

Increasing Diversity in the Biomedical Research Workforce

ACTIONS FOR IMPROVING EVIDENCE



Coalition of
Urban Serving Universities



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The Association of Public and Land-grant Universities (APLU) is a research, policy, and advocacy organization representing 236 public research universities, land-grant institutions, state university systems, and affiliated organizations. Founded in 1887, APLU is North America's oldest higher education association with member institutions in all 50 states, the District of Columbia, four U.S. territories, Canada, and Mexico. Annually, member campuses enroll 4.7 million undergraduates and 1.2 million graduate students, award 1.2 million degrees, employ 1.4 million faculty and staff, and conduct \$42.7 billion in university-based research.



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The Association of American Medical Colleges is a not-for-profit association representing all 145 accredited U.S. and 17 accredited Canadian medical schools; nearly 400 major teaching hospitals and health systems, including 51 Department of Veterans Affairs medical centers; and more than 80 academic and scientific societies. Through these institutions and organizations, the AAMC represents 160,000 faculty members, 83,000 medical students, and 115,000 resident physicians.

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Introduction

The participation of underrepresented individuals in the biomedical sciences, as well as in the science, technology, engineering and mathematics (STEM) fields is a critical issue affecting our nation's health and the future of research. By 2050, less than 50 percent of the general population will be non-Hispanic whites, making the U.S. a majority-minority country (United States Census Bureau [US Census], 2014). However, our nation's scientists remain a homogeneous group. Certain racial/ethnic groups (African Americans, Hispanics, Native Americans, and Hawaiian/Pacific Islanders), women, individuals with disabilities, and socioeconomically disadvantaged individuals are persistently underrepresented (UR) in the research workforce (Valantine & Collins, 2015). In order to address the health needs of our rapidly diversifying population with cultural sensitivity and inclusiveness—and make progress toward health equity—we will need to leverage the talents of individuals from all backgrounds. Infusing the scientific process with diverse perspectives is essential to the future success of biomedical and STEM research.

Over the next five years, UR student enrollment in post-secondary education is expected to increase by 25 percent (Sowell, Allum, & Okahana, 2015). However, in order to ensure that this growth extends to the STEM workforce, doctoral degree completion among UR students must also increase. UR doctoral degree attainment continues to lag; although 21 percent of bachelor's degrees in the United States were awarded to UR students in 2011–2012, only 8.5 percent of doctoral

“Put quite simply, diversity invites innovation. At its center is difference, not sameness, which encourages a broad palette of solutions for the complexity of health challenges before us. I believe that we must keep science top of mind as we pursue strategies to increase diversity in science.”

—Hannah A. Valantine, M.D., NIH Chief Officer for Scientific Workforce Diversity (Valantine, n.d.)

degrees were granted to UR individuals (National Center for Education Statistics [NCES], 2013).¹ According to the Council of Graduate Schools, only 43 percent of Black/African American students completed STEM doctoral degrees within 10 years, compared to 56 percent of White students (Sowell, Zhang, Bell, & Redd, 2008). These disparities persist after degree completion. For example, the National Science Foundation found that only 4 percent of post-doctoral scholars in STEM fields were from UR groups (National Science Foundation [NSF], 2011), and the National Institutes of Health (NIH) revealed that only 5 percent of 2010 NIH Principal Investigators on research project grants (RPGs)² are UR (Working Group on Diversity in the Biomedical Research Workforce, 2012).

A growing body of evidence supports the relationship between diversity and performance across disciplines. Prior research in the field of economics shows that

1 If the proportion of UR students attaining PhDs in science were the same as those attaining bachelor's degrees in the sciences, the number of Hispanic/Latino science doctorates would need to double and the number of Black/African American science doctorates would need to triple (Working Group on Diversity in the Biomedical Research Workforce, 2012, p. 22).

2 The Research Project (R01) grant is an award made to support a discrete, specified, circumscribed project to be performed by the named investigator(s) in an area representing the investigator's specific interest and competencies, based on the mission of the NIH. For more information: <https://grants.nih.gov/grants/funding/r01.htm>

diverse teams are able to solve complex problems more quickly and effectively than homogeneous teams (Valantine & Collins, 2015; Page, 2008; Hong & Page, 2004). A recent study found that companies in the top quartile of racial/ethnic diversity were 35 percent more likely to achieve financial returns above the industry median, and companies in the top quartile of gender diversity were 15 percent more likely to do so (Hunt, Layton, & Prince, 2015). As a group, companies with more race- and gender-diverse business teams also had more customers and a greater portion of market share than companies with homogeneous teams (Herring, 2009). Even our financial system is affected by diversity. Ethnic homogeneity in markets has been shown to contribute to “price bubbles” and trader errors, resulting in more severe financial crashes (Levine et al., 2014).

In higher education, a diverse learning environment increases students’ exploration of diverse perspectives, reduces levels of racial prejudice, and increases tolerance of alternative points of view and other human differences (Carnevale & Fry, 2000)—outcomes that benefit all students, not just those who are UR. In the research workforce, a recent study found that ethnically diverse co-authors produce higher-quality science as measured by journal impact factor and number of citations (Freeman & Huang, 2014). Another study found that journal articles authored by gender-heterogeneous teams were perceived as higher-quality in the peer-review process, and received 34 percent more citations (Campbell, Mehtani, Dozier, & Rinehart, 2013).

In the healthcare industry, workforce diversity is part of the comprehensive strategy to address inequities in health and health care. UR health professionals care for a disproportionate number of minority and medically underserved patients, and those patients report higher levels of satisfaction—particularly when receiving mental health care (Health Resources and Services Administration [HRSA], 2006). In some instances, a

diverse biomedical research workforce also improves engagement with research participants from UR groups (Noah, 2003; Whitla et al., 2003). Establishing trust among study participants and ensuring that research is culturally informed helps avoid biased outcomes, particularly in clinical trials, where minorities are underrepresented (Ford et al., 2008; Corbie-Smith, Thomas, & St George, 2002).

Universities have developed numerous interventions designed to increase recruitment, persistence and success of UR individuals in the biomedical science and STEM fields. However, although specific programs have produced descriptive material, more empirical research is needed to identify outcomes and the effectiveness of institutional strategies. The process of diversifying the research workforce is complex and affected by institutional and community contexts. The same rigorous methods of inquiry used in scientific discovery can be applied to the challenge of producing a more diverse workforce. University leaders need to be assured that practices are firmly grounded in evidence and will lead to improvements across the university.

Universities play an essential role in preparing the future workforce, and have the opportunity to catalyze changes that will enhance the research enterprise, drive discovery, and increase our nation’s competitiveness in the global economy. This report provides a set of specific actions—including pilots, cross-institutional studies, and analysis of national datasets—to strengthen the scientific evidence needed to guide university interventions in the future. These ideas provide a starting point for the Coalition of Urban Serving Universities (USU)/Association of Public and Land-grant Universities (APLU) and the Association of American Medical Colleges (AAMC) member institutions to work collaboratively with national partners toward the shared goals of increasing access to STEM and biomedical science careers, and ensuring student success in those fields.

Action Groups: Purpose and Methods

USU/APLU and AAMC efforts to improve evidence originated with Urban Universities for HEALTH (Health Equity through Alignment, Leadership and Transformation of the Health Workforce), a national learning collaborative funded through a cooperative agreement with the NIH National Institute on Minority Health and Health Disparities (NIMHD). The project aims to improve evidence and the use of data that will help universities enhance and expand a culturally sensitive, diverse and prepared health workforce to improve health and health equity in underserved urban communities. Over the past four years, Urban Universities for HEALTH has examined institutional strategies for improving health workforce diversity and cultural effectiveness, and developed metrics that university leaders can use to track their progress toward health workforce goals.³

The USU/APLU and AAMC sought to build upon the work of Urban Universities for HEALTH and apply lessons learned to similar efforts in the area of STEM and biomedical sciences. In order to achieve this objective, the partnership convened three cross-institutional “action groups” composed of research leaders and experts (see Appendix A) based at USU/APLU and AAMC member institutions. The purpose of the groups was to examine evidence in specific areas that impact university practices, identify gaps where further evidence or analysis is needed, and recommend actions for improving evidence that could be implemented by the USU/APLU, the AAMC, and their member institutions. Group members were nominated by their presidents or chancellors, and were drawn from a wide variety of scientific disciplines. Both research-intensive institutions and undergraduate-serving institutions that produce large numbers of UR scholars were invited to participate.

Evidence was examined within four areas:

- **LEADERSHIP, ORGANIZATIONAL CHANGE, AND CLIMATE**—the impact of university leadership and institutional climate on the success of UR students and faculty in STEM and the biomedical sciences, as well as larger change efforts at the university
- **DIVERSE STUDENT SUCCESS**—the models for and approaches to developing student talent along the educational and career continuum in biomedical and STEM fields, and to ensuring student persistence and success
- **RECRUITMENT AND ADMISSIONS**—the effectiveness of interventions in increasing recruitment of UR students, as well as criteria and processes to evaluate applicants in graduate admissions
- **DIVERSE FACULTY HIRING AND ADVANCEMENT**—evidence-based strategies for assembling a diverse pool of candidates, mitigating bias during hiring, and supporting advancement of UR faculty

Each group pursued one or two of the above areas. For example, one group named “Diverse Talent Development” researched both student success and faculty hiring and advancement. The groups used a four-step process to complete their work. First, group members reviewed literature and existing evidence in each of the four content areas. Both group members and USU/APLU staff contributed articles and data sources. Second, using the Peer Esteem Snowballing Technique (PEST) (Christopoulos, 2009), the groups developed an initial shortlist of research experts to interview. Interviewees then recommended two or three other experts to contact. The goals of these key informant interviews were to: 1) validate existing

³ Urban Universities for HEALTH publications can be found at: <http://urbanuniversitiesforhealth.org/knowledge-base/publications>

evidence, 2) obtain feedback on priority evidence gaps in the researcher's area of expertise, and 3) obtain feedback on initial ideas for improving evidence. Twenty-one experts were contacted and eighteen were interviewed via phone.

Third, members of the action groups worked together to develop action items that the USU/APLU and AAMC could pursue to improve evidence in these critical

areas. Group members contributed ideas during four open brainstorming sessions, and a consensus-building process was used to refine and prioritize each idea. The resulting list of action items was submitted to all group members for written feedback and approval. Finally, proposed actions were prioritized by USU/APLU presidents and chancellors based on the potential for the ideas to produce more empirical evidence, to advance the field, and to impact the work of institutions.

Understanding the Evidence

The following summary of evidence is focused on areas to be addressed by the action items, and is not intended to be exhaustive. Each content area spans a wide variety of complex and interdependent topics, and volumes could be devoted to summarizing the evidence within each area and evaluating the strength of the evidence. This type of comprehensive review is beyond the scope of the current project.

LEADERSHIP, ORGANIZATIONAL CHANGE AND CLIMATE

To make progress towards improving diversity on a campus, leadership support is needed at all levels, from trustees and regents to deans and department chairs. In a recent USU study, the visibility of top leaders such as university boards and presidents was identified as one of the most important factors for catalyzing institutional change (Coalition of Urban Serving Universities [USU], 2011). However, it is important to note that leaders' stated commitments to diversity are more effective if backed by concrete actions (Avery, 2015). Evidence from the corporate sector suggests that establishing management accountability for diversity goals has the greatest impact on the achievement of those goals (Kalev, Dobbin, & Kelly, 2006). Tying success with diversity efforts to compensation of senior leaders and establishing performance metrics may be one way to accomplish this objective;⁴ in addition to enforcing accountability, it may also help to ensure diversity efforts survive leadership transitions (Juhas, 2015).

Increasing organizational diversity and inclusion requires a commitment to systemic change. Diversity must be an integral component of every institution's strategic plan and mission. Diversity efforts are more

effective when linked to core institutional functions such as accreditation, budgeting, and mission (Curtis, Dreachslin, & Sinioris, 2007).⁵ This demonstrates leadership commitment and prevents diversity from being viewed as a parallel or "add-on" priority (Avery, 2015; Smith, Parker, Clayton-Pederson, Moreno, & Teraguchi, 2006). However, in order to be successful, diversity efforts must be sufficiently staffed and funded, rather than relying on external support (i.e., grant funding) for their survival (Avery, 2015; Hurtado, Milem, Clayton-Pederson, & Allen, 1998). Developing a long-term plan for sustaining these important programs with internal funding will deepen their impact.

Increasing diversity in leadership ranks is also essential for organizational change. Some prior research has suggested that in addition to bias and stereotyping, managers tend to promote those who are most like themselves ("homosocial reproduction") for reasons of trust and communication concordance (Kalev et al., 2006; Heilman, 2001). Broad representation in leadership ranks mitigates this tendency and improves opportunities for women and minorities in the leadership pipeline. It also makes organizational commitments to equity more visible and reinforces positive images of leaders from all backgrounds (Working Group on Diversity in the Biomedical Research Workforce, 2012; National Academy of Sciences, 2011; Urban Institute, 2005).

Prior research also shows that an inclusive campus climate⁶ is important for achieving the full benefits of diversity. An inclusive climate aids UR student retention across disciplines by increasing students' sense of belonging and scientific identity, reducing incidences of racism and discrimination, and fostering

4 There is evidence to support this strategy at the faculty and chair level, but few universities have tied senior leaders' compensation to diversity outcomes (Bennett, 2015).

5 Hiring a chief diversity officer, or establishing an office of diversity, is often the first step taken by leaders who want to improve diversity and campus climate. However, prior research suggests that this strategy is only effective if the diversity officer is empowered and equipped with resources, and if the university responds to the diversity officer's recommendations. The individual(s) hired must also be highly qualified and possess knowledge of best practices and relevant human resources laws; the individual cannot simply "look the part" (Avery, 2015).

6 Campus climate refers to the perceptions, attitudes, and behaviors that reflect the core culture of the institution (AAMC, 2013a).

academic engagement and performance unrelated to pre-collegiate education and preparation (Hernandez, Nguyen, Saetermoe, & Suarez-Orozco, 2013; Butts et al., 2012; Urban Institute, 2005). It improves the learning experience for all students by exposing them to a wide variety of cultural perspectives that expand their understanding of the world and help them develop critical thinking skills needed for success (Association of American Medical Colleges [AAMC], 2013a; Piercy et al., 2005). In addition, discrimination, lack of support, lack of collegiality, and other climate-related factors were found to have a negative impact on faculty retention (O'Meara, Louder, & Campbell, 2014), particularly among UR faculty (McKay et al, 2007; Piercy et al., 2005).

Many universities are now conducting institutional climate assessments. Several studies have indicated that climate assessments are more effective if conducted regularly and accompanied by actionable next steps that are informed by the results (AAMC, 2013a). Methods used to conduct these assessments vary widely from institution to institution and tend to focus heavily on individual perceptions of climate. Further testing of these tools for validity and reliability will facilitate bringing climate assessment to scale across many more universities.

Institutions can take action to make campus climate more inclusive. Examples include creating zero tolerance policies for discrimination, clearly defining the process for responding to complaints, and assuring members of the campus community that the university will take action in response to reported issues (Avery, 2015). Affinity groups and other informal networks contribute to a more inclusive climate by providing individuals from all backgrounds with the space to

connect, socialize, and conduct collaborative work (Sturm, 2006). Integrating diversity content into the curriculum and highlighting faculty research on topics related to diversity and inclusion may also be a method for improving campus climate (Hurtado, Milem, Clayton-Pederson, & Allen, 1998).

Providing diversity or unconscious bias training to faculty and staff may reduce incidences of discrimination at the university (Sabin, 2015). A review of diversity training programs found that most diversity training events last less than one day and are highly dependent on organizational context (Kulik & Roberson, 2008). Many have been successful at increasing participants' knowledge of different groups' experiences, customs, and cultures, but the impact of training on attitudes toward diversity has been mixed. Strategies that are supported by some evidence include focusing on the rational business case for diversity, and incorporating experiential learning techniques (Kulik & Roberson, 2008). As an alternative to traditional diversity training, unconscious bias training—which specifically targets participants' own internal biases—has garnered significant interest within the higher education community. While it is difficult for a training intervention to actually *change* an individual's implicit biases over the long term (Sabin, 2015), evidence suggests that providing unconscious bias training for faculty members mitigates bias and reduces its impact in the workplace (Carnes et al., 2015). On the other hand, at least one recent study also suggests that focusing attention on stereotypes that shape unconscious bias may actually increase the prevalence of those stereotypes (Duguid & Thomas-Hunt, 2015). Additional research would be useful to determine whether or not unconscious bias training provides benefits beyond simple awareness.⁷

HIGHLIGHTS FROM THE FIELD

The James Irvine Foundation Campus Diversity Initiative is a large-scale diversity and climate initