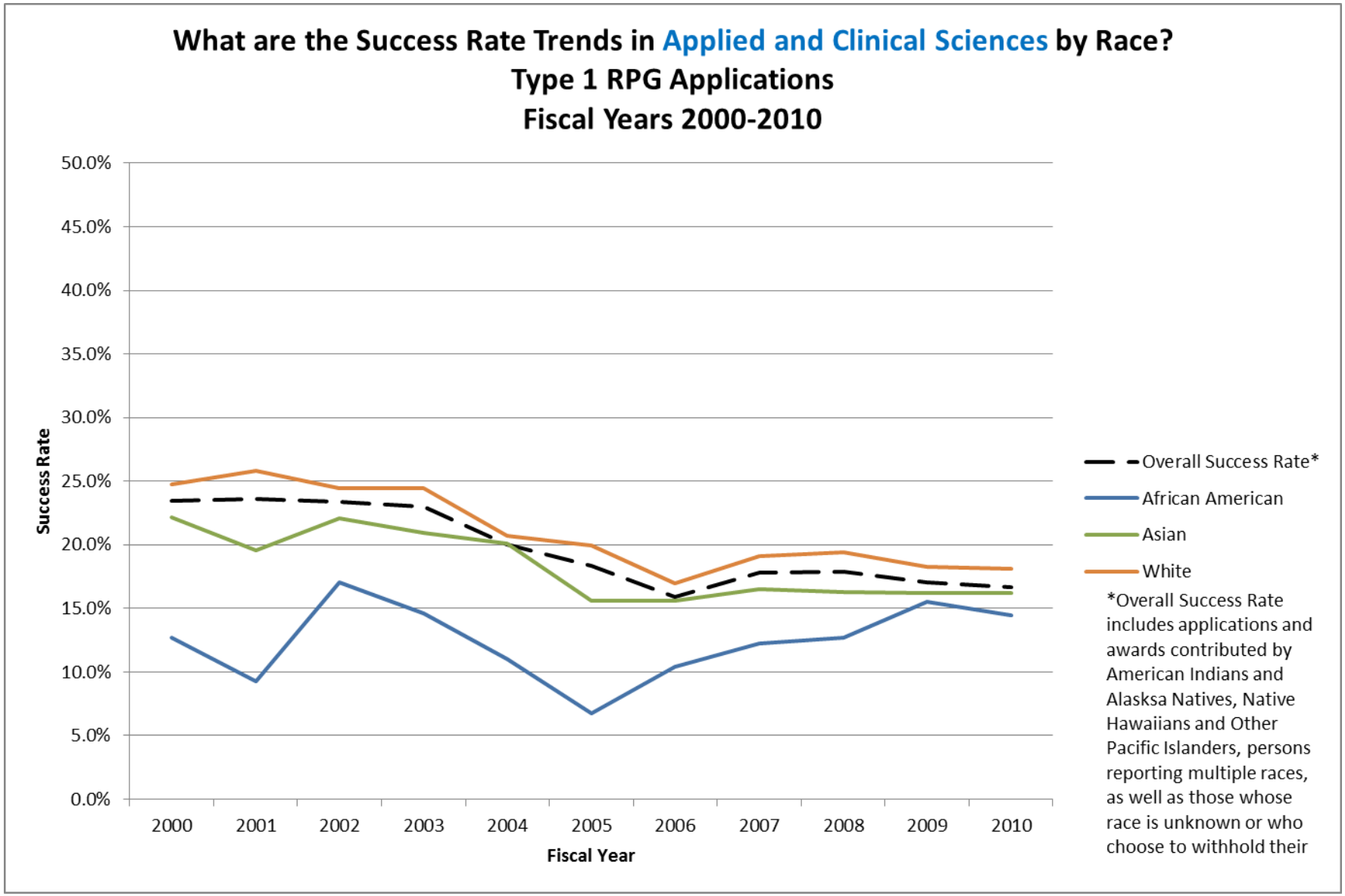


Figure 3D: Success Rates by Field of Science and Race – Basic Sciences

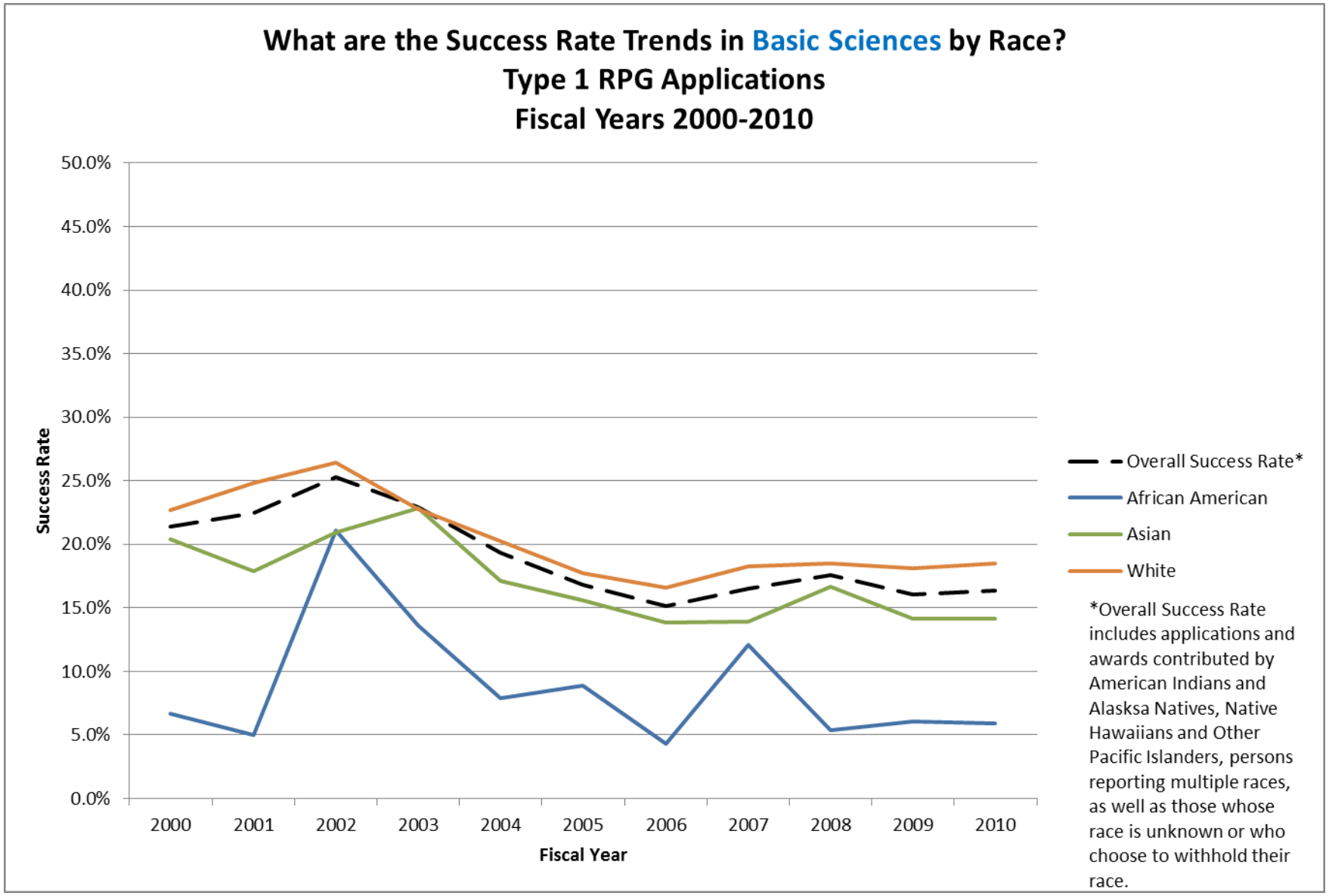


Figure 3E: Success Rates by Field of Science and Race – Behavioral Sciences

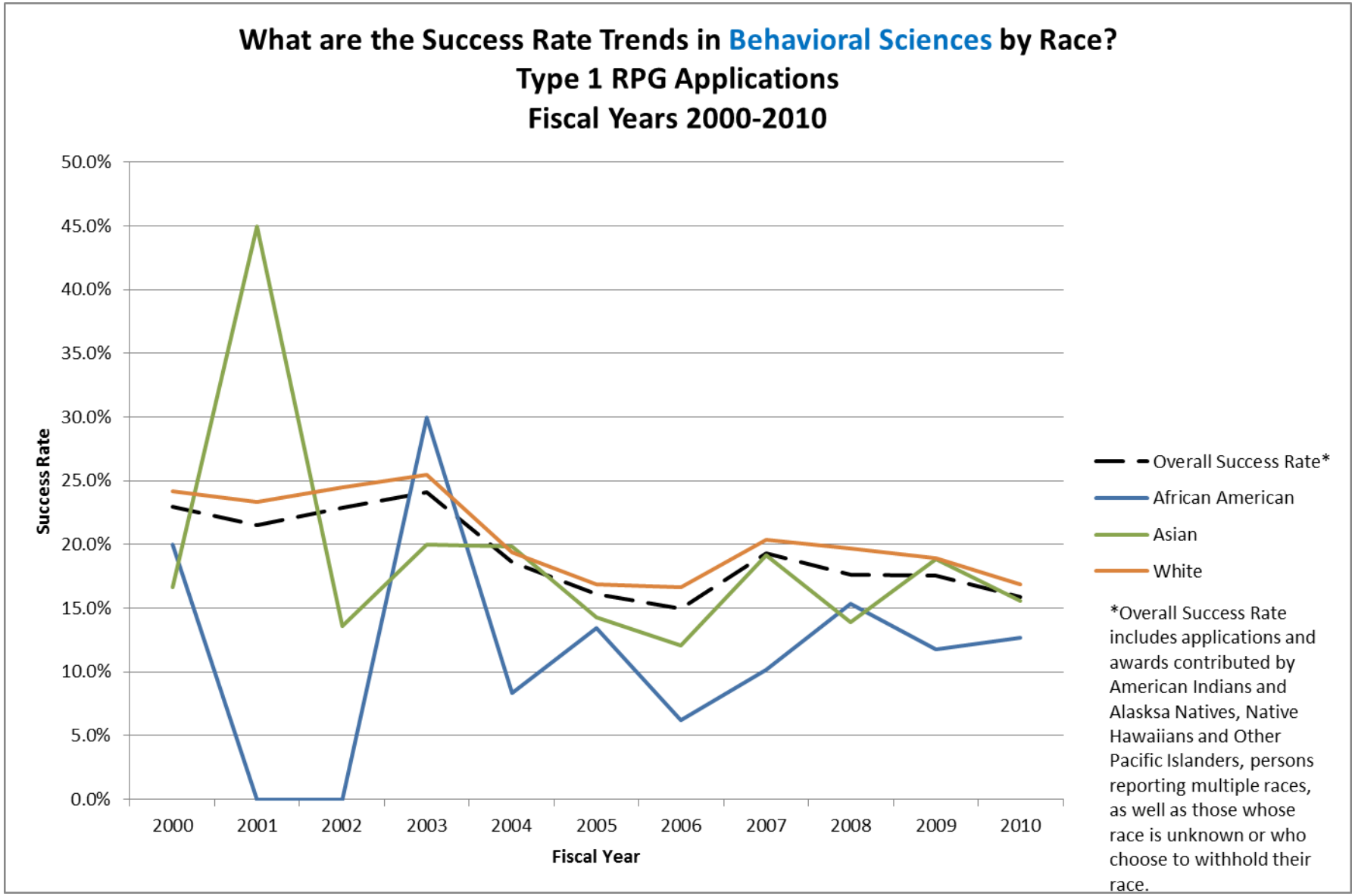


Figure 4: Distribution of Priority Scores for each Race, Unsuccessful Unsolicited Type 1 A0 R01s, FY 1999 – 2009

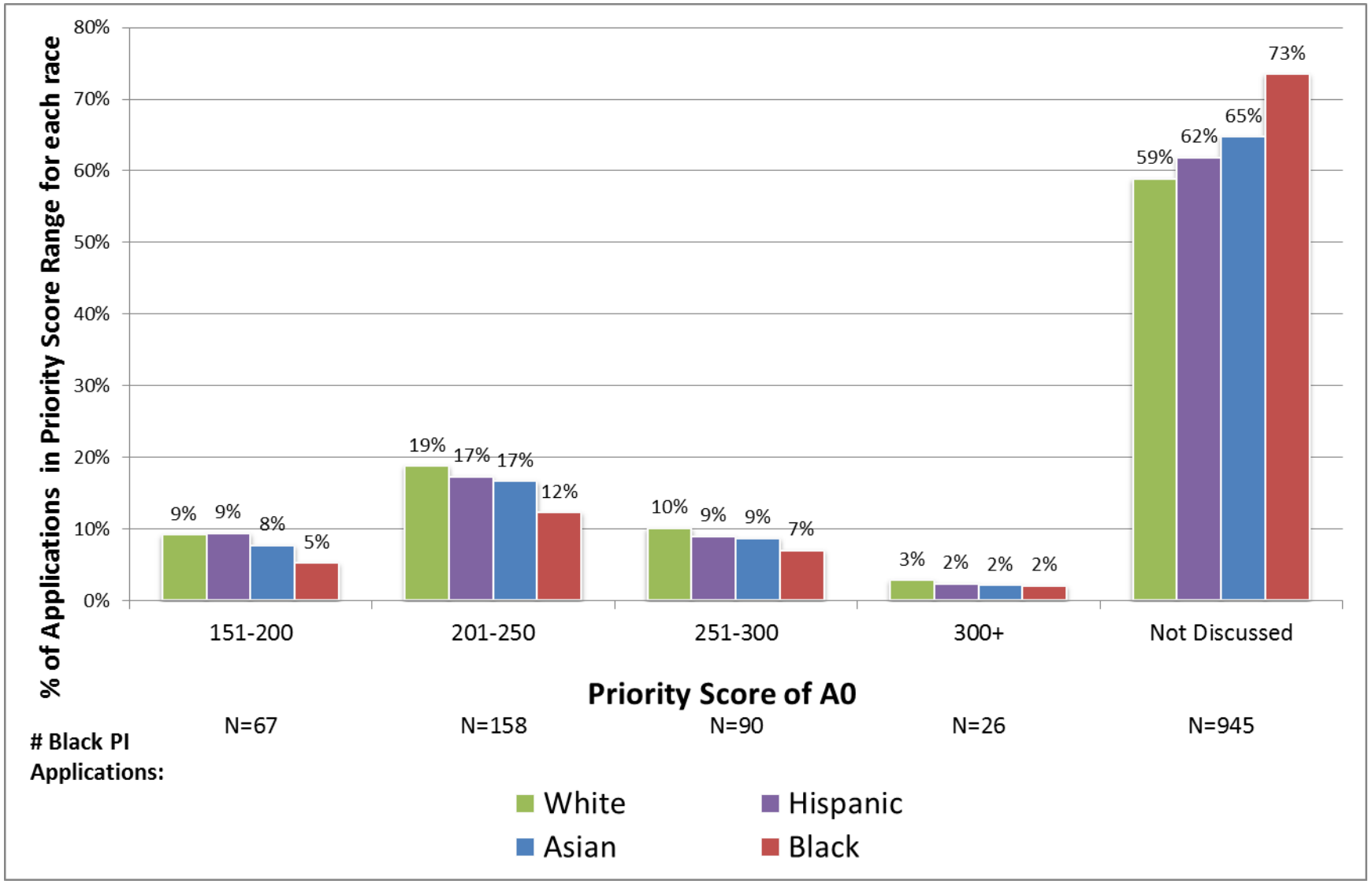


Figure 4A: Distribution of Applications by Race and Overall Impact Score Unsuccessful Unsolicited Type 1 A0 R01s, FY 2010-2011

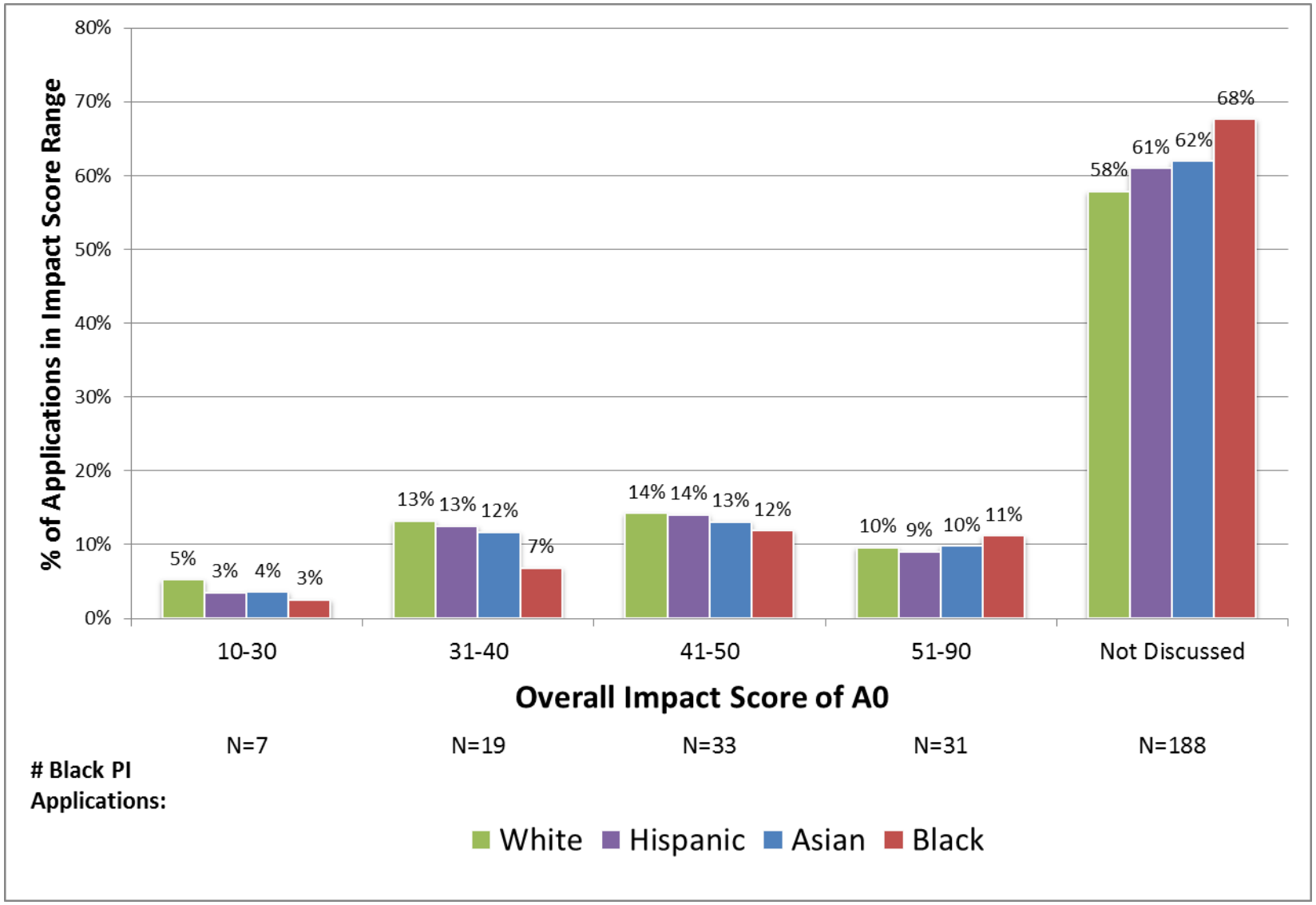


Figure 4B: Resubmission Rate by Race/Ethnicity

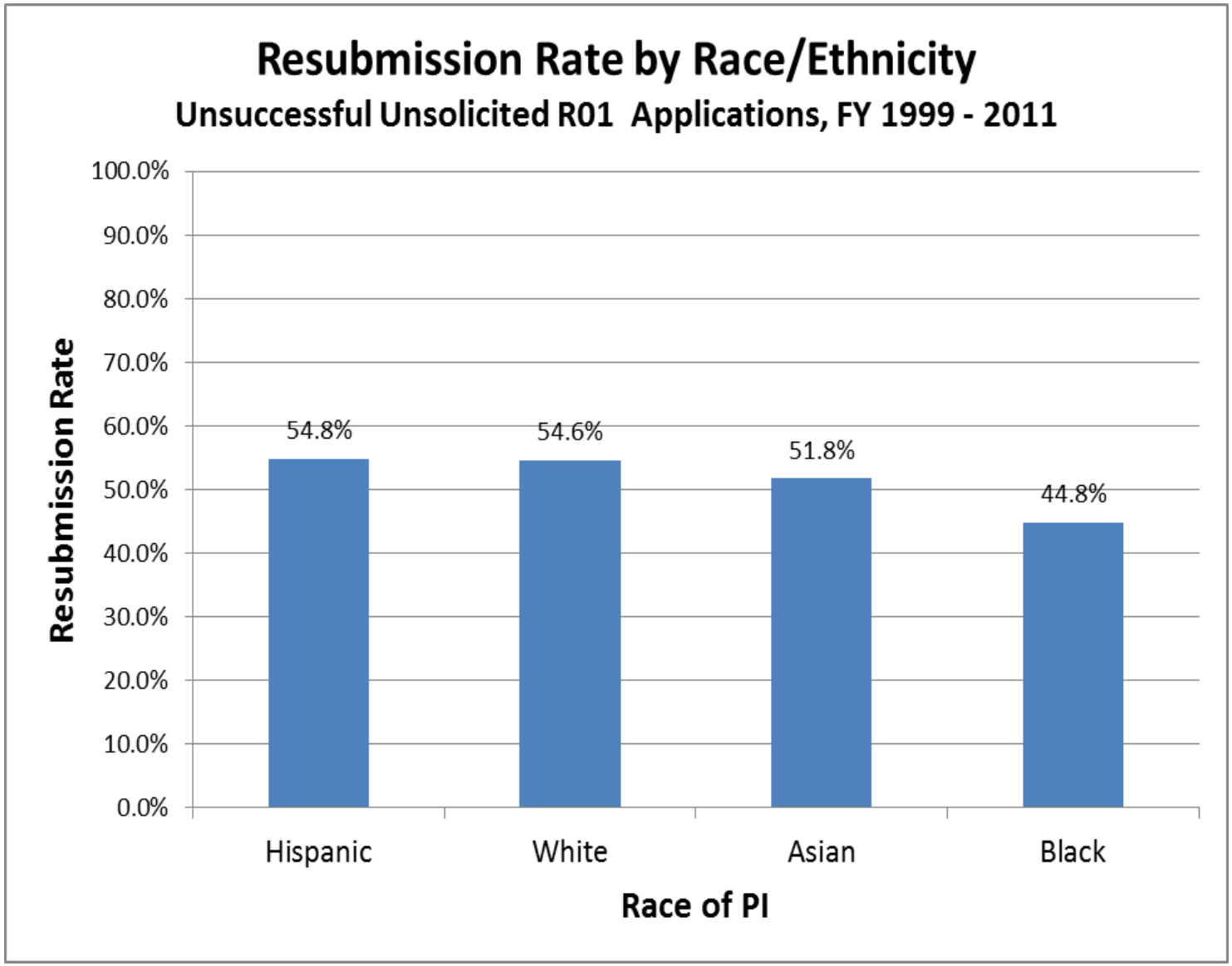


Figure 4C: Resubmission Rate by Review Experience

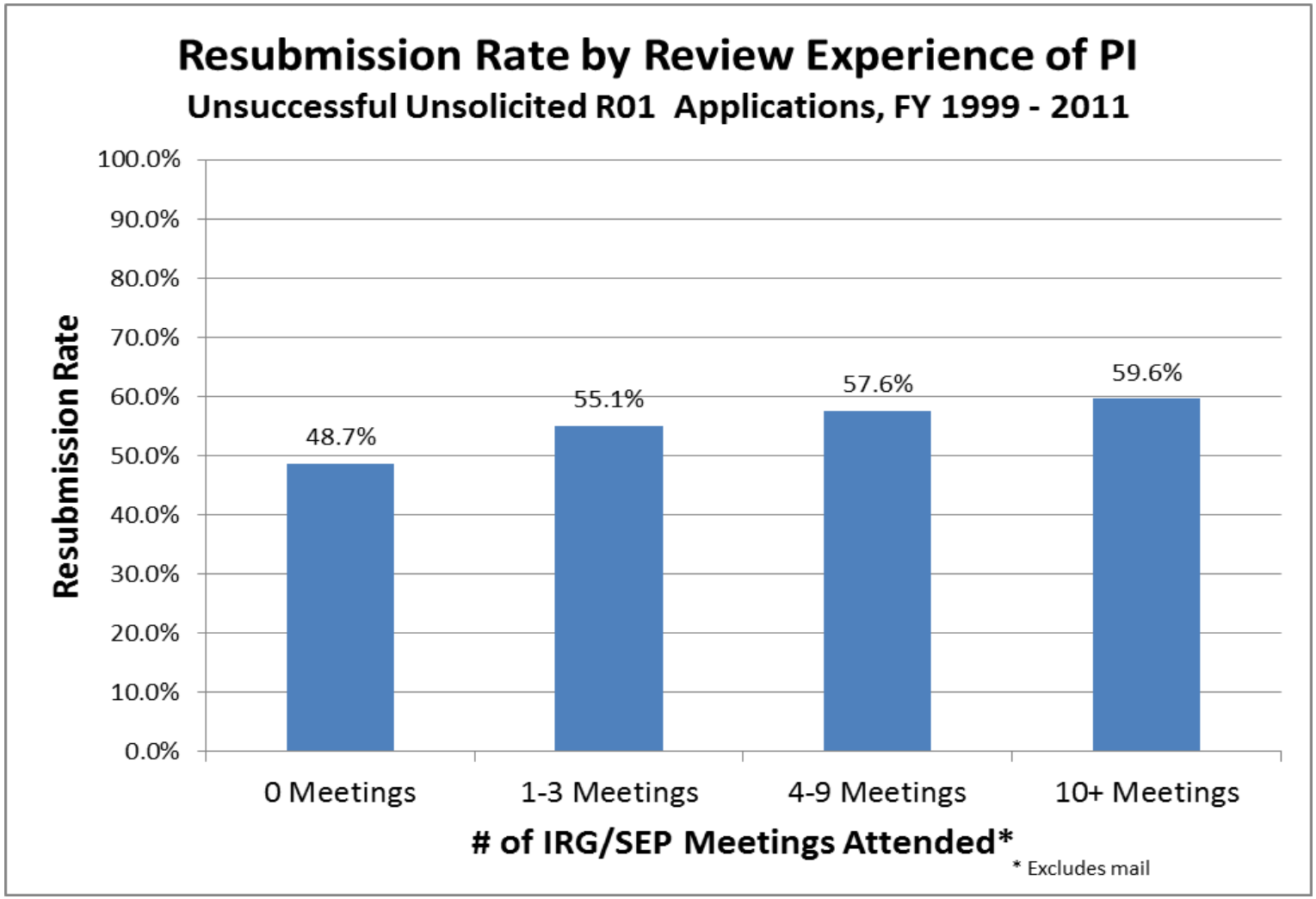


Figure 4D: Resubmission Rate by Funding History of PI

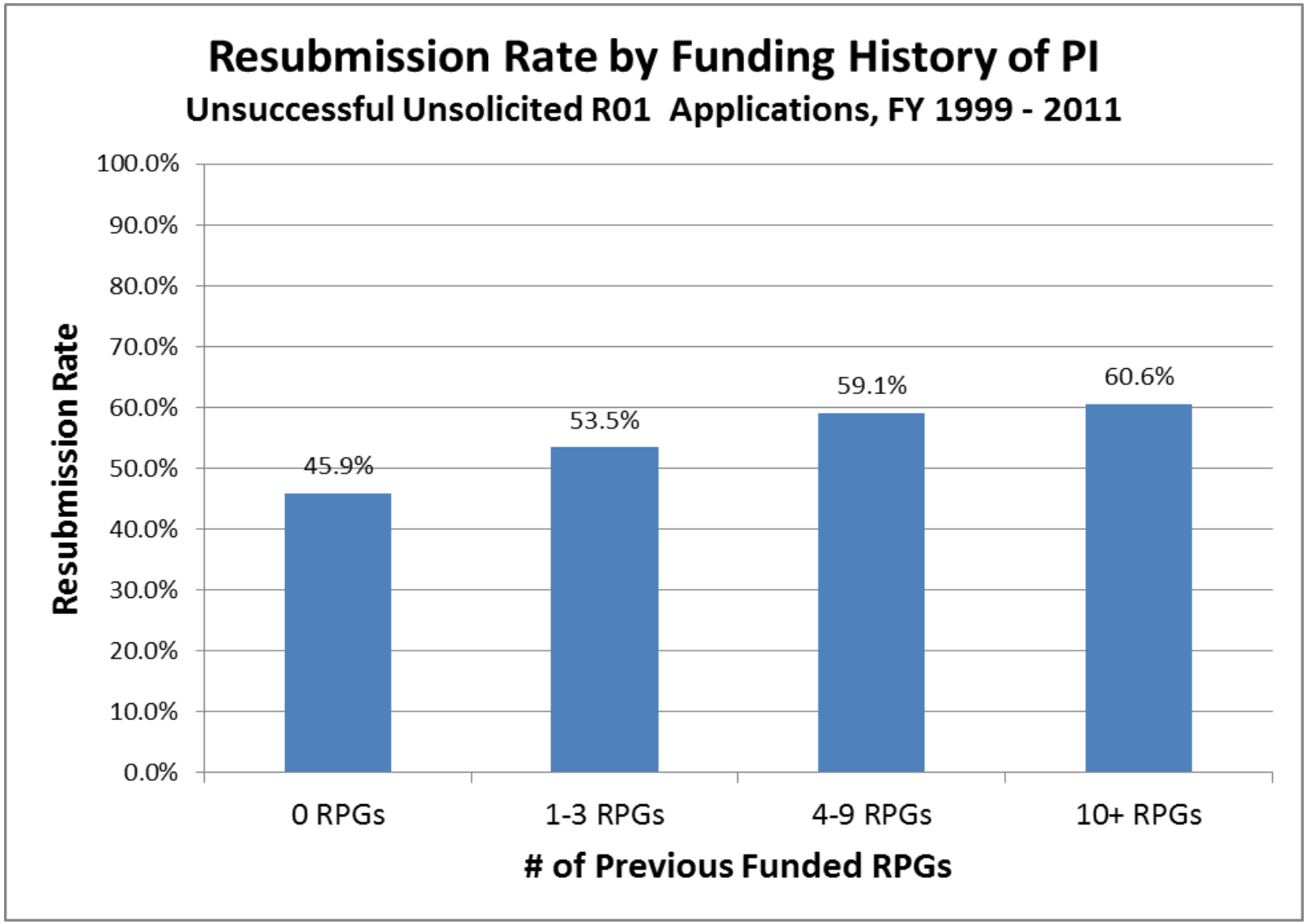


Figure 4F: Resubmission Rate by Priority Score and Race/Ethnicity

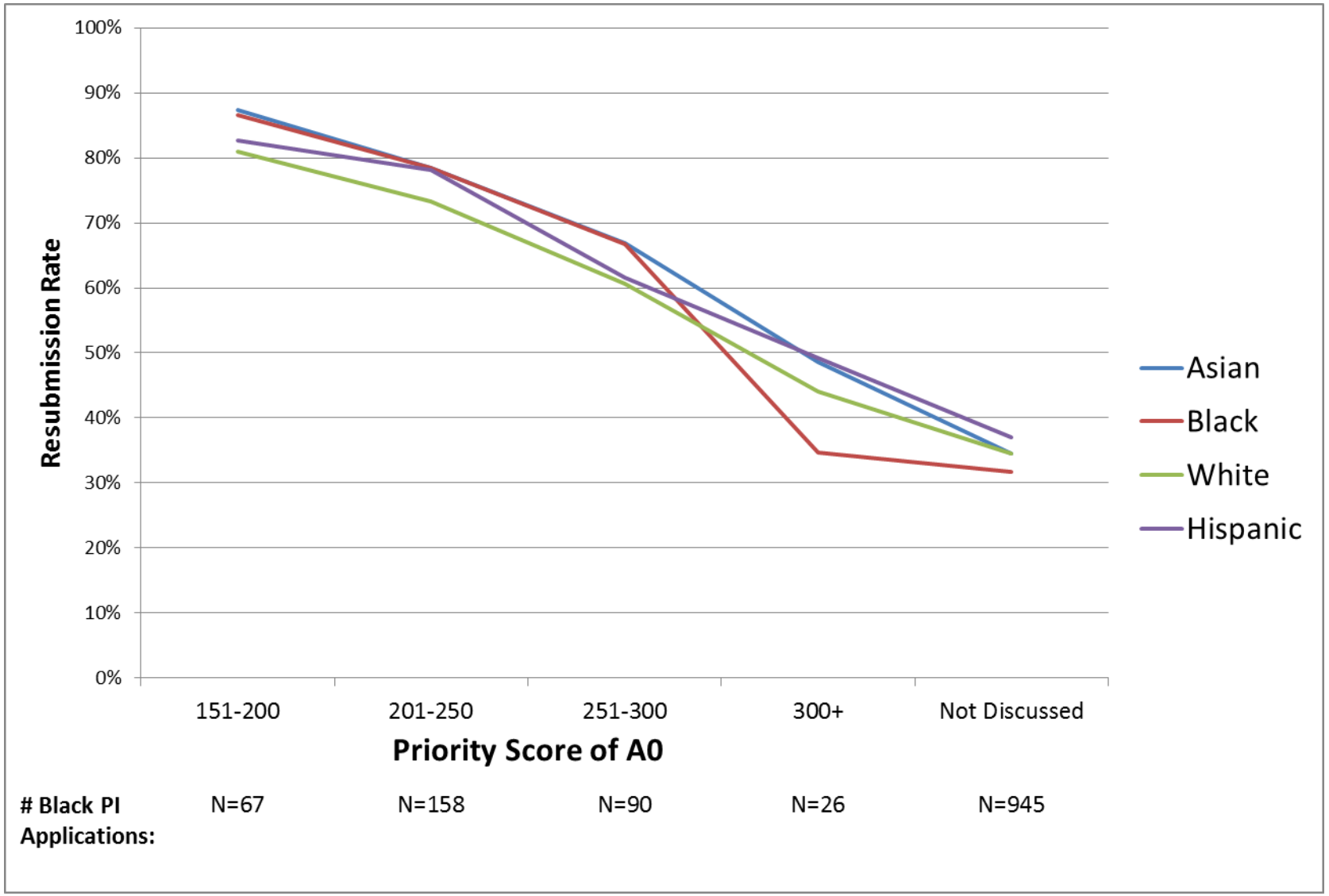


Figure 4G: Resubmission Rate by Overall Impact Score and Race/Ethnicity

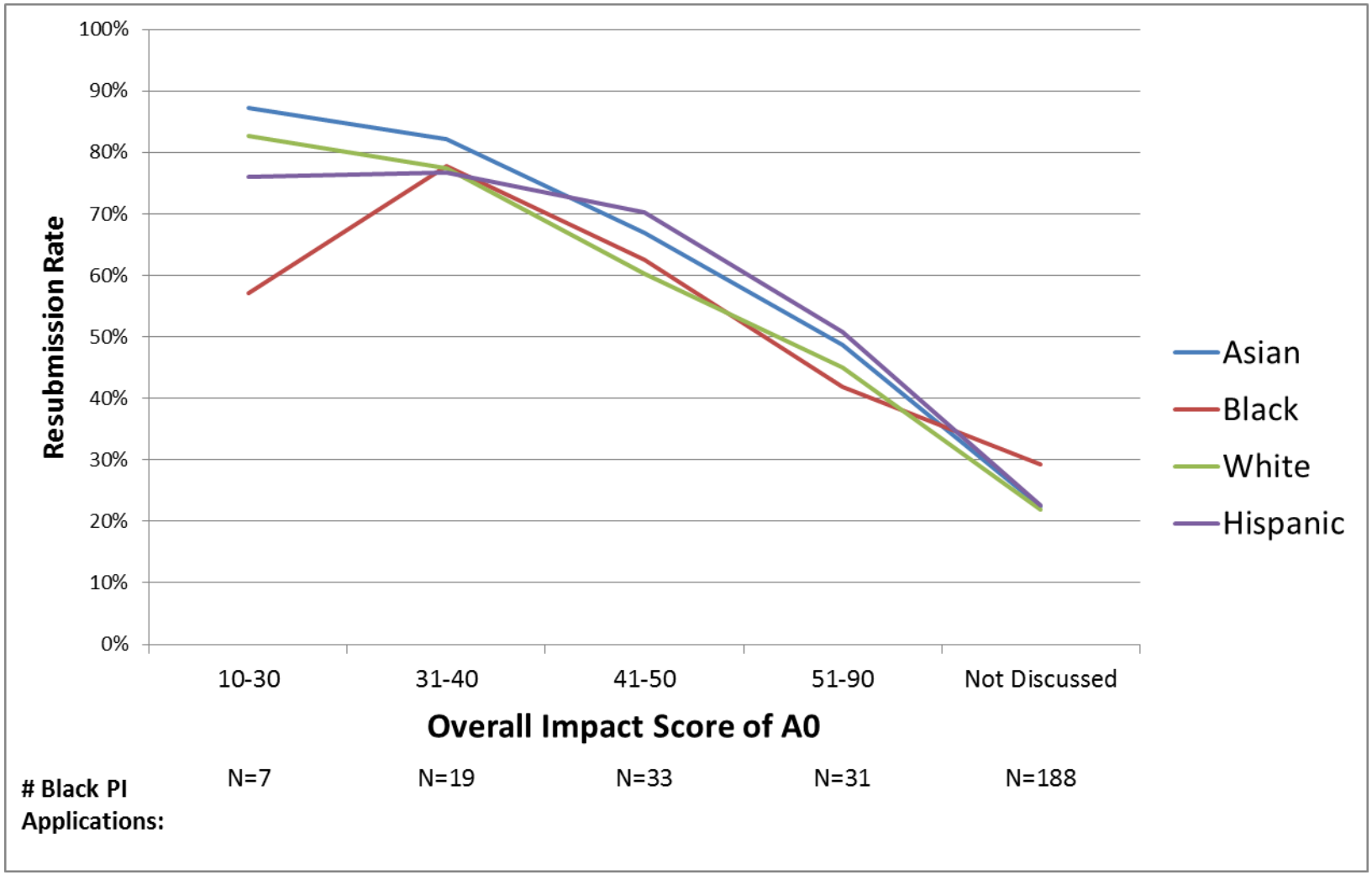


Figure 5: Awarded Degrees in Biological Sciences, Chemistry, and Physics to Citizens and Permanent Residents by US Institutions (2000 to 2008)

	BS/BA Total		BIO (PHD)	CHEM (PHD)	PHYSICS (PHD)	PhD Total		BS/BA to PhD Ratio
Totals	711,062		51,126					0.12
White, Non-Hispanic	489,064		27,518	9,318	4,461	41,297		0.08
Asian or Pacific Islander*	93,899		14,777	1,224	493	16,494		0.18
Black, Non-Hispanic	55,040		1,315	451	146	1,912		0.03
Hispanic	38,679		1,728	535	167	2,430		0.06
American Indian or Alaska Native	4,803		150	53	14	217		0.05
URM BS/BA Total	98,522		URM PhD Tota			4,559		0.05
Average URM BS/BA per Year	**10,947**		**Average URM PhD per Year**			**507**		**0.05**
*Anyone reported as "Asian" or "Asian or Pacific Islander" is reported above in the "Asian or Pacific Islander classification. This changed after 2008, when “Native Hawaiian or Other Pacific Islander” was included as a separate racial classification.								

