National Heart, Lung, and Blood Institute Workshop Summary: Enhancing Opportunities for Training and Retention of a Diverse Biomedical Workforce

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Abstract

Rationale: Committed to its mission of conducting and supporting research that addresses the health needs of all sectors of the nation’s population, the Division of Lung Diseases, National Heart, Lung, and Blood Institute of the National Institutes of Health (NHLBI/NIH) seeks to identify issues that impact the training and retention of underrepresented individuals in the biomedical research workforce.

Objectives: Early-stage investigators who received grant support through the NIH Research Supplements to Promote Diversity in Health Related Research Program were invited to a workshop held in Bethesda, Maryland in June, 2015, in order to (1) assess the effectiveness of the current NHLBI diversity program, (2) improve its strategies towards achieving its goal, and (3) provide guidance to assist the transition of diversity supplement recipients to independent NIH grant support.

Methods: Workshop participants participated in five independent focus groups to discuss specific topics affecting underrepresented individuals in the biomedical sciences: (1) Socioeconomic barriers to success for diverse research scientists; (2) role of the academic research community in promoting diversity; (3) life beyond a research project grant: non–primary investigator career paths in research; (4) facilitating career development of diverse independent research scientists through NHLBI diversity programs; and (5) effectiveness of current NHLBI programs for promoting diversity of the biomedical workforce.

Measurements and Main Results: Several key issues experienced by young, underrepresented biomedical scientists were identified, and solutions were proposed to improve on training and career development for diverse students, from the high school to postdoctoral trainee level, and address limitations of currently available diversity programs. Although some of the challenges mentioned, such as cost of living, limited parental leave, and insecure extramural funding, are also likely faced by nonminority scientists, these issues are magnified among diversity scientists and are complicated by unique circumstances in this group, such as limited exposure to science at a young age, absence of role models and mentors from underrepresented backgrounds, and social norms that relegate their career endeavors, particularly among women, to being subordinate to their expected cultural role.

Conclusions: The factors influencing the participation of underrepresented minorities in the biomedical workforce are complex and span several continuous or overlapping stages in the professional development of scientists from these groups. Therefore, a multipronged approach is needed to enable the professional development and retention of underrepresented minorities in biomedical research. This approach should address both individual and social factors and should involve funding agencies, academic institutions, mentoring teams, professional societies, and peer collaboration. Implementation of some of the recommendations, such as access to child care, institutional support and health benefits for trainees, teaching and entrepreneurial opportunities, grant-writing webinars, and pre-NIH career development (Pre-K) pilot programs would not only benefit biomedical scientists from underrepresented groups but also improve the situation of nondiverse junior scientists. However, other issues, such as opportunities for early exposure to science of disadvantaged/minority groups, and identifying mentors/life coaches/peer mentors who come from similar cultural backgrounds and vantage points, are unique to this group.

Keywords: underrepresented minorities; diversity programs; career development; biomedical research; postdoctoral
The mission of the National Institutes of Health (NIH) is to acquire and disseminate to the research and medical community, and the public, new knowledge that will improve the health of the entire nation. A diverse workforce, representing the heterogeneity of the nation’s population as well as its health needs, is necessary to fulfill this mission. However, increasing the diversity of basic and physician scientists conducting biomedical research in the United States remains an unmet challenge.

According to data collected by the National Science Foundation, 28% of high school graduates are underrepresented minorities, yet only 10% of advanced degree recipients in science and engineering are from this group (Figure 1). Women (6%) account for a slightly greater proportion than men (4%) (1). The NIH has recently broadened its definition of underrepresented minorities to include individuals from African American/Black, Latino/Hispanic, Native American/American Indian, disabled, and economically disadvantaged backgrounds. In a recent article written by Valantine and Collins, it is estimated that only 4% of the nation’s scientific research faculty are African American, 4% are Hispanic, 0.2% are Native American, and 0.1% are Hawaiian/Pacific Islander in origin (2). Hence, independent investigators from these groups remain a scarcity in the academe.

Despite the number of opportunities available for the training of this group (Table 1), there are barriers to success that remain unaddressed. To uncover these barriers, the NHLBI Division of Lung Diseases (DLD) hosted the Training for a Diverse Biomedical Workforce Workshop on June 25 and 26, 2015 in Bethesda, Maryland. The DLD gathered the current DLD postdoctoral and junior faculty (independent investigator) awardees of the Research Supplements to Promote Diversity in Health-related Research Program. This program is intended to attract individuals from groups who are underrepresented in the biomedical sciences by providing a continuum of research opportunities and training.

The workshop was organized to solicit information that will assist in identifying the needs and barriers to achieving success as a biomedical research scientist, based on their personal experiences. Nineteen trainees and two extramural senior scientists from underrepresented backgrounds were assigned to five distinct topical areas. They actively engaged in discussions, offered suggestions, and proposed recommendations related to research, career development, and funding opportunities that can assist in realizing independent careers in science. This is a goal that the NHLBI and the NIH as a whole aim to support, through key strategic programs directed toward diverse biomedical scientists (3). Groups were organized to have an equal representation of sexes and ethnic/racial groups as much as possible. Given that female participants outnumbered male participants (13:6), sex equality was not possible in all groups.

Each group was assigned a specific topic to discuss (described below), with ideas and suggestions recorded by a rapporteur. Specific suggestions and recommendations to improve these programs from each subgroup were then presented to the entire group. The objective of this report is to present to the public and the scientific community the findings of this workshop and the proposed solutions to improve the participation of underrepresented minorities in the biomedical workforce, if implemented by funding agencies, universities, professional societies, and individuals.

### Topics Discussed

#### Socioeconomic Barriers to Success for Diverse Research Scientists

The expectation in the academic community is that early-stage investigators, such as postdoctoral trainees and junior faculty, will wholly invest themselves in achieving the research milestones necessary to become an independent investigator and eventually achieve tenure. This expectation very often comes at a cost, particularly to women in science. The discussion group for this topic was unintentionally composed of four women who were asked to give an account of their journey in academia. As a result, many of the issues women face as impediments to achieving success in an academic research career were highlighted in their discussions, although these may apply as well to underrepresented men in science fields.

It is generally believed that the salaries of early-stage investigators do not reflect the effort exerted and expected for the position. Lack of salary adjustment to match the cost of living in certain areas of the country can become a major issue for trainees who persist on postdoctoral salaries. Additional factors associated with the pursuit of advanced academic degrees, including higher student debt, compound this problem. This economic pressure significantly influences an individual’s ability to care for self and family.

Another major issue is the lack of adequate child care, which is highly variable from institution to institution. In some cases, although child care is available for faculty members and is subsidized by the institution, postdoctoral fellows are ineligible for this benefit. The strain of being a working mother is also an issue that needs to be addressed.

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**Figure 1.** Milestones in higher education for minorities and nonminorities. Adapted by permission from Reference 1.
Pregnant women require support in the workplace from pregnancy onward, as unplanned health issues may arise during or after pregnancy. There is a need for institutional understanding and support for women who need time to adjust to their role as new mothers and the necessity to balance family and work responsibilities. This is also applicable to new fathers who may require parental leave. Personal and economic factors, in addition to the competitive environment inherent to careers in science, have significant impacts on mental health. Struggling with these social issues, combined with child-care expenses, have caused many women to choose to stay home and give up their careers to further their academic research. Similar issues may be applicable to scientists who are not members of minority groups. However, this is especially relevant to women from underrepresented groups, where social and economic burdens become additional stressors on the trainees’ role as caregivers, not only for their immediate family but also for their extended families.

This leads to an associated issue, which is the difficulty of reentering the academic workforce. Delaying a research project long term is not feasible, considering the rate at which science evolves. An additional burden can arise when there is a need for trainees to move to a different state and, in some cases, country, away from their families. Issues of being the major breadwinner in some cases, country, away from their families. Issues of being the major breadwinner in some cases, country, away from their families.

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The role of the Academic Research Community in Promoting Diversity

A major issue driving the disparity in minority participation in academic research is the lack of exposure to these career paths at a young age. Students from underrepresented groups may not have close acquaintances, including family members, friends, or others within their communities, who have pursued careers in academia. Without role models to advise them about academic research careers, it is unlikely that they will consider this career trajectory for themselves.

Universities can make a major impact on young, diverse students in their local communities by providing them with opportunities to meet and interact with faculty members from underrepresented backgrounds who have chosen academic careers. For example, summer research programs could be designed to target high school students from diverse backgrounds and give them first-hand experience working in a laboratory alongside student and faculty researchers. A multitiered mentoring approach, whereby these students can meet regularly with graduate students, postdocs, and faculty who come from cultural backgrounds that they can identify with, may motivate these students to pursue higher education and ultimately a career in research. Mentors with similar backgrounds may also be able to give insights into the particular obstacles faced by minority scientists and advice on how to navigate these challenges most effectively.
At the undergraduate level, efforts should also be made to better inform students about available research opportunities. University multicultural affairs offices should have a greater role as a resource for students interested in science careers by advertising research opportunities on and off campus, so that minority students are made aware of available programs. Increased scholarship opportunities for underrepresented students through universities, government agencies, private foundations, and professional societies are also needed to provide stipends and research supplies for students participating in these programs.

Although it is important to increase the number of minority trainees and potential faculty, there must also be a greater emphasis placed on recruitment and retention of minority faculty at research institutions. In relation to this, applying social cognitive theory and the concept of communities of practice should be considered as part of the effort. Bandura’s social learning theory proposes that the best way to learn is by observing, imitating, and modeling others. By observing peers or near-peers in one’s community of practice, one can develop feelings of self-efficacy and gain confidence in the ability to take action (5–7). By applying some of the same theories, institutions would create a space where these faculties feel “safe.”

Academic institutions need to be engaged to ensure that scientific departments are actively recruiting talented minority candidates and fostering the careers of minority faculty. Funding agencies such as the NIH and National Science Foundation could consider an institution’s demonstrated commitment to diversifying faculty in their departments when making funding decisions, particularly for diversity fellowships and grants. Institutional commitment toward achieving the life/work balance mentioned above to benefit diversity scientists would also provide evidence that universities are making an honest effort to increase the number and promote retention of successful minority faculty.

The NIH is currently piloting a number of recruitment and retention strategies both within the NIH and extramurally to promote diversity in the biomedical workforce. The NIH Common Fund introduced a three-component program in 2014 that aims to “develop, implement, and evaluate innovative approaches to research training and mentoring, with the goal of engaging individuals from diverse backgrounds and helping them prepare for and succeed in biomedical research careers” (8). The three elements are the National Research Mentoring Network, consisting of more than 100 actively engaged partner institutions composing five regions; the Building Infrastructure Leading to Diversity program, with 10 university partners; and the Coordination and Evaluation Center, which coordinates consortium-wide activities and evaluates the efficacy of the training and mentoring approaches developed by the BUILD and NTMN awardees.

Life beyond a Research Project Grant: Non–Primary Investigator Career Paths in Research

Young scientists face many challenges in pursuing an academic research career such as tenure-track faculty positions, in which attainment of research project grant (R01) funding is pivotal to the success of an independent research direction. For those in research-focused institutions, teaching opportunities are very limited. This is a major issue for those who have to rely on soft money for most or all salary support and who cannot be compensated with paid teaching efforts. Mentor and mentee relationships are often another major challenge, often perceived as being more competitive rather than supportive of an independent research direction. Because the diversity supplement should be a logical extension of the parent grant, the project’s close association with the mentor’s research poses an obstacle for the trainee’s independence. Although the diversity supplement funding provides a limited period of salary support, project support and travel funds are often insufficient to sustain an independent research direction that the trainee can take.

These challenges are of great concern to the current generation of young scientists, especially considering the current economic climate and trends in academic tenure track positions. Thus, alternatives to the attainment of R01 funding were discussed. The research associate role is an attractive alternative career path because it provides the opportunity to pursue important research questions without having the burden of assuming the role of principal investigator. However, there are concerns over the responsibilities and roles of the research associate, delineation from laboratory technician roles, and opportunities to pursue autonomous research directions.

There were also concerns over the perceived value of the research associate regarding salary and cost effectiveness for the requirements of a Ph.D. degree. Academic institutions with technology transfer offices often have opportunities such as fellowships and training on how to commercialize technology as well as pilot grants specifically for technology commercialization. The NIH has programs housed in the National Center for Advancing Translational Sciences that support the development of technologies at many points along the pathway from laboratory to market. The NHLBI also offers advisory assistance to investigators interested in development and commercialization of heart, lung, blood, and sleep disorders products, through its Office of Translational Alliances and Coordination. Significant funding opportunities are available for therapeutic/technology development, licensing intellectual property, and commercialization through the Small Business Innovation Research and Small Business Technology Transfer programs.

Career paths in industry and business were also discussed, including postdoctoral positions, medical science liaisons and consultants within pharmaceutical and biotech companies, or venture capital firms. Positions for scientists in government agencies were highlighted, including Food and Drug Administration, Federal Bureau of Investigation laboratories, and program administration at the NIH. Careers in science policy and law were also believed to be attractive, with ample opportunities for scientists to communicate and influence scientific issues at the congressional level as well as to the general public and opportunities to shape intellectual property- or patent policy–related issues.

Facilitating Career Development of Diverse Independent Research Scientists through NHLBI Diversity Programs

For early research investigators from an underrepresented background, finding one’s research “niche” and securing funding were identified as the major hurdles to successful transition into an independent research
scientist position. Reaching independence in research requires experimentation into areas of research that are independent from that of one's mentor(s). Supplemental funds, although covering the salary of the mentee, provide very little room to engage in experiments to generate essential preliminary data separate from the parent grant. A pre-NIH career development (pre-"K") award pilot program is proposed that could help increase the competitiveness of the applicants and set the stage for career development.

There is also a need for formal training in areas that will help in the progression of their science (e.g., basic and advanced biostatistics) and in their career development as well (e.g., nuts and bolts of negotiation for a faculty position). Access to practical information related to the grant review process would help diverse research scientists to prepare stronger, more competitive grant applications. Examples of common questions postdoctoral fellows have in the preparation of grant applications include: key components of research proposals, number/quality of peer-reviewed publications deemed acceptable by the reviewers, value of review papers, importance of past awards, and timeliness of the submission of the application (i.e., second, third, or fourth year of postdoctorate). Examples of successful grant applications would also help give postdoctoral fellows an idea of what is needed.

There is a clear need for a platform that allows real-time transfer of helpful information from successful scientists/mentees to the new generation of scientists. For example, sessions hosted by the NHLBI during meetings such as the American Thoracic Society International Conference, where all levels in the process of writing an application are represented, from the NIH Program Officer, Awardee/Assistant Professor to Postdoctoral Fellow, are particularly helpful to the attendees because of the relevance of practical information that is shared in these venues. However, the information remains confined to the attendees of the meeting and is unavailable to the rest of the community of postdoctoral fellows.

The creation of a blog (Benchmarks for Career Development) is proposed as a cost-effective and interactive way to post valuable information in real time that would be available to all interested parties, including mentors. It is also crucial for early investigators to regularly interact with an external, highly skilled mentor or coach who complements, rather than substitutes for, traditional mentoring. This has proven successful among scientists in formation of mentoring teams consisting of an experienced faculty leader and a network of mentees who can also provide peer mentoring (5). The mentor/coach provides a “safe environment” for discussion, which is another venue by which to obtain valuable insights on career development. It is proposed that the NIH require the identification and regular correspondence with an external mentor/coach as an expectation for all diversity graduate/postdoctoral fellowship and supplement awardees.

**Effectiveness of Current NHLBI Programs for Promoting Diversity of the Biomedical Workforce**

Table 1 summarizes the NHLBI-sponsored programs to promote diversity in the biomedical workforce. In addition to the above funding opportunities, an additional training position to appoint a diversity candidate on an existing T32 Program for Institutions that Promote Diversity may be requested by the principal investigator, if all slots have been filled for the year, provided the candidate will be appointed to a regular slot for the subsequent year.

The perception from the participants is that the research supplement has enabled their professional scientific maturation by giving them more independence, albeit limited, of managing their own project, and more autonomy in the lab. The early diversity programs are also perceived as very important for the development of skills for individuals who otherwise would not have had exposure to current scientific concepts that could improve their standing among peers and help them develop their scientific career. Participants also emphasized the importance of supporting key aspects of the mission of minority-serving institutions. Applications from minority-serving institutions face specific challenges, including lack of institutional research infrastructure, limited mentoring in certain scientific disciplines, lack of state-of-the-art equipment, highly skilled mentor or coach who

### Table 2. Summary of key issues and support mechanisms to promote diversity in the biomedical workforce

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<tr>
<th>Key Issues Facing Diverse Trainees</th>
<th>Support Mechanisms</th>
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<tr>
<td>Cost of living</td>
<td>Adjust stipend based on regional cost of living; loan repayment assistance; institutional support for trainees with families</td>
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<tr>
<td>Starting a family, new mothers/fathers</td>
<td>Child care supplements for postdocs; maternity or parental leave support from university/mentor; flexibility in work hours</td>
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<tr>
<td>Exposure to science at young age</td>
<td>University-organized science programs for diverse high school students; better advertising/increased funding of research opportunities for diverse undergraduates</td>
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<td>Retention of minority faculty</td>
<td>Accountability of universities to retain minority faculty, reflected in NIH funding decisions</td>
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<tr>
<td>Exploring non–primary investigator career options</td>
<td>More teaching opportunities; entrepreneurial mentorship</td>
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<tr>
<td>Restricted research directions as postdoc</td>
<td>Flexibility in funds for diversity supplements; Pre-K award pilot program for independent investigations</td>
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<tr>
<td>Securing extramural funding</td>
<td>Meetings/webinars for grant-writing forums; more transparent guidelines for writing successful grants</td>
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<tr>
<td>Finding external mentor(s)</td>
<td>Emphasis from NIH, NHLBI on diversity supplement/fellowship awardees to find and maintain relationship with a mentor other than primary investigator; mentor/coach system with additional peer mentoring</td>
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*Definition of abbreviations: NHLBI = National Heart, Lung, and Blood Institute; NIH = National Institutes of Health; Pre-K = pre-NIH career development.*
equipment, and lack of in-house expertise to support trainee development, among others.

To improve the existing NHLBI diversity supplement mechanism, it is recommended that more flexibility be built into the award to enhance the independence of the awardee and to provide opportunity to expand on their research interests and expertise. This is particularly important if the parent grant is relatively small or the institution does not have the resources to perform the specialized research. Increased allowance for travel to key educational meetings for trainees is also needed, as the current budget is insufficient to cover the costs of registration fees, travel, and hotel costs. Travel allowance for off-site training opportunities should also be considered.

Online technologies, such as social networking and webinars, could be used to facilitate exposure to state-of-the-art scientific knowledge that would enhance training for all individuals participating in NHLBI-sponsored research. Trainees themselves could then identify key topics for the community at large that would inform the development of these virtual educational activities. NHLBI could increase awareness of the longstanding T32 Program for Institutions that Promote Diversity (RFA-HL-16-007), a mechanism that facilitates cross-institutional exposure for trainees in minority-serving institutions and small institutions that lack facilities or key technologies, by collaborating with a research center that has strong, well-established research training programs. Such an arrangement could enhance the quality of the training and science being conducted at the minority institution and help meet research training needs. (See more at: http://grants.nih.gov/grants/guide/rfa-files/RFA-HL-16-007.html). Incentives for mentors who support minority scientists could also increase the number of available mentors and quality of mentorship for this group.

To promote diversity in the pulmonary research community, NHLBI should continue to identify advocates/mentors within the NHLBI community to provide guidance to early mentees, particularly high school students, undergraduate students, and graduate students. These mentors may then encourage mentees to take advantage of the NHLBI mechanisms to promote diversity in the scientific workforce (Table 1). Partnerships with other scientific societies (e.g., American Thoracic Society, American Heart Association, and American Lung Association) could also be used to provide a common curriculum and unified content that represent the current knowledge and future direction of science to enable professional development in the context of the diversity programs.

Synopsis

Through organized discussions between diversity supplement awardees, established diverse faculty members, and NHLBI staff at the NHLBI-DLD Training for a Diverse Biomedical Workforce workshop, solutions were proposed to tackle many of the issues that are faced by young scientists from underrepresented backgrounds that impede their progression. Table 2 summarizes the findings from this workshop and can be used by universities and funding agencies to develop new programs aimed at increasing diversity in biomedical fields. Implementation of some of these recommendations, such as access to child care, institutional support and health benefits for trainees, teaching and entrepreneurial opportunities, grant-writing webinars, and pre-K pilot programs would not only benefit biomedical scientists from underrepresented groups but also improve the situation of nondiverse junior scientists. However, other issues, such as opportunities for early exposure to science of disadvantaged/ minority groups and identifying mentors/ life coaches/peer mentors who come from similar cultural backgrounds and vantage points, are unique to this group.

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