Source: NSF Women, Minorities, and Persons with Disabilities Report 2011, Tables 5.7 and 7.4

Table 5A: Top Baccalaureate Institutions of Black Science and Engineering Doctorate Recipients, 2005 to 2009

All institutions	5,530
Foreign or unknown	1,682
Top 49 U.S. institutions	1,593
Howard University*	**106**
Florida A&M University	**80**
Spelman College	**79**
Morehouse College	**65**
Hampton University	**59**
Xavier University of Louisiana	**58**
Morgan State University	**54**
Southern University and A&M College	**50**
University of Maryland, Baltimore County	48
North Carolina A&T State University	**46**
Tuskegee University	**42**
University of Maryland, College Park	41
Harvard University	38
University of Michigan, Ann Arbor	37
Alabama A&M University	**33**
University of California, Berkeley	32
Brown University	30
University of Florida	30
Massachusetts Institute of Technology	29
Georgia Institute of Technology	27
University of North Carolina at Chapel Hill	27
Rutgers University, New Brunswick	26
Tennessee State University	**26**
Yale University	26
North Carolina State University, Raleigh	25
Jackson State University	**24**
Michigan State University	24
University of Virginia, main campus	24
Temple University	23
University of Illinois at Urbana-Champaign	23
Lincoln University	**22**
Prairie View A&M University	**22**
Grambling State University	**21**
Duke University	20
Florida State University	20
University of Pennsylvania	20

Cornell University	19
CUNY City College	19
Fisk University	**19**
Norfolk State University	**19**
Ohio State University, main campus	19
North Carolina Central University	**18**
Texas A&M University	18
University of California, Davis	18
University of Missouri-Columbia	18
Wayne State University	18
Clark Atlanta University	**17**
Louisiana State University and A&M College and Hebert Laws Center	17
Stanford University	17
Other institutions	2,255

**Historically Black Colleges and Universities in bold*

Source: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Earned Doctorates, 2005–09., Table 7-10 http://www.nsf.gov/statistics/wmpd/pdf/tab7-10.pdf

Table 5B: Graduate enrollment in science and engineering fields, citizenship, and race/ethnicity of U.S. citizens and permanent residents: 2000–10

													% change	
													2000	2009
Characteristic	2000	2001	2002	2003	2004	2005	2006	2007 old[a]	2007 new[a]	2008	2009	2010	–10[b]	–10
All science and engineering	413,536	429,229	454,834	474,645	475,873	478,275	486,287	502,375	516,199	529,275	545,685	556,532	35	2.0
U.S. citizen or permanent resident	290,651	294,608	309,119	327,181	332,022	338,513	343,603	353,142	365,091	369,781	382,342	390,403	35	2.1
Hispanic or Latino	17,203	17,974	19,634	21,241	22,212	23,387	24,140	25,032	25,739	26,098	27,265	28,609	65	4.9
Not Hispanic or Latino														
American Indian or Alaska Native	1,602	1,683	1,734	1,879	1,848	1,958	2,112	2,168	2,262	2,618	2,549	2,500	55	-1.9
Asian	23,748	25,467	28,290	30,746	29,570	29,547	29,232	30,134	30,697	30,356	31,754	32,185	35	1.4
Black or African American	20,834	21,455	22,668	24,174	24,624	25,248	25,664	26,565	27,637	28,680	29,973	31,094	50	3.7
Native Hawaiian or Other Pacific Islander[c]	1,250	1,027	939	1,040	1,075	1,027	947	1,145	1,200	1,121	1,125	1,088	-15	-3.3
White	205,569	206,018	213,135	222,674	224,850	225,776	227,993	232,043	240,204	242,623	250,443	255,256	25	2.0
More than one race[c]	439	464	384	423	493	528	501	543	551	1,319	2,300	4,989	1,035	116.9
Unknown race/ethnicity	20,006	20,520	22,335	25,004	27,350	31,042	33,014	35,512	36,801	36,966	36,933	34,682	75	-6.1
Temporary visa holder	122,885	134,621	145,715	147,464	143,851	139,762	142,684	149,233	151,108	159,494	163,343	166,129	35	1.7

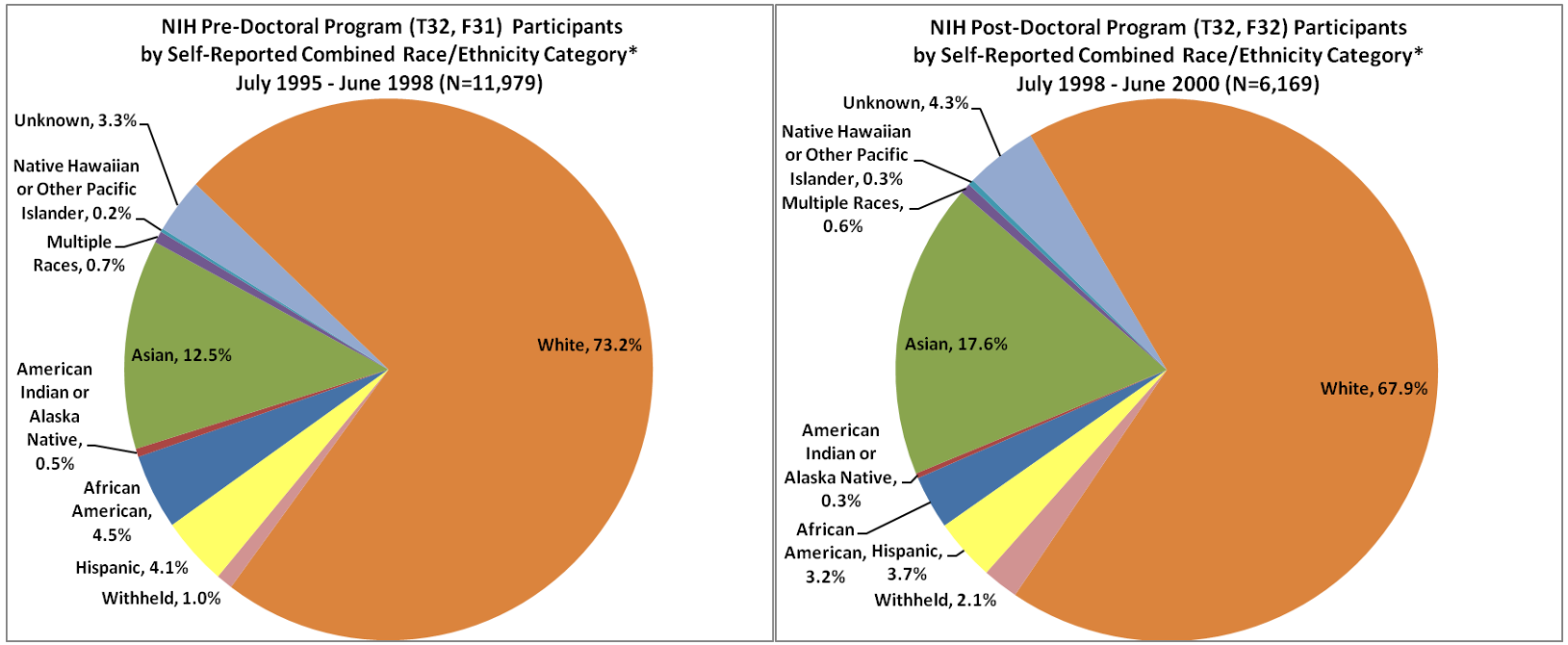
[a] In 2007 survey was redesigned and five fields were added or reclassified to improve reporting. "2007new" shows data as collected in 2007; "2007old" shows data as they would have been collected in prior years. Due to methodological changes, counts should be used with caution for trend analysis. See http://www.nsf.gov/statistics/nsf10307/ for more detail.

[b] "% change 2000–10" is rounded to nearest 5% to reflect potential imprecision of this estimate due to methodological changes in 2007.

[c] Reporting of race/ethnicity in 2008–10 GSS has been affected by changes in reporting of race/ethnicity in the Integrated Postsecondary Education Data System (IPEDS). Starting in 2008 IPEDS respondents were asked to use a new race/ethnicity classification that included a category for two or more races (see http://nces.ed.gov/ipeds/reic/resource.asp) and separate reporting of Native Hawaiians and Other Pacific Islanders from Asians. New classification was optional in 2008 and 2009 IPEDS but mandatory in 2010 and may have contributed to significant increase in GSS reporting of "More than one race," not Hispanic.

Source: National Science Foundation/National Center for Science and Engineering Statistics, NSF-NIH Survey of Graduate Students and Postdoctorates in Science and Engineering. http://www.nsf.gov/statistics/infbrief/nsf12317/

Figure 6: NIH Predoctoral (left) and Postdoctoral (right) Program Participants by Self-Reported Combined Race/Ethnicity Category1



[1] Due to the time period of the cohorts, and the race/ethnicity data collection structure during that time period, ethnicity is reported in conjunction with race, so that persons reporting Hispanic ethnicity are only included in the Hispanic total, and are not included in any of the race totals

Figure 7: Selected Career Outcomes of the 1995-1998 Cohort of NIH PreDoctoral (T32, F31) and NIH Postdoctoral (T32, F32) Program Participants by Self-Reported Combined Category

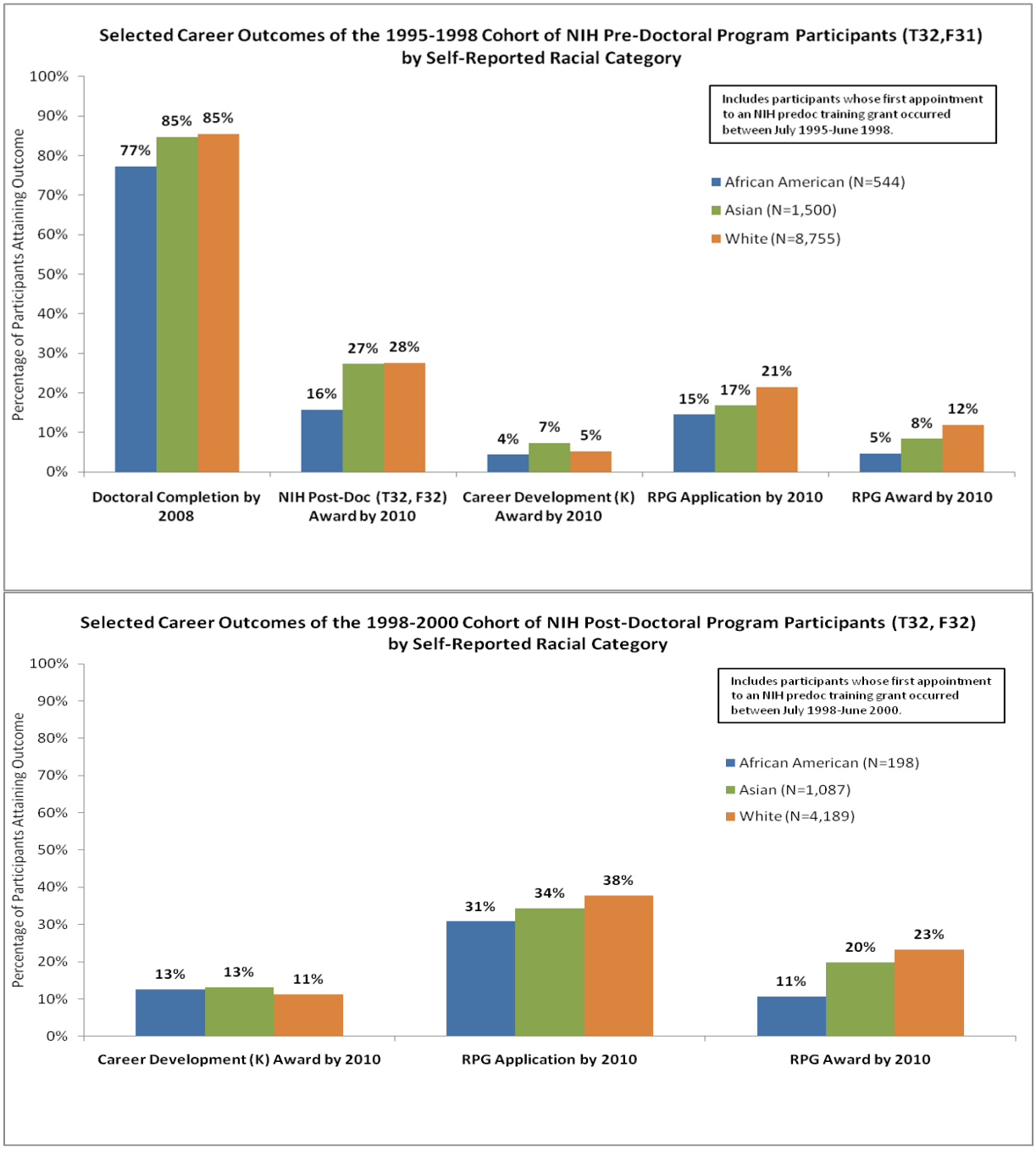


Figure 8: NIH IRP Principal Investigator Race/ Ethnicity Demographics

Principal Investigator Race/Ethnicity Demographics										
	1993-1994	2001-2002	Aug-04	Nov-05	Oct-06	Apr-07	Oct-08	Oct-09	Oct-10	Apr-11
Black or African American	15	22	15	14	13	14	14	15	14	15
Hispanic	24	33	41	39	37	36	35	38	37	37
American Indian/Alaska Native	2	3	2	1	1	1	1	1	1	1
Asian/Pacific Islander	98	115	146	147	150	169	175	194	198	201
White	1163	1090	1048	1009	999	1018	972	968	961	945
Foreign National	-	-	-	-	-	-	-	27	31	24
TOTAL	1302	1263	1252	1210	1200	1238	1197	1243	1242	1223
Principal Investigator Race/Ethnicity Demographics - %										
	1993-1994	2001-2002	Aug-04	Nov-05	Oct-06	Apr-07	Oct-08	Oct-09	Oct-10	Apr-11
American Indian/Alaska Native	0.15%	0.24%	0.16%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%
Asian/Pacific Islander	7.53%	9.11%	11.66%	12.15%	12.50%	13.65%	14.62%	15.61%	15.94%	16.43%
Black or African American	1.15%	1.74%	1.20%	1.16%	1.08%	1.13%	1.17%	1.21%	1.13%	1.23%
Hispanic	1.84%	2.61%	3.27%	3.22%	3.08%	2.91%	2.92%	3.06%	2.98%	3.03%
White	89.32%	86.30%	83.71%	83.39%	83.25%	82.23%	81.20%	77.88%	77.38%	77.27%
Foreign National	-	-	-	-	-	-	-	2.17%	2.50%	1.96%
TOTAL	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %

Figure 8A: NIH IRP PostBac IRTA Applicants and Accepted by Race

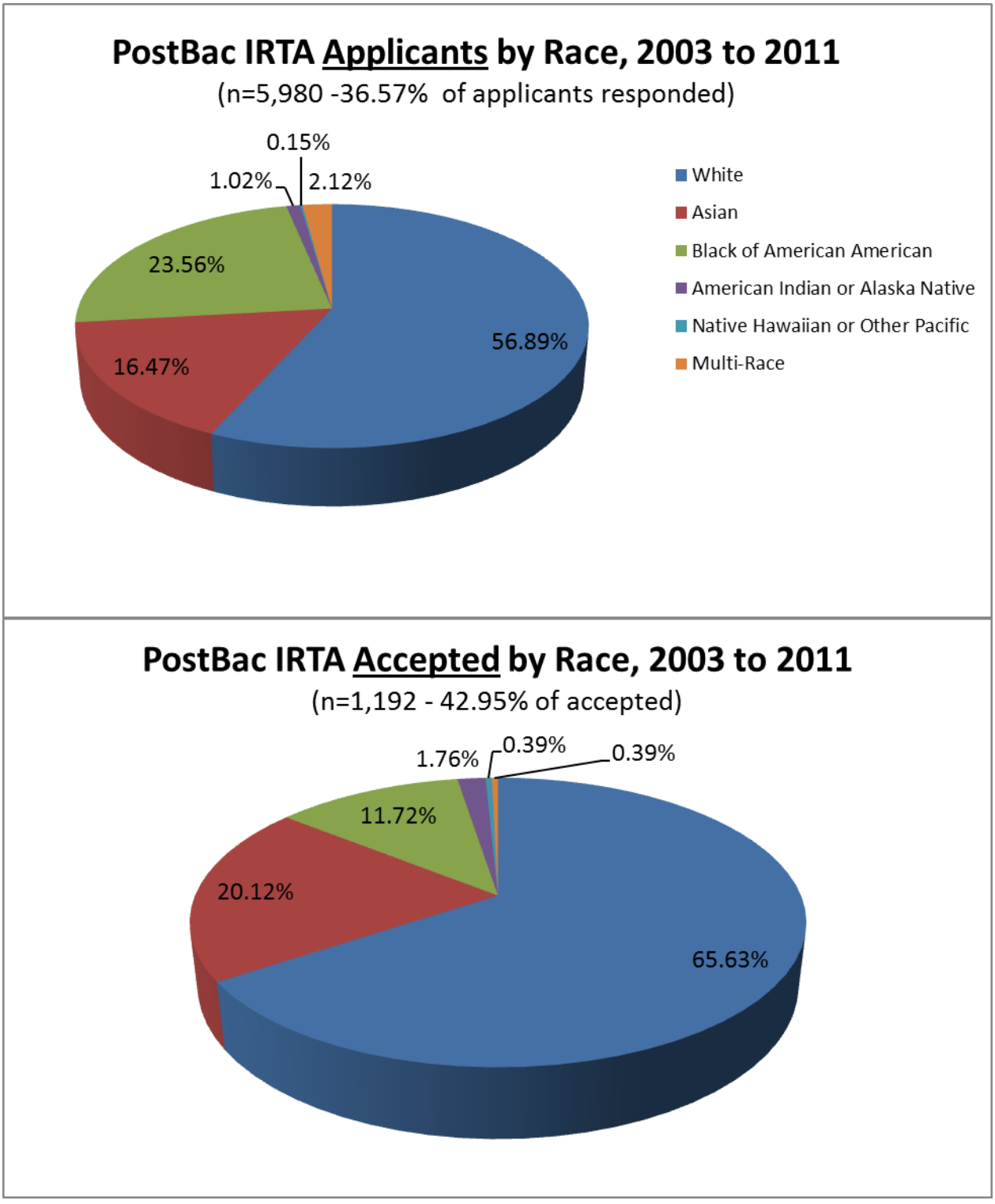


Figure 8B: NIH IRP PostBac IRTA Applicants and Accepted by Ethnicity

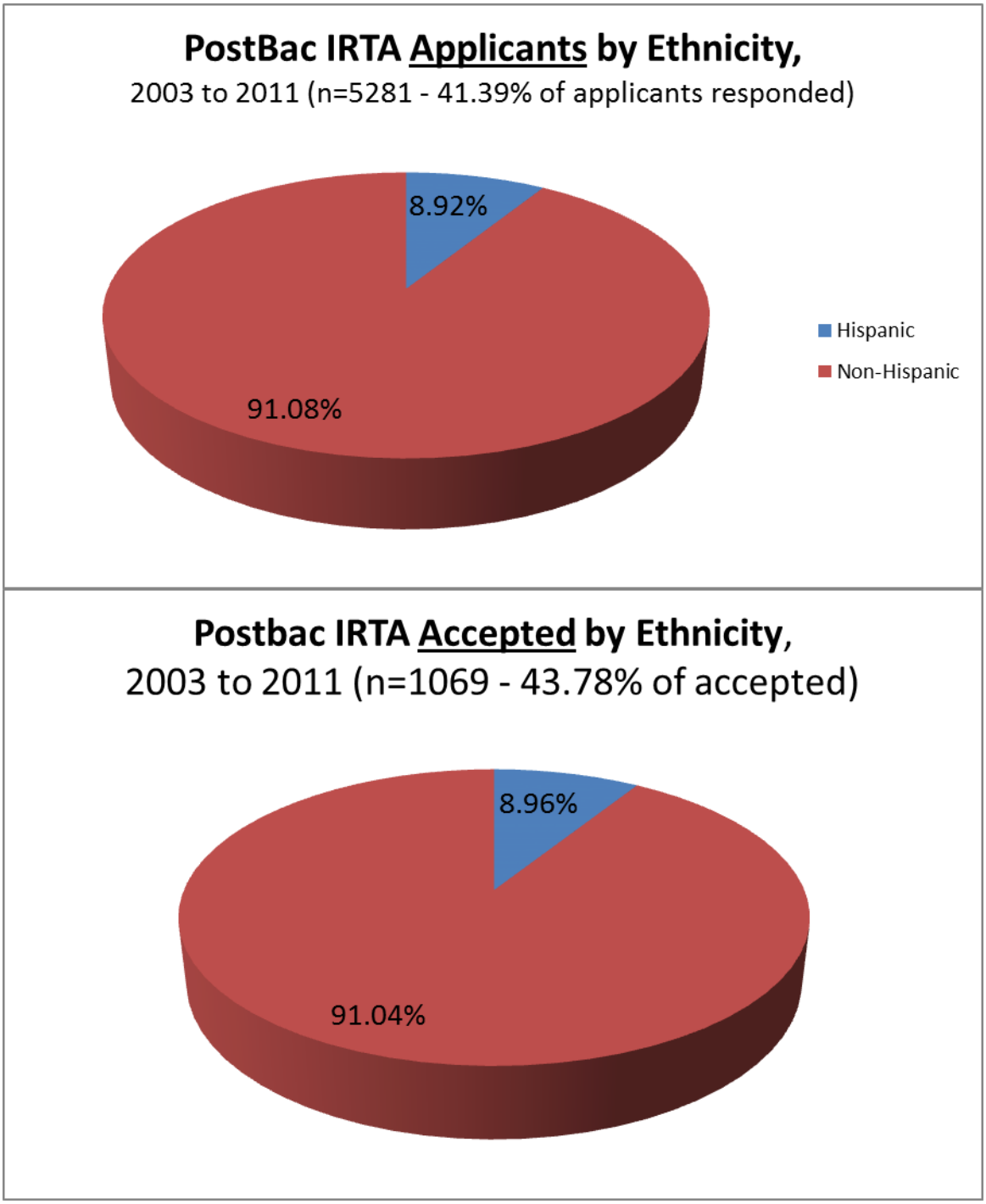


Figure 8C: NIH IRP PostDoc Applicants by Race

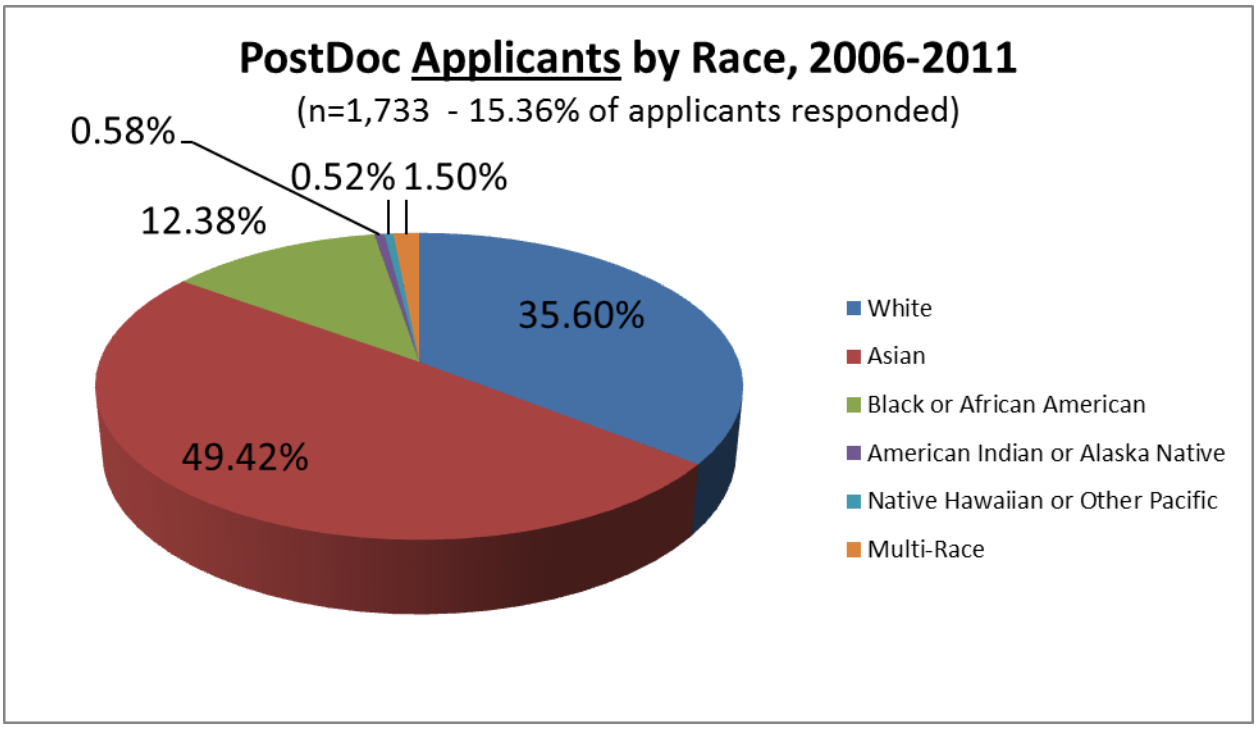


Figure 8D: NIH IRP PostDoc Applicants by Ethnicity

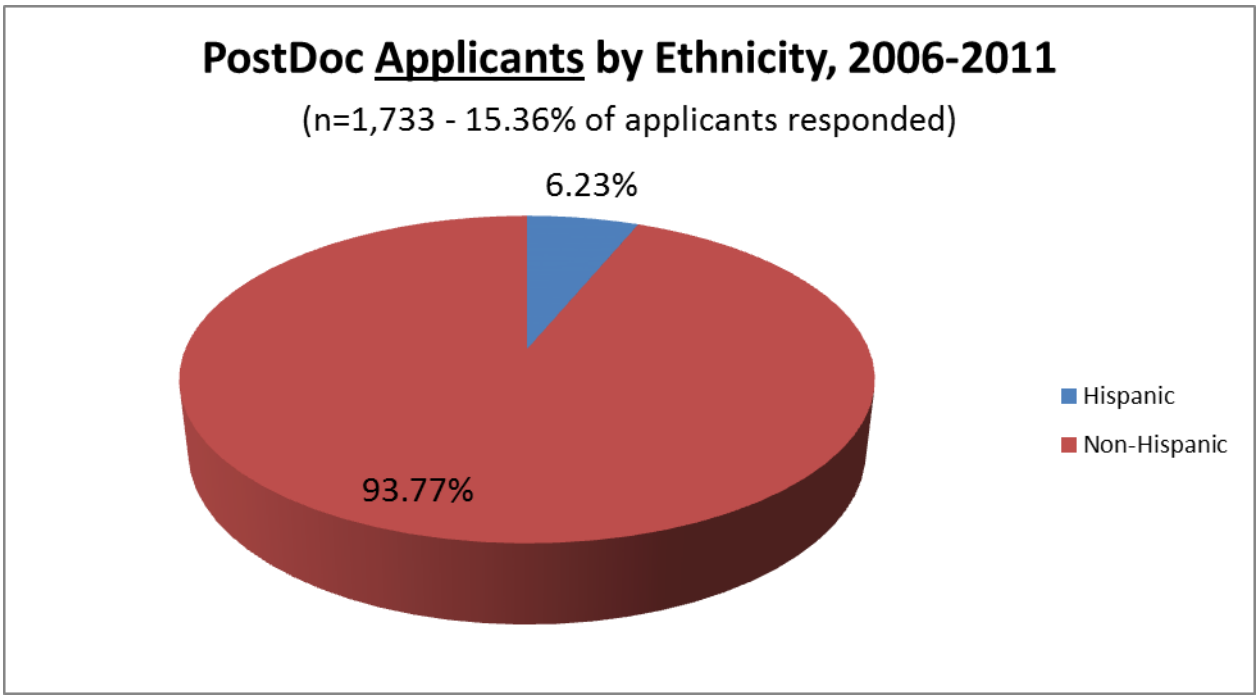


Figure 9A: Impact Model - Unadjusted Summary Statistics for FY 2010 Research Grant Applications

Research Question: Are there differences in the overall Impact score and funding rates between races ***before*** controlling for Criterion scores, NIH institutional factors and Principal Investigator demographics?

Race	N	Impact	Funding Proportion
White	31,579	37.8	0.21
MPI Multiple Races*	3,019	39.9	0.17
Asian	10,184	40.0	0.16
Native Hawaiian or Other Pacific Islander	30	40.2	0.10
Withheld	1,368	40.2	0.17
Single PI Multiple Races	448	40.6	0.18
American Indian or Alaska Native	96	41.0	0.19
African American	825	43.1	0.13
Unknown	7,197	43.4	0.13
Total	**54,746**	**39.1**	**0.18**

There are large differences in outcomes between races, with White PIs having the best outcomes and underrepresented minorities having the worst outcomes

Figure 9B: Impact Model - Regression Model Results Controlling for NIH Institutional Factors and PI Demographics

Criterion	Change in Impact Score
Approach	6.76*
Significance	3.41*
Innovation	1.38*
Investigator	1.32*
Environment	-0.46*

* Indicates significance at the 99% confidence level,

** 95% confidence level

Criterion Interpretation: Coefficients should be interpreted as the change in overall Impact score due to a one point increase (or worsening) in the given criterion, all else equal

†: Multiple Principal Investigator (MPI) applications with principal investigators of different races

Figure 9C: Impact Model - Regression Model Results Controlling for NIH Institutional Factors and PI Demographics

Race	Change in Impact Score
African American	1.21*
Single PI Multiple Races	0.74
Withheld	0.45
Unknown	0.37**
Asian	0.20
American Indian	-0.12
Pacific Islander	-0.30
MPI Multiple Races†	-0.42
White	-

* Indicates significance at the 99% confidence level,

** 95% confidence level

Race Interpretation: Coefficients should be interpreted as the change in overall Impact score for an application from a PI of a given race compared to White PI, all else equal

In comparison to Whites, African Americans receive overall Impact scores that are 1.2 points higher (worse), all else equal

Figure 9D: Funding Model – Regression Results Controlling for NIH Institutional Factors and PI Demographics

Criterion	Scores at 20th Percentile
Approach	-28.0%*
Significance	-18.6%*
Investigator	-7.6%*
Innovation	-7.1%*
Environment	+6.0%*

* Indicates significance at the 99% confidence level

Criterion Interpretation: Coefficients should be interpreted as the change in the probability of funding due to a one point increase (or worsening) in the given criterion for an application with criterion scores at the 20th percentile, all else equal

Figure 9E: Funding Model – Regression Results Controlling for NIH Institutional Factors and PI Demographics

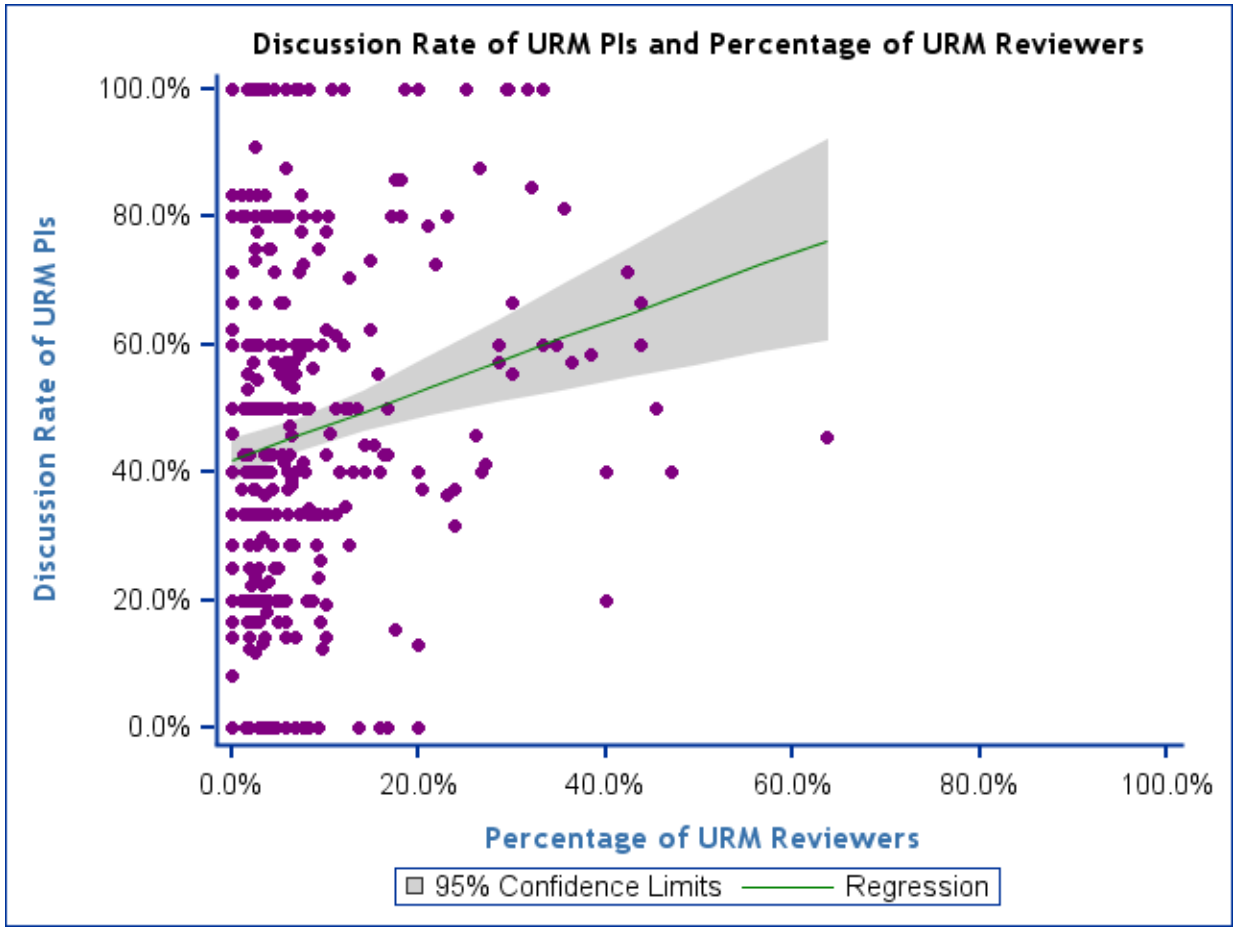
Race	Scores at 20th Percentile
Pacific Islander	-19.3%
Withheld	-4.8%
Unknown	-4.6%**
American Indian	-3.5%
Asian	-1.1%
African American	-0.1%
Single PI Multiple Races	3.5%
MPI Multiple Races†	4.9%
White	-

Race Interpretation: Coefficients should be interpreted as the change in the probability of funding for an application with criterion scores at the 20th percentile from a PI of a given race compared to White PI, all else equal

†: Multiple Principal Investigator (MPI) applications with principal investigators of different races

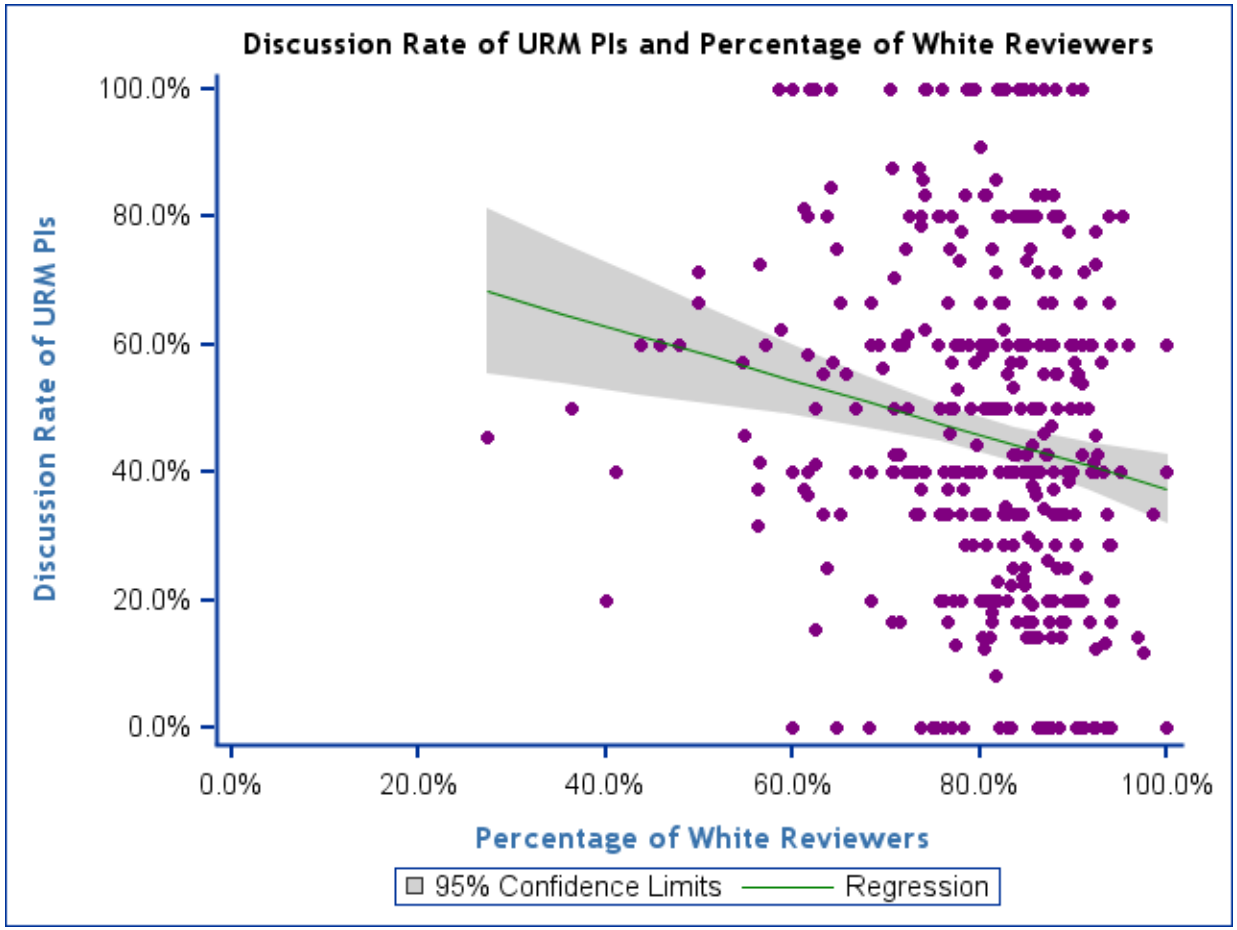
In comparison to Whites, differences in funding probabilities are small and statistically insignificant, except for Unknown Race, once the criterion scores are taken into account

Figure 10A: Discussion rate of URM PIs and Percentage of URM Reviewers



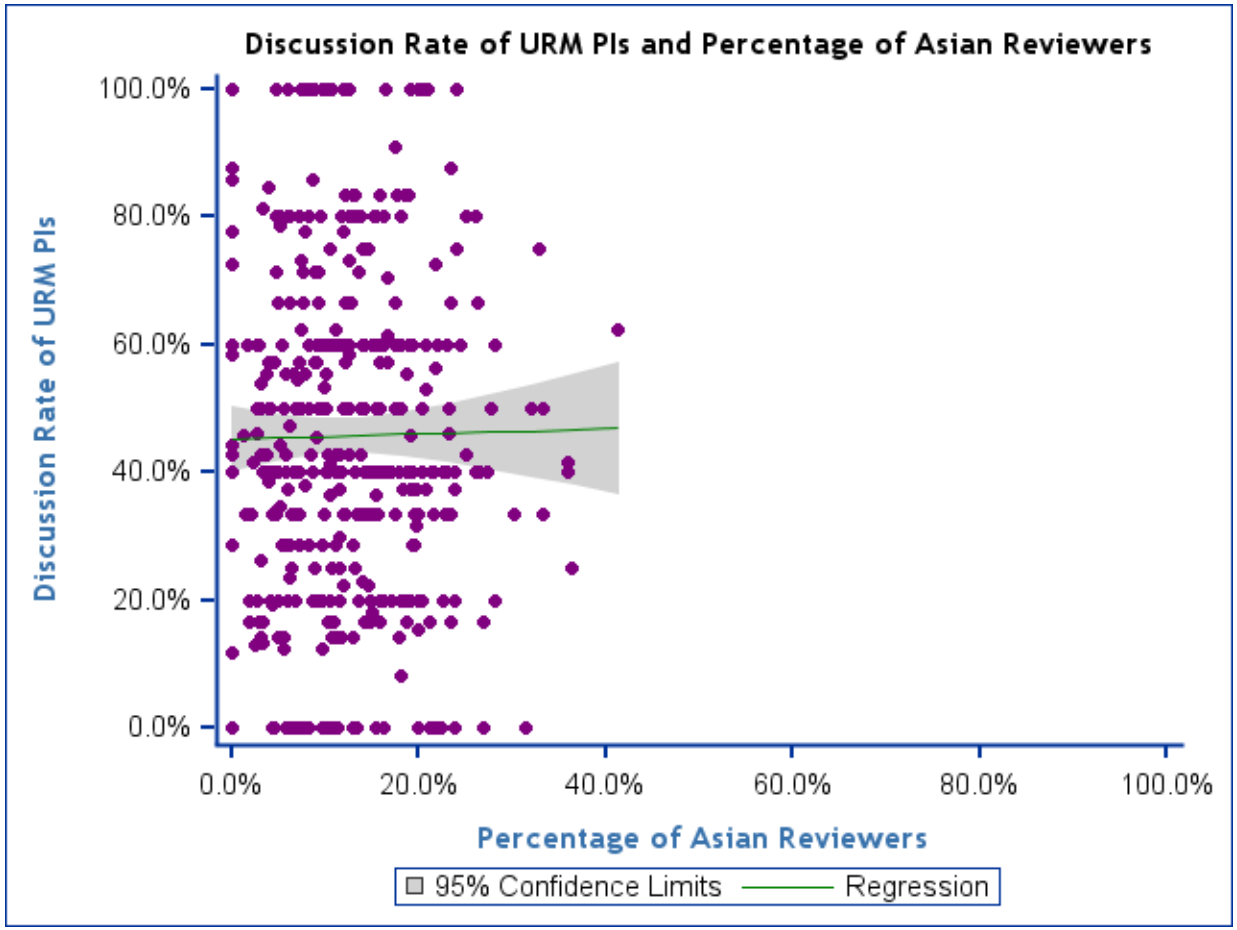
There is a statistically significant positive relationship between the percentage of URM reviewers and the discussion rates of URMs. However, the relationship is very weak (correlation = 0.19) and the amount of variation in discussion rates explained by the percentage of URM reviewers is only 3.7%, meaning that the percentage of URM reviewers has very little influence on the discussion rates of URM PIs.

Figure 10B: Discussion rate of URM PIs and Percentage of White Reviewers



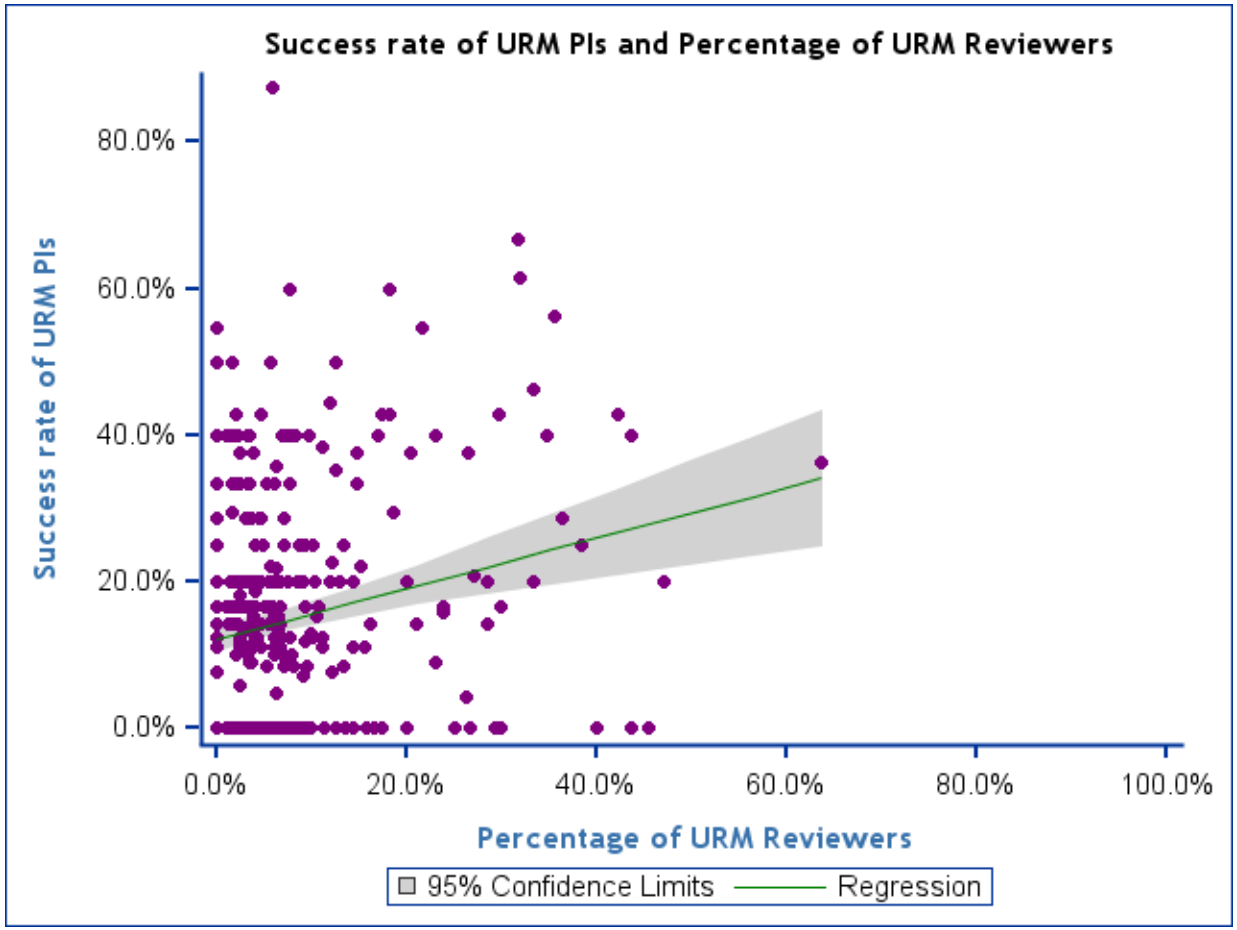
There is a statistically significant negative relationship between the percentage of White reviewers and the discussion rates of URMs. However, the relationship is very weak (correlation = -0.17), and the amount of variation in discussion rates explained by the percentage of white reviewers is 3%, meaning that the percentage of White reviewers has very little influence on the discussion rates of URM PIs

Figure 10C: Discussion rate of URM PIs and Percentage of Asian Reviewers



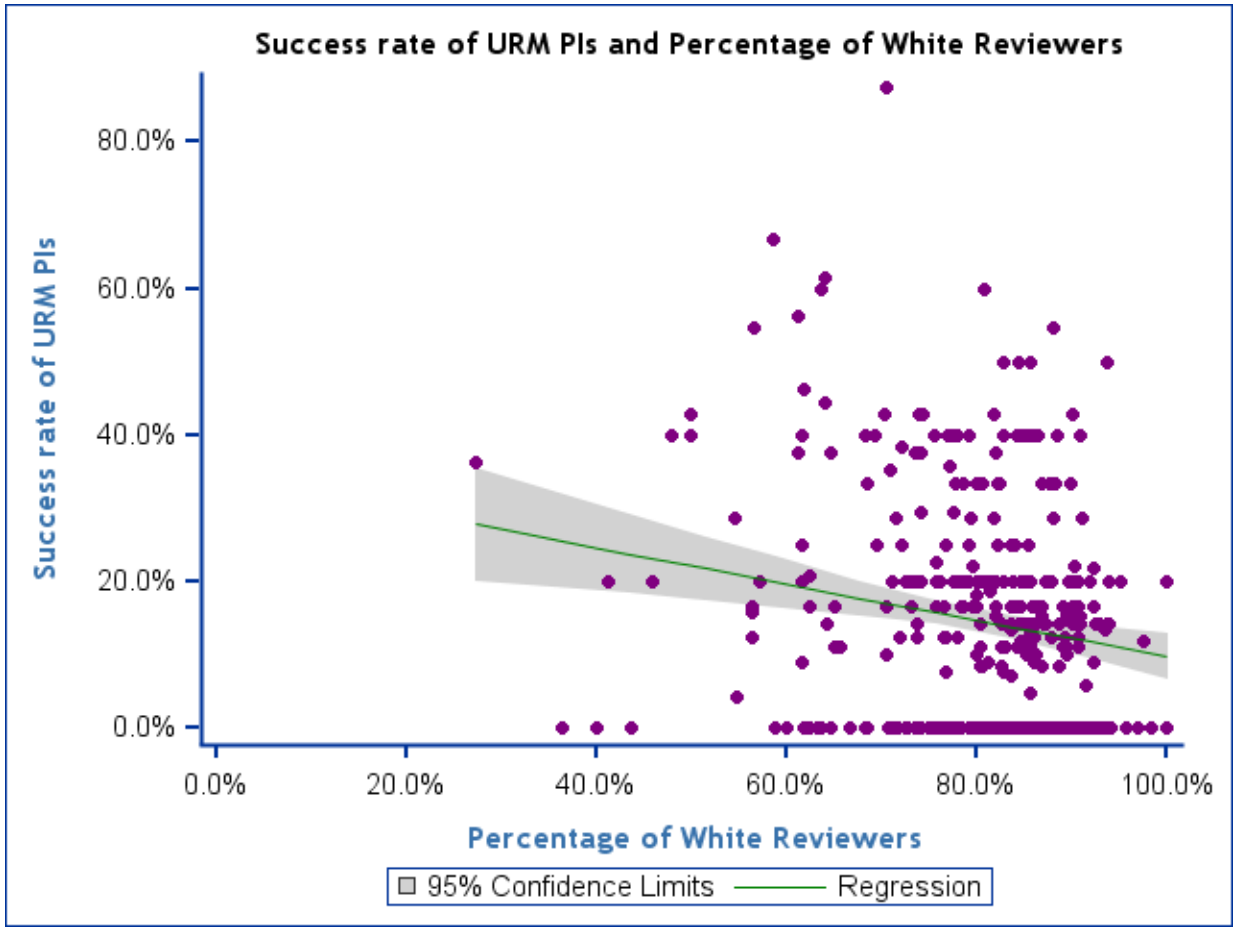
There is no statistically significant relationship between the discussion rates of URM PIs and the percentage of Asian reviewers (correlation=0.01). This means that the percentage of Asian reviewers has no influence on the discussion rates of URM PIs.

Figure 10D: Success rate of URM PIs and Percentage of URM Reviewers



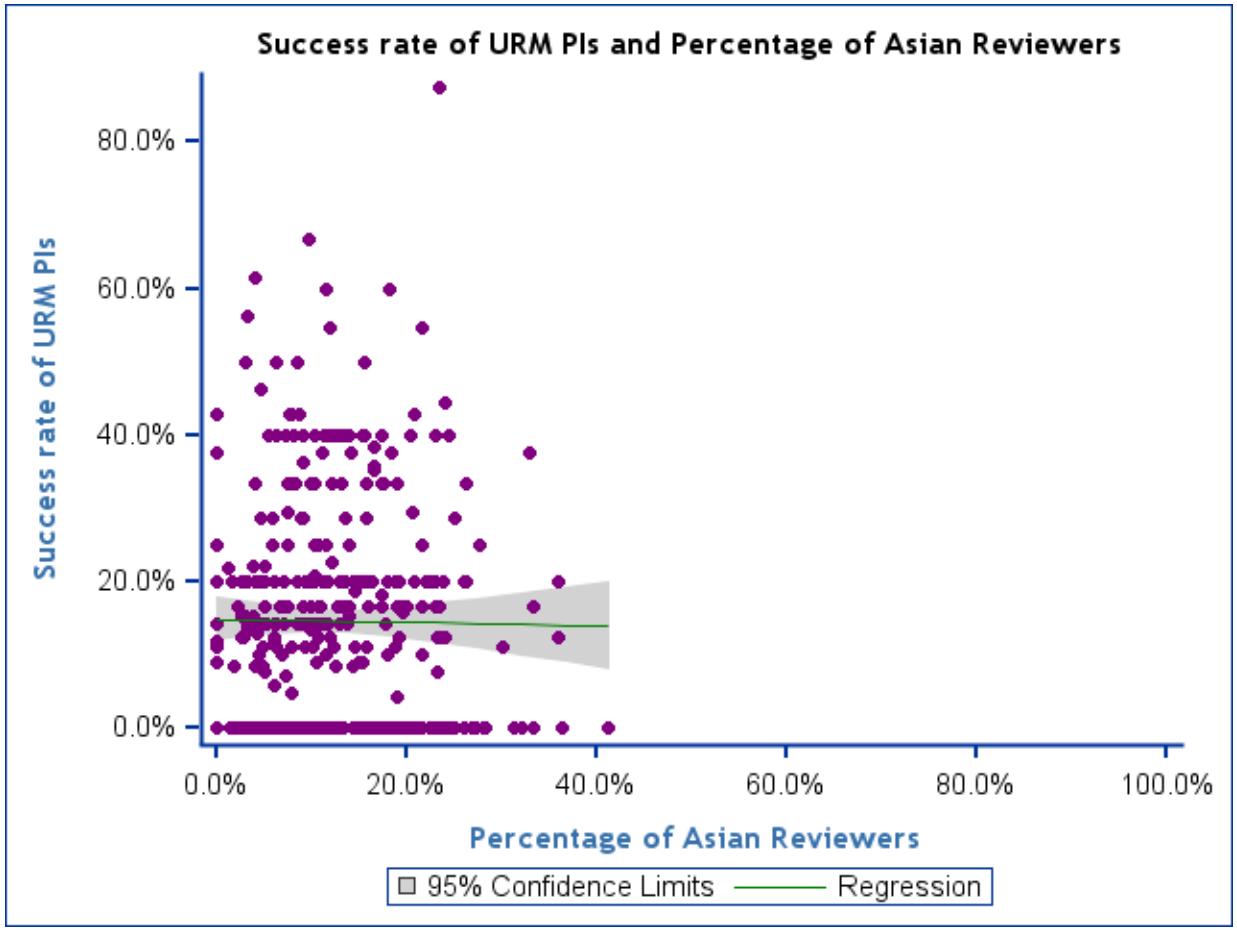
There is a statistically significant positive relationship between the percentage of URM reviewers and the success rates of URMs. However, the relationship is very weak (correlation = 0.21) and the amount of variation in success rates explained by the percentage of URM reviewers is only 4.3%, meaning that the percentage of URM reviewers has very little influence on the success rates of URM PIs.

Figure 10E: Success rate of URM PIs and Percentage of White Reviewers



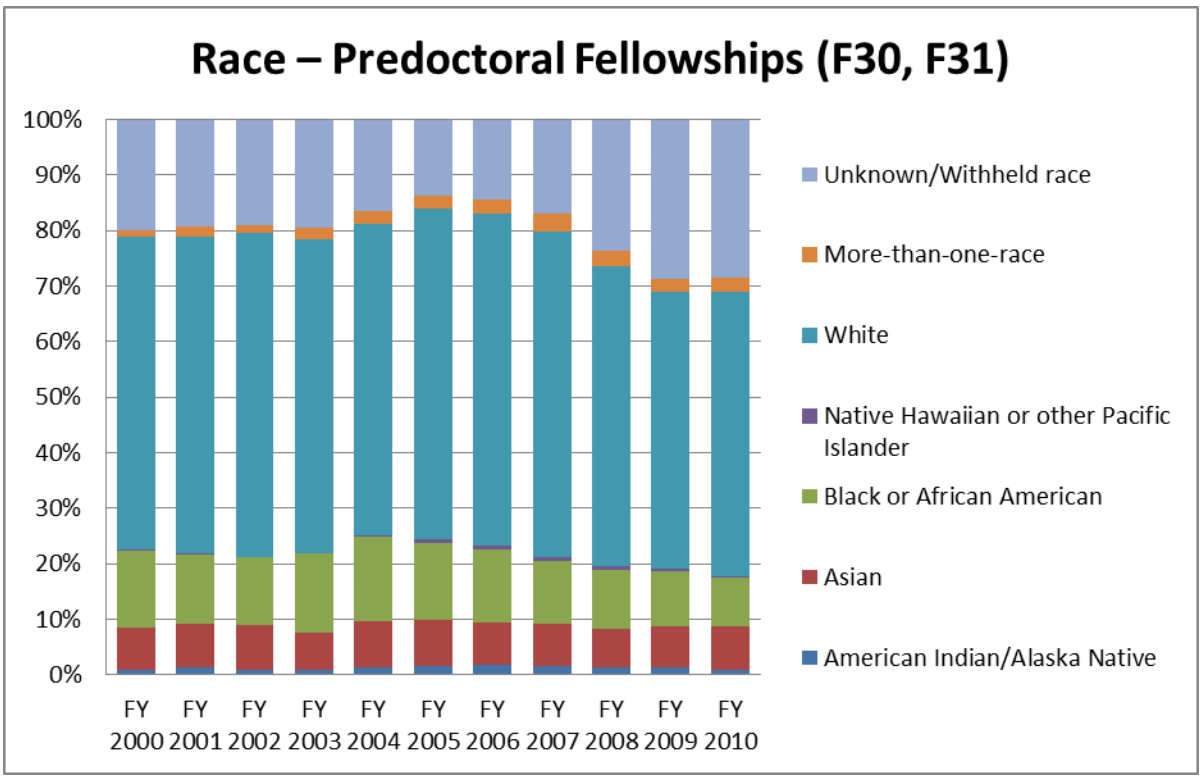
There is a statistically significant negative relationship between the percentage of White reviewers and the success rates of URMs. However, the relationship is very weak (correlation = -0.17), and the amount of variation in success rates explained by the percentage of white reviewers is 2.9%, meaning that the percentage of White reviewers has very little influence on the success rates of URM PIs.

Figure 10F: Success rate of URM PIs and Percentage of Asian Reviewers



There is no statistically significant relationship between the success rates of URM PIs and the percentage of Asian reviewers (correlation=-0.01). This implies that the percentage of Asian reviewers has no influence on the success rates of URM PIs.

Figure 11A: Descriptive Statistics Race/Ethnicity for Awardees from FY 2000-10 – Predoctoral Fellowships (F30, F31)



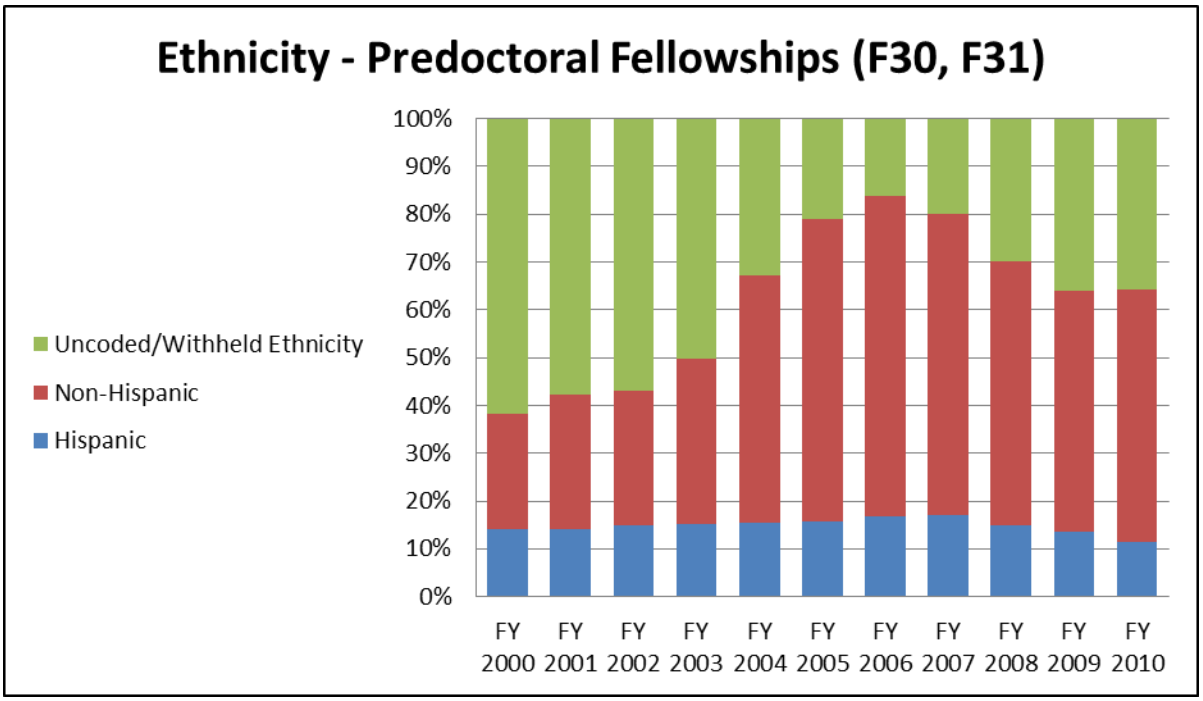
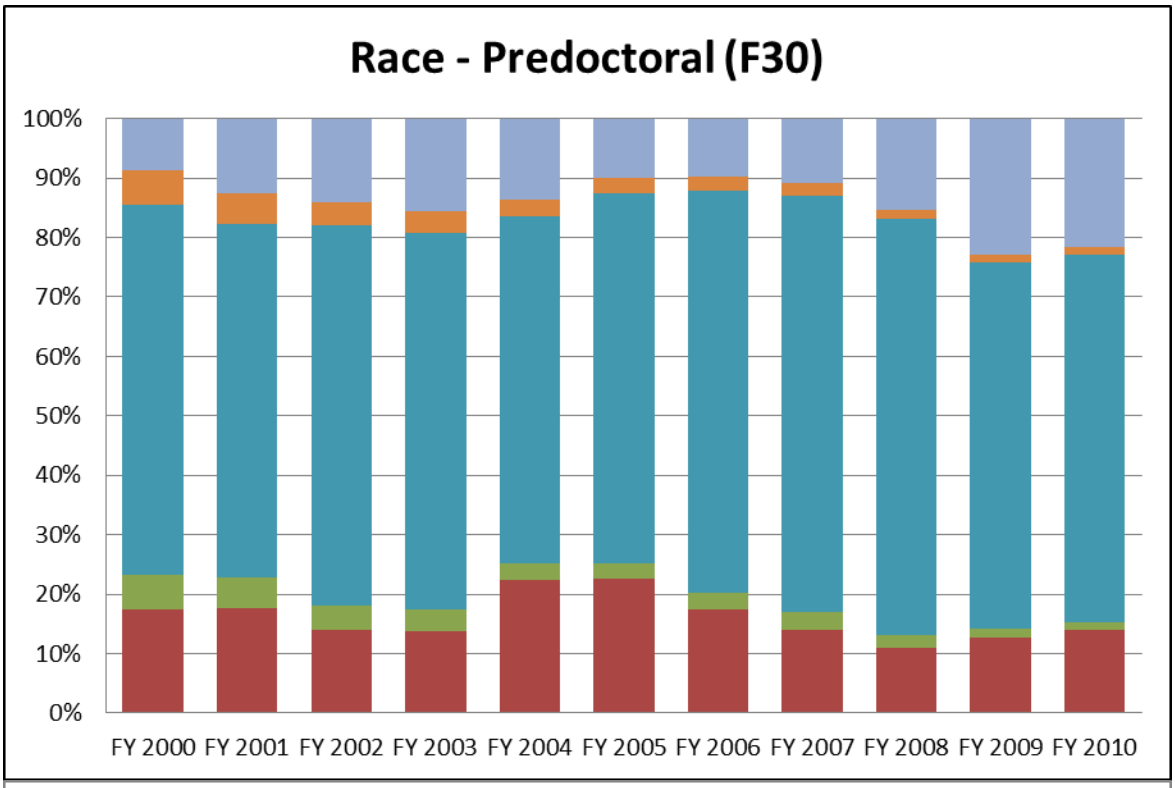


Figure 11B: Descriptive Statistics Race/Ethnicity for Awardees FY2000-10– Predoctoral Fellowships (F30)



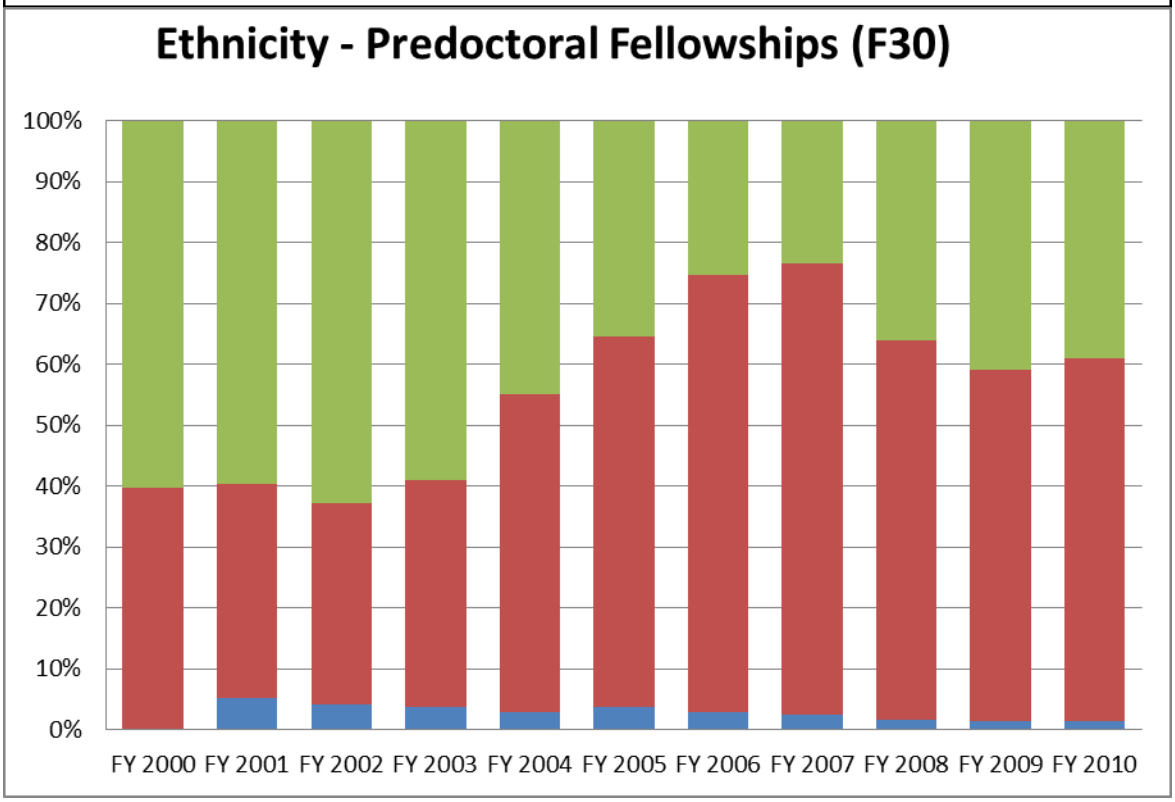
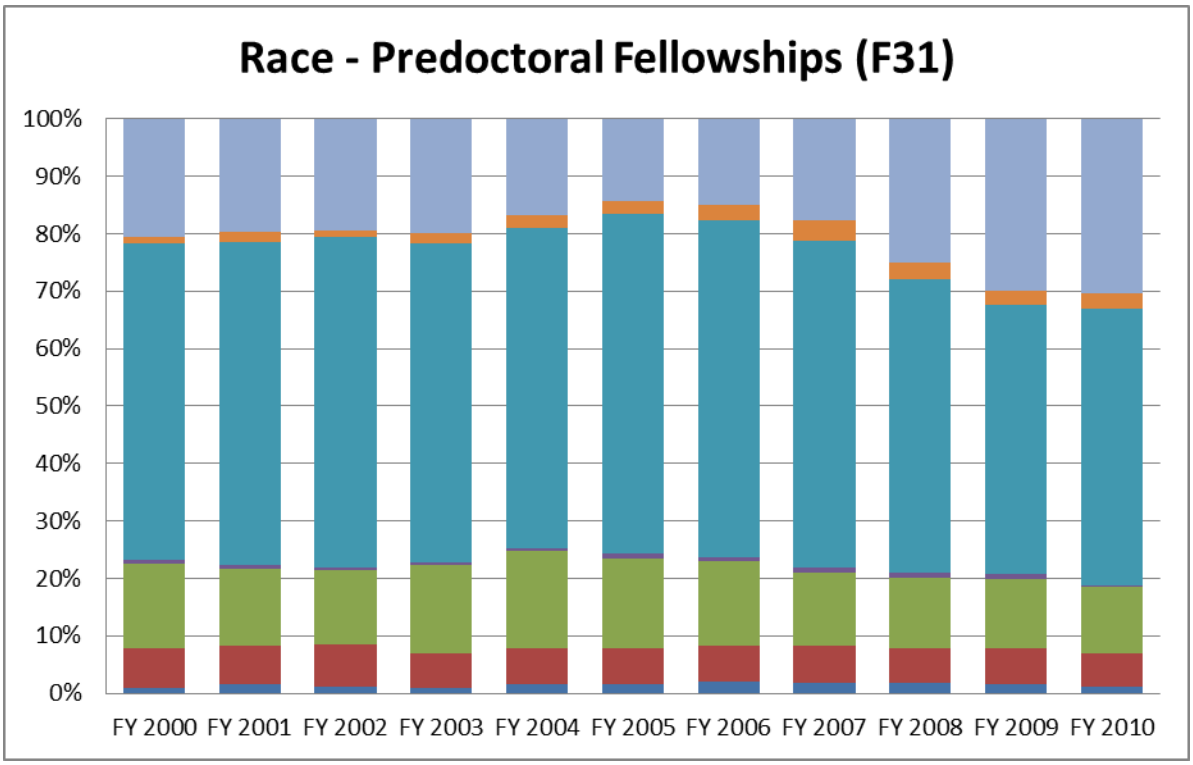


Figure 11C: Descriptive Statistics Race/Ethnicity for Awardees FY2000-10– Predoctoral Fellowships (F31)



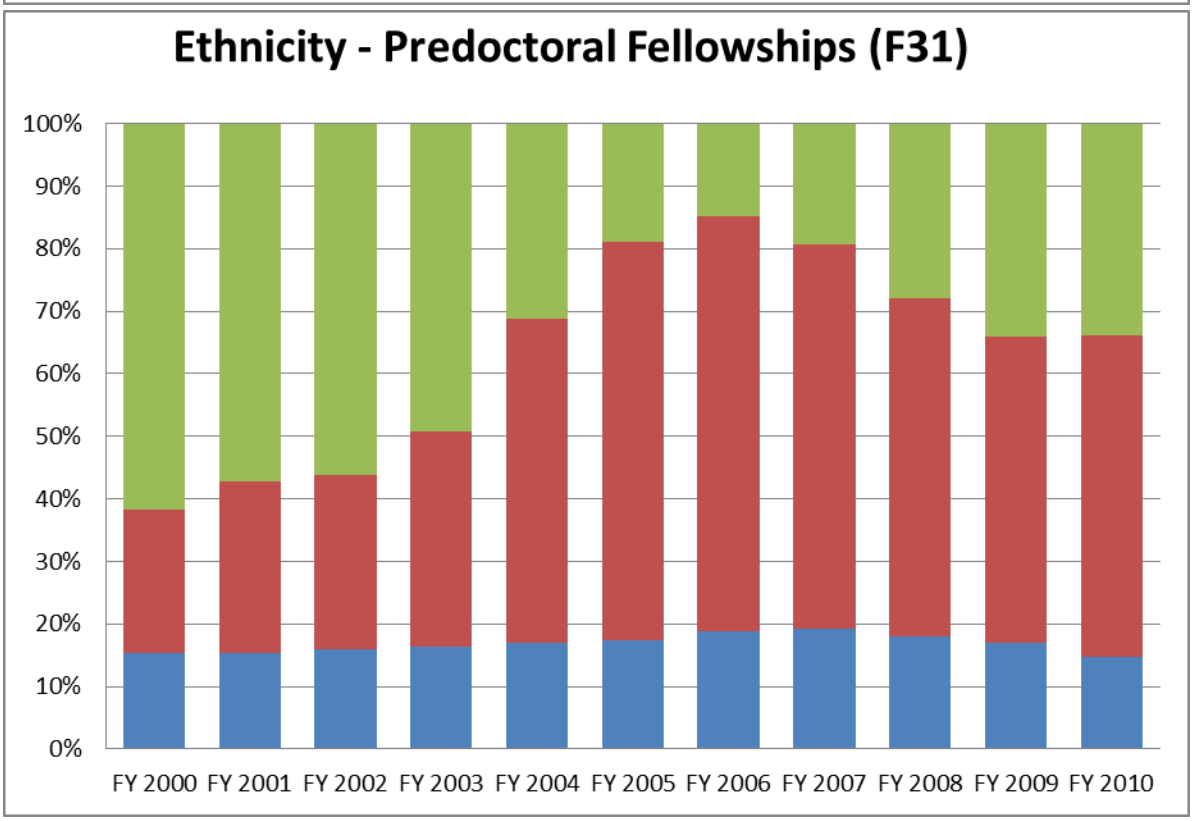
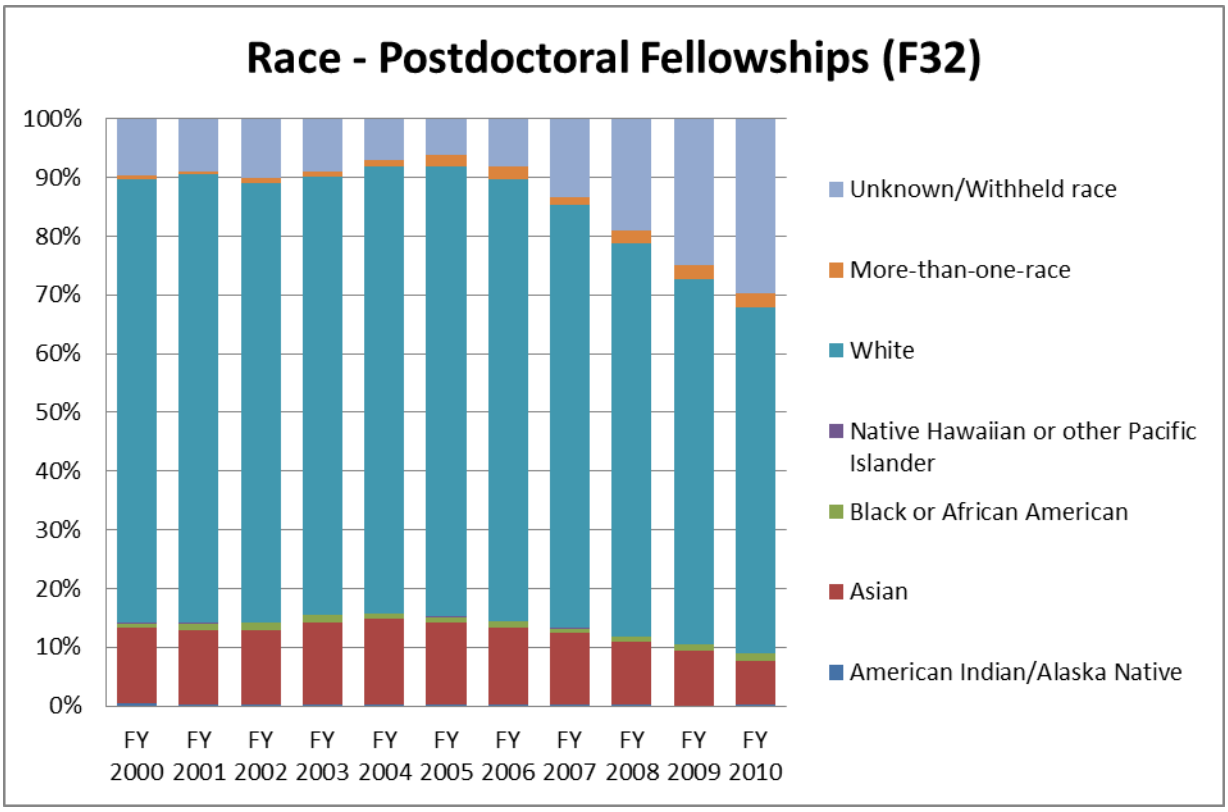


Figure 11D: Descriptive Statistics Race/Ethnicity for Awardees FY2000-10– Postdoctoral Fellowships (F32)



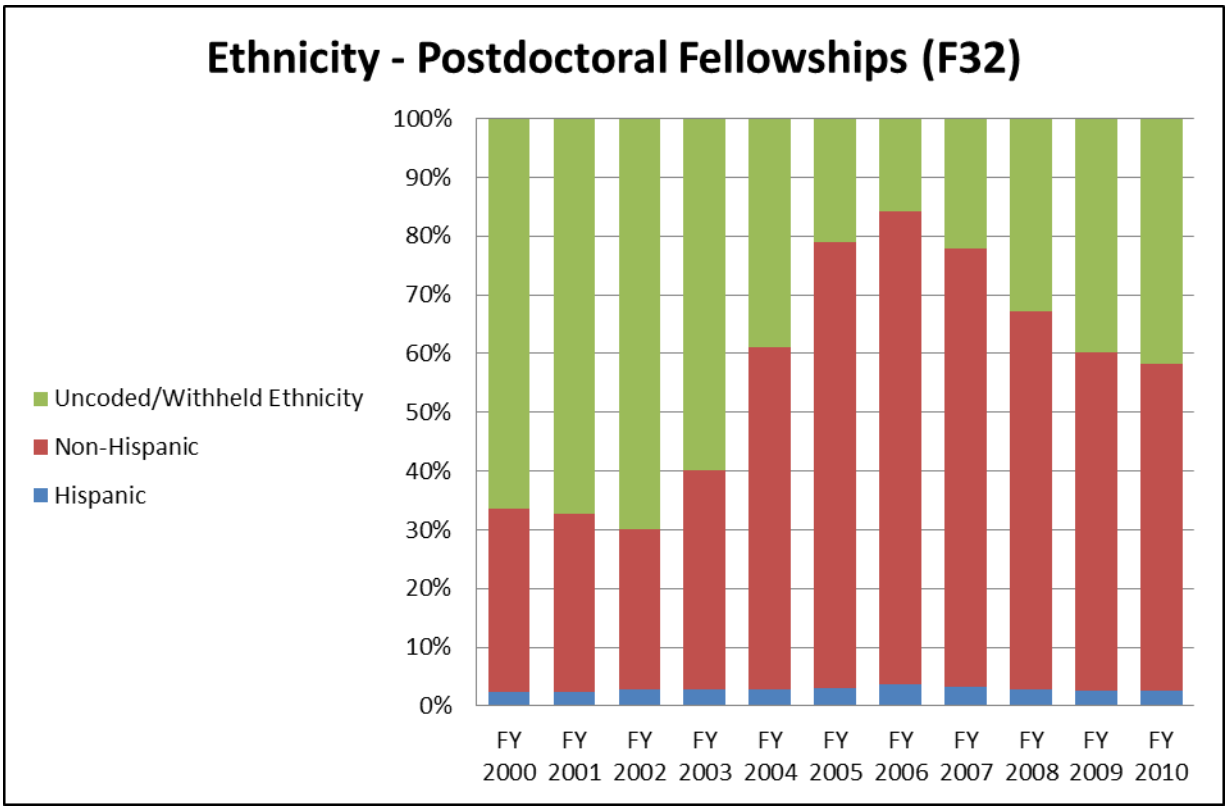
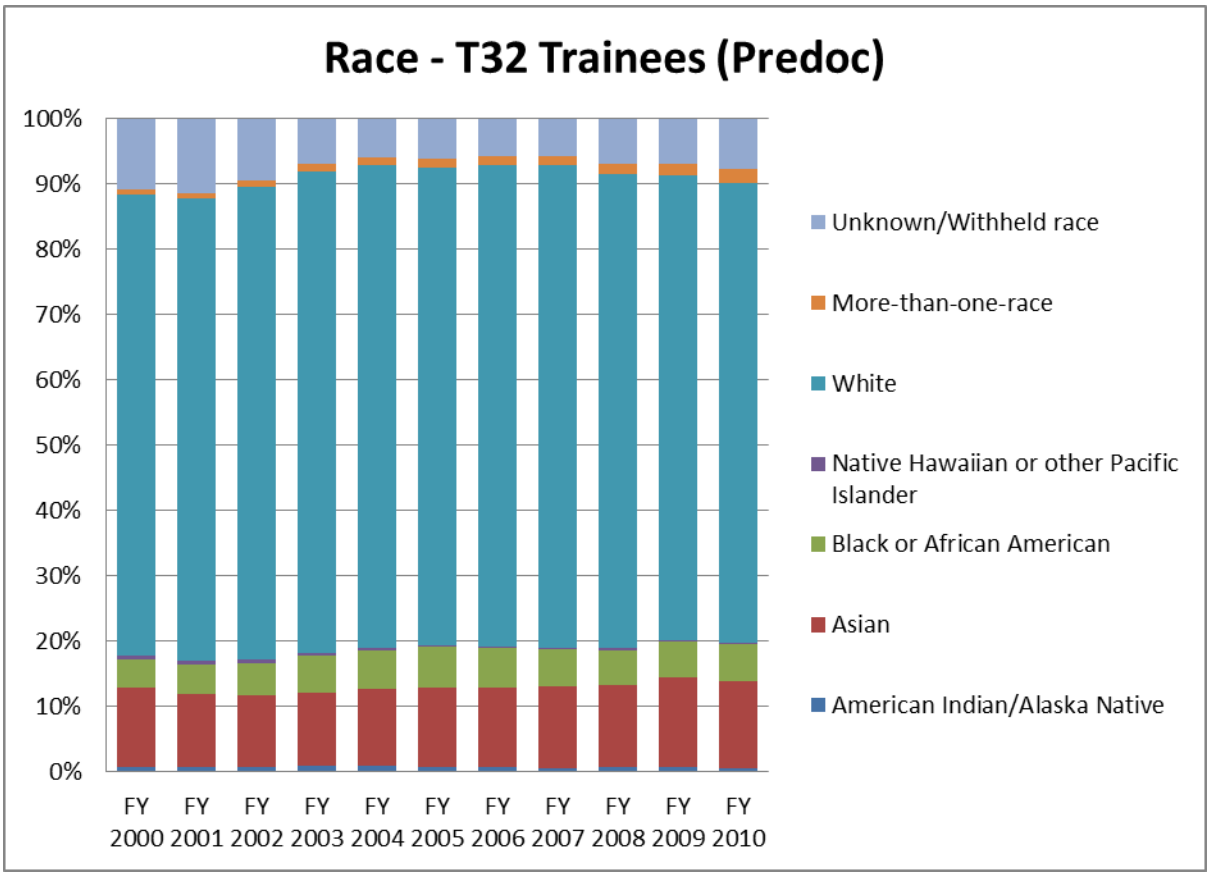


Figure 11E: Descriptive Statistics Race/Ethnicity for Awardees FY2000-10– Predoctoral Fellowships (T32)



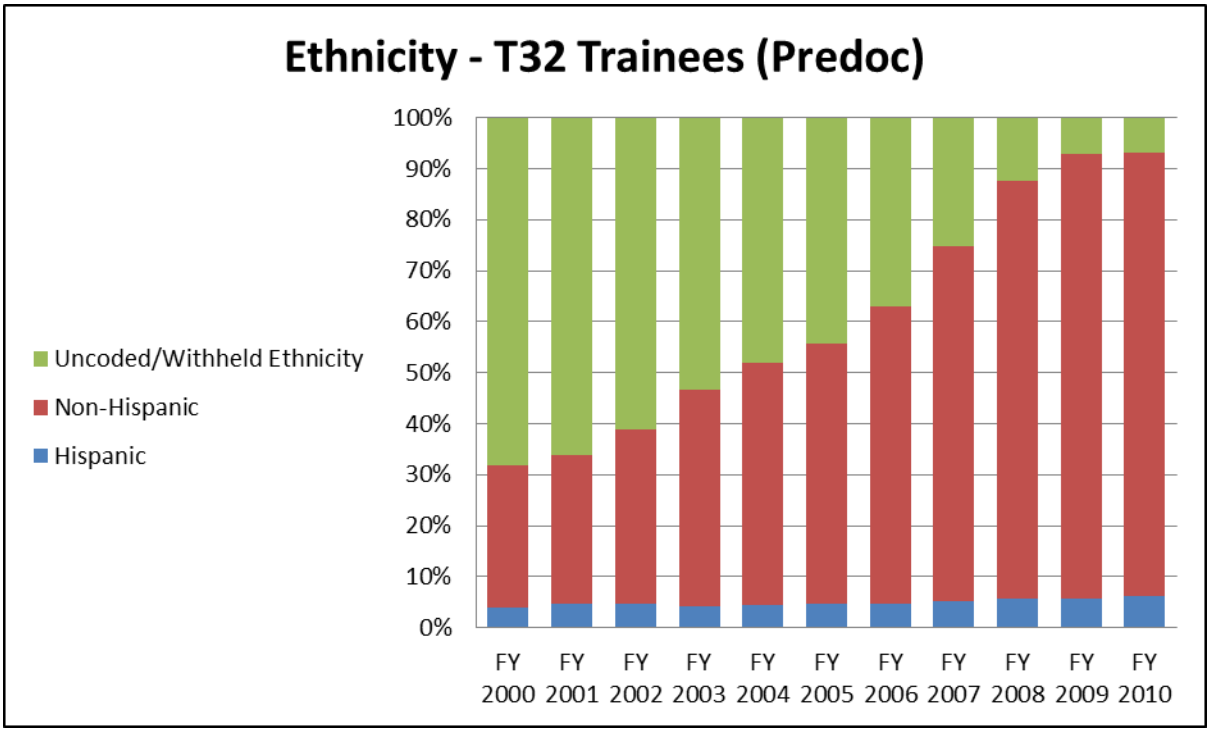
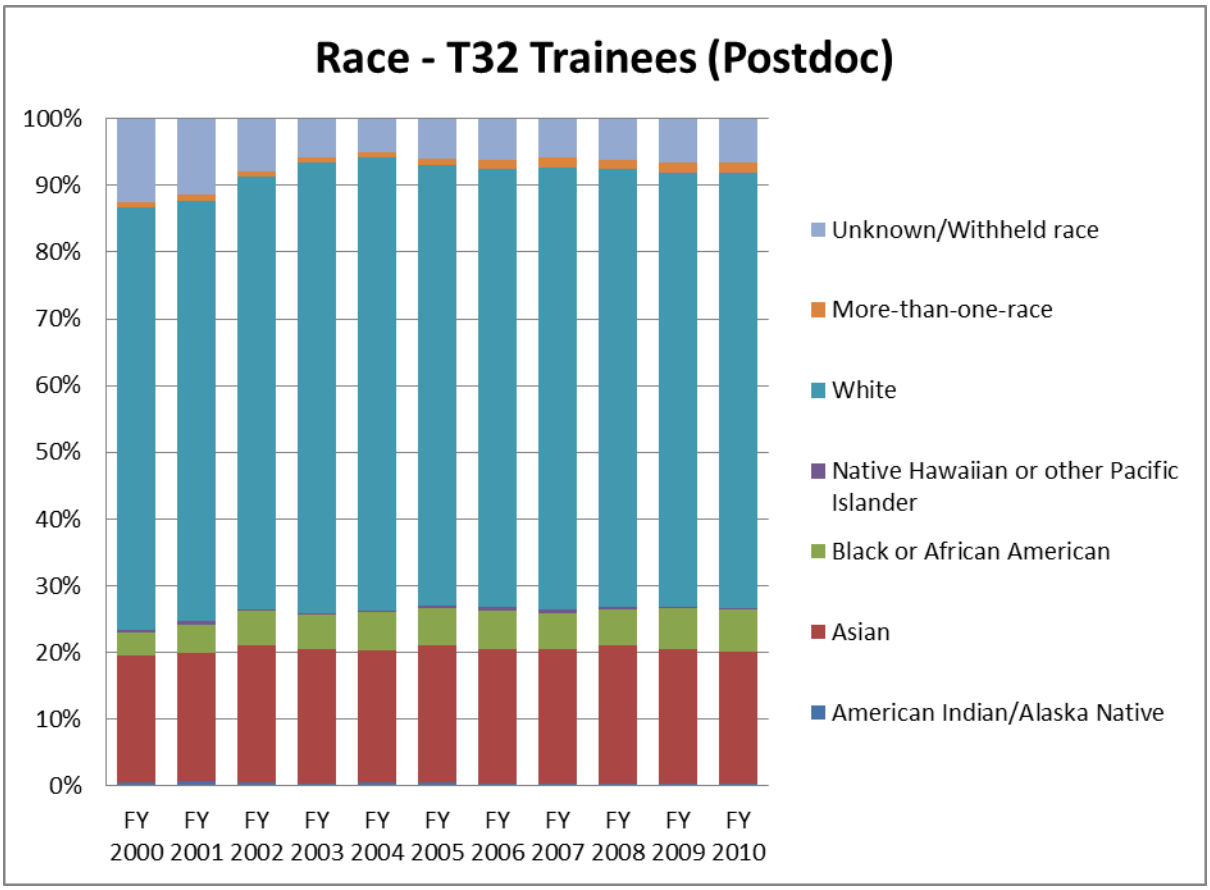


Figure 11F: Descriptive Statistics Race/Ethnicity for Awardees FY2000-10– Postdoctoral Fellowships (T32)



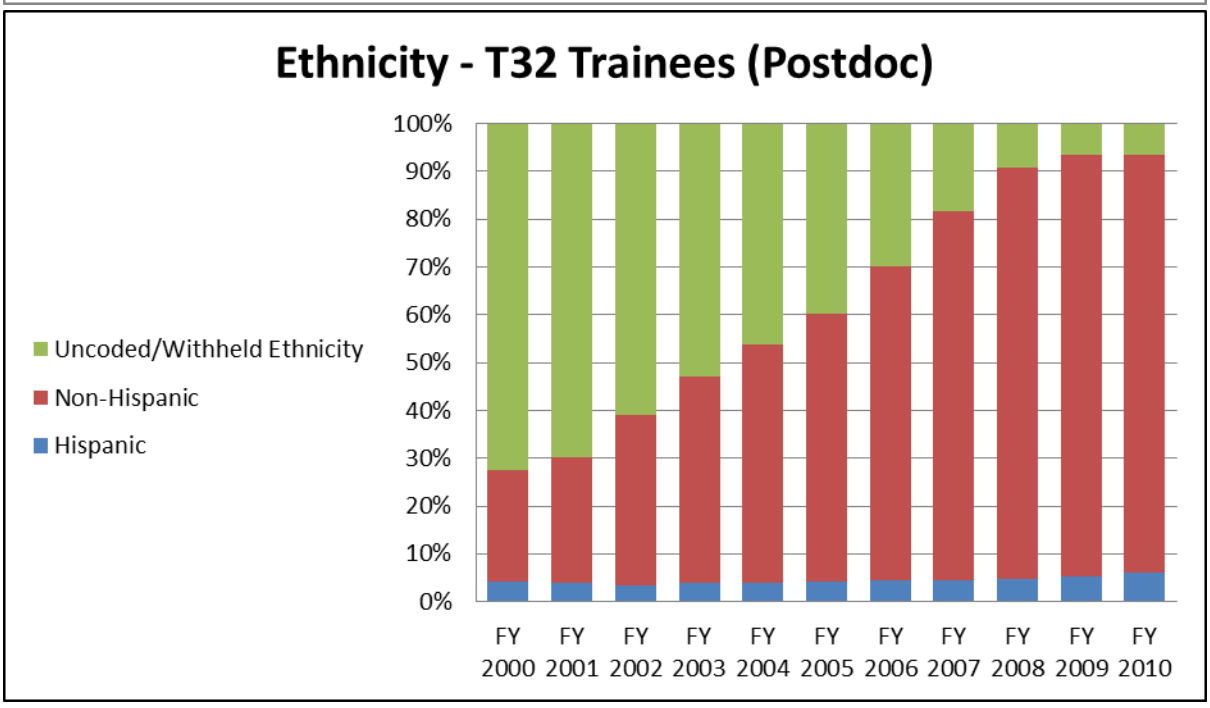
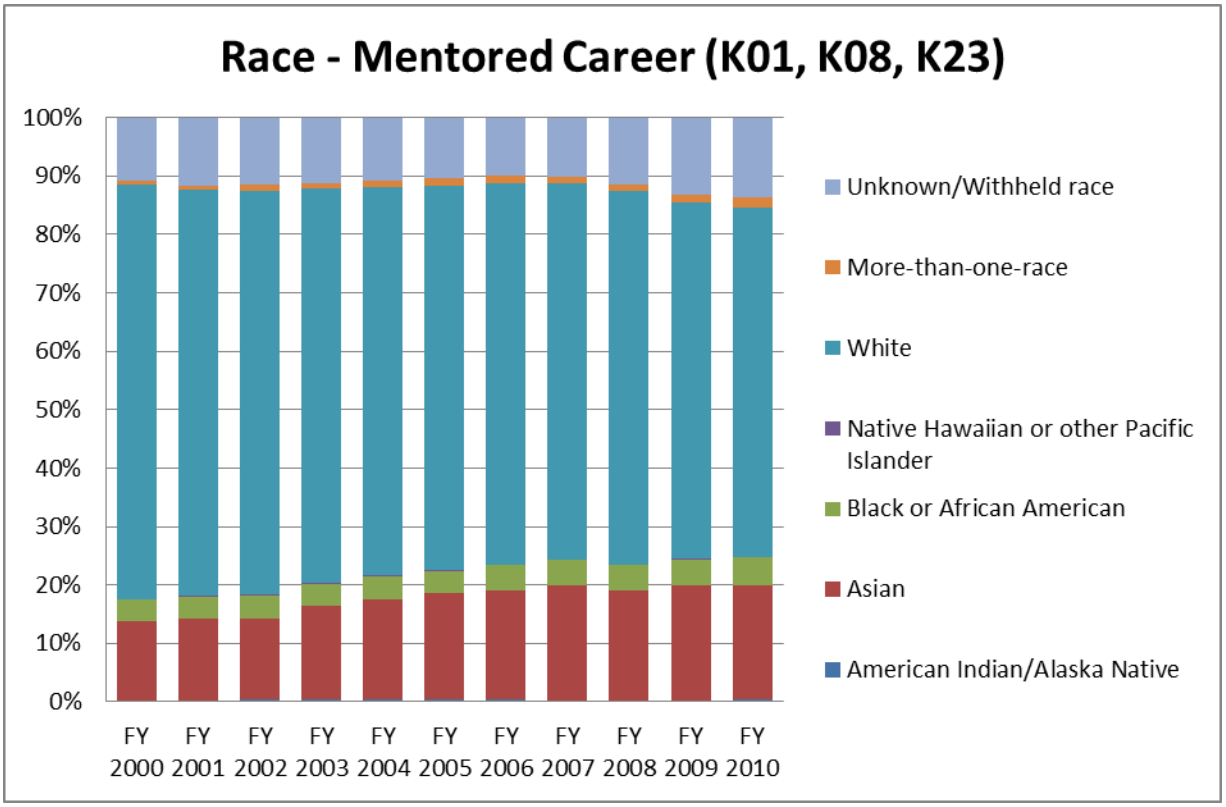


Figure 11G: Descriptive Statistics Race/Ethnicity for Awardees FY2000-10– Mentored Career (K01, K08, K23)



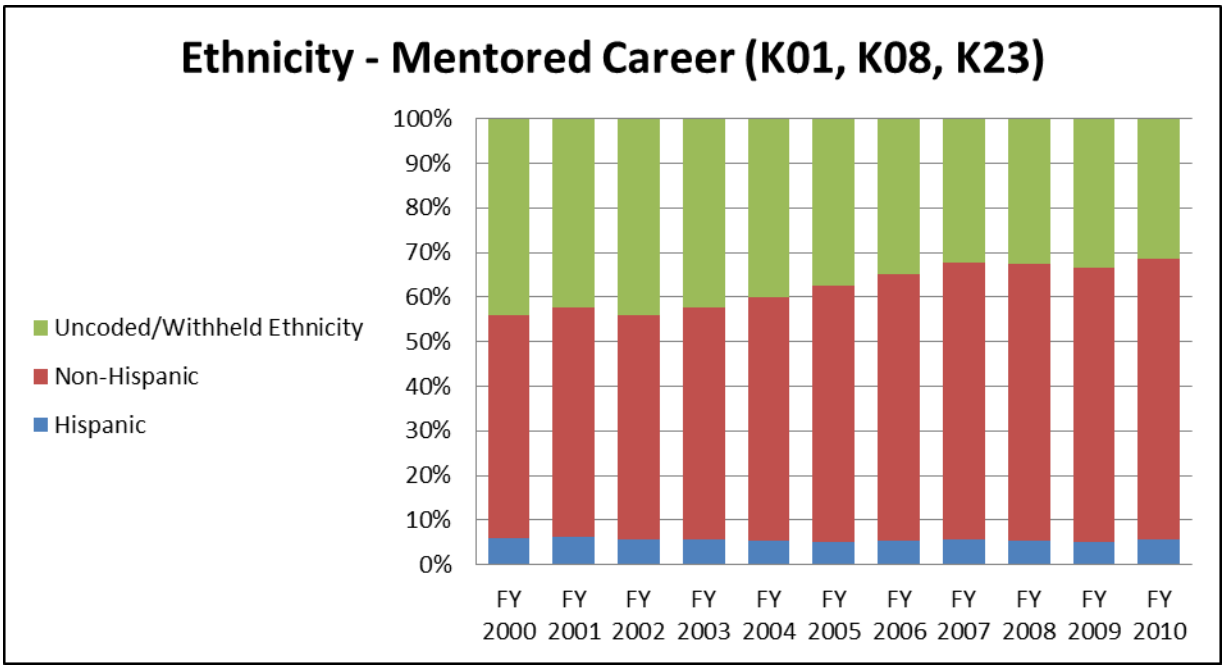
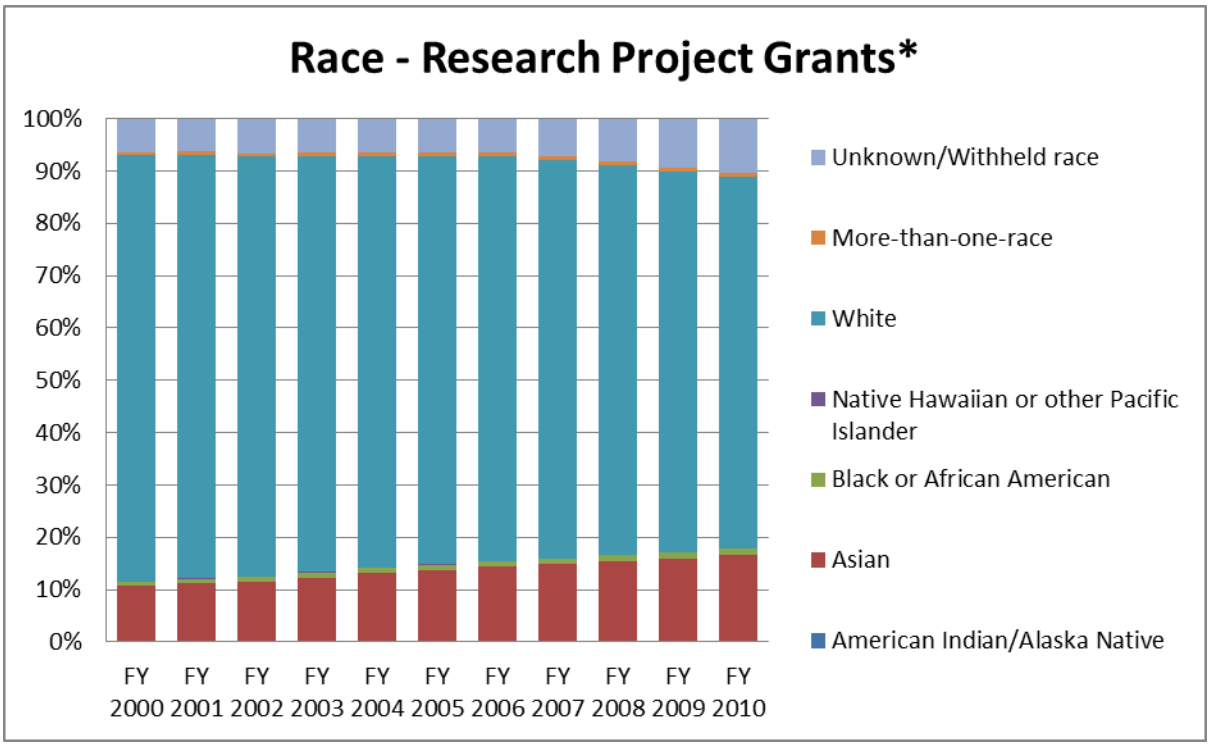
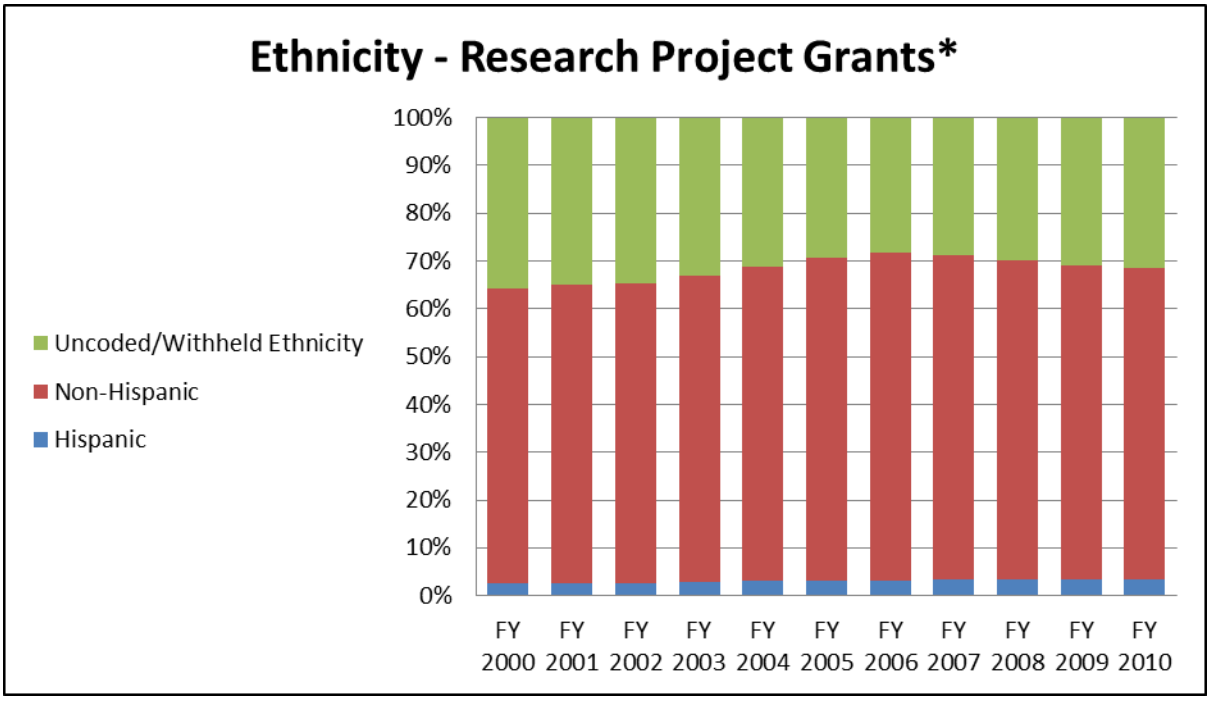


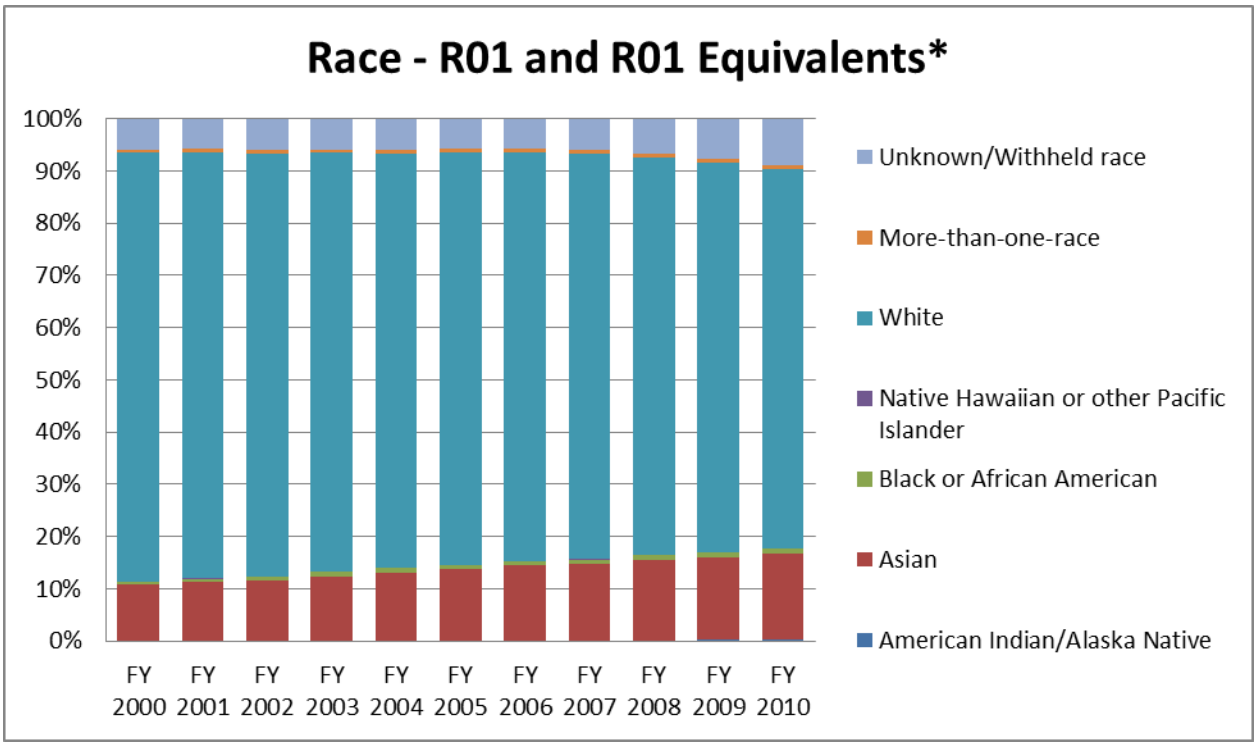
Figure 11H: Descriptive Statistics Race/Ethnicity for Awardees FY2000-10– RPG

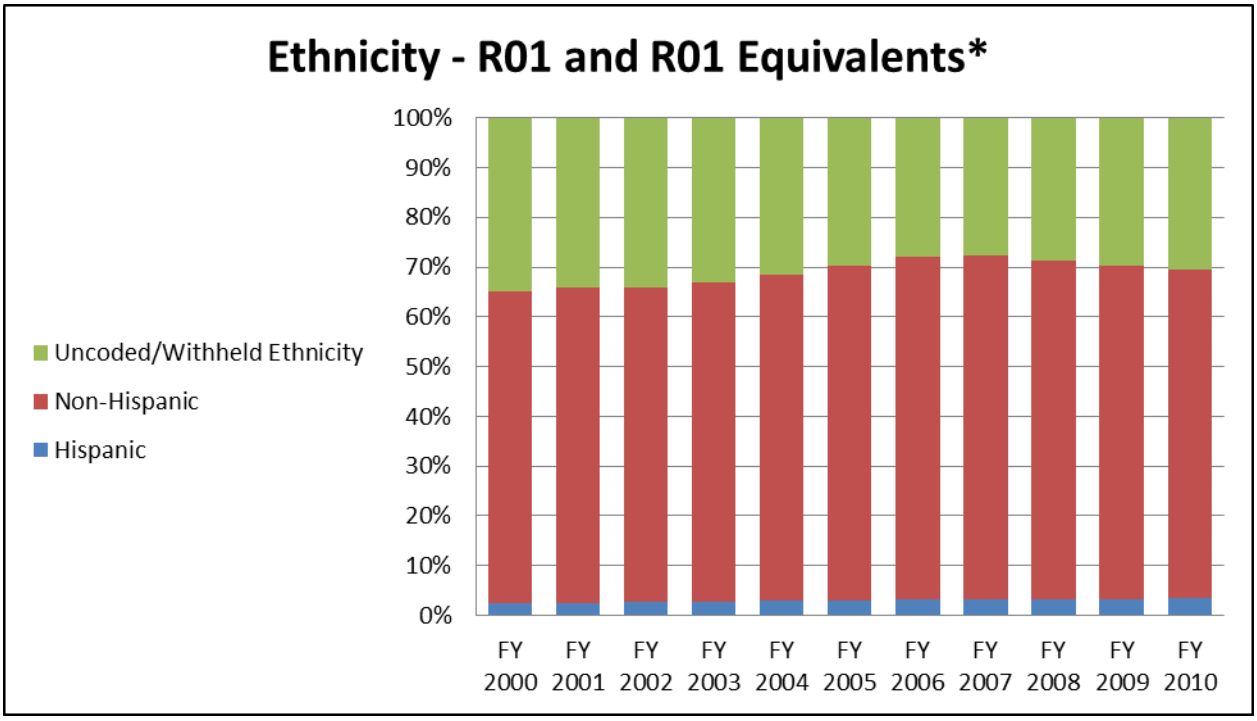




*RPGs include activity codes: 'R00', 'R01', 'R03', 'R15', 'R21', 'R22', 'R23', 'R29', 'R33', 'R34', 'R35', 'R36', 'R37', 'R55', 'R56', 'RC1', 'RC2', 'RC3', 'RC4', 'RL1', 'RL2', 'RL5', 'RL9', 'P01', 'P42', 'PN1', 'UC1', 'UC2', 'UC3','UC4','UH2', 'UH3', 'UH5', 'UC7', 'U01', 'U19', 'U34', 'DP1', 'DP2', 'DP3', 'DP4', and 'DP5'.

Figure 11I: Descriptive Statistics Race/Ethnicity for Awardees FY2000-10– R01 and R01 Equivalents





*R23, R29, R37, and DP2

Appendix 6: Summary of Ongoing Data Analysis

The NIH has contracted with Discovery Logic to carry out the following studies and prepare associated reports on their findings:

(1) **Variables associated with success:** The contractor will analyze CVs or biosketches for African American applicants in order to identify factors like training, mentoring, education, affiliations that may be associated with successful review outcomes. Those factors will be incorporated to the extent possible into regression models.

(2) **Training experiences**. The contractor will use information from NIH grant biosketches, CVs, and from publications to obtain information on what training or grant programs engaged the PI in the period prior to their R01 application. The contractor will examine all sources of funding, from NIH and from other organizations.

(3) **Networks**. The contractor will use information on co-authors (# and institutional affiliation) and co-author publications (# and citations) to derive information on the "connectivity quotient" and H-index of the investigator's collaborators. If possible, the contractor will explore the relationship of prior citations of the PI's work by reviewers.

(4) **Mentors**. The contractor will use grant acknowledgements, biosketch data, and dissertation data to determine graduate student and postdoctoral advisors, and then derive "connectivity quotient" and an H-index.

(5) **Career activity**: The contractor will explore and analyze participation on committees and advisory/editorial including Federal Advisory Committees (FACA Panels). Biosketches will be examined to determine honors, awards, and membership/participation in scientific and disciplinary societies.

(6) **Subsequent NIH grant activity**: We would assess what NIH grants the investigator has applied for and received, beyond the R01s explored in the Science paper. Examine the biosketch to determine whether the investigator has research grants from other organizations.

The contractor will randomly select approximately 600 investigators from each racial/ethnic group employed in the Ginther, et al. paper, for a total of 2400 people. The contractor will analyze information as described above and will incorporate this information into regression models similar to those used in the Ginther, et al. paper to identify factors that correlate either in a positive or negative way with success rates and disparities in success rates across racial and ethnic groups. A report on these findings will be generated.

Deliverables:

The contractor will construct a regression model employing variables extracted from applications and CVs as described above.

The contractor will prepare a preliminary report by June 1, 2012 that describes various regression models using the collected variables. In that preliminary report the contractor, using approaches similar to those used in the paper by Ginther, et al. will describe the influence of the collected variables on success rates and the differences in success rates across racial/ethnic groups.

By the end of August, 2012 the contractor will prepare a complete and final report suitable for publication with tabular and graphic displays to explain the findings.
The contractor also will deliver, by the end of August, a complete dataset as well as a de-identified dataset for archiving and/or posting at the time the report is released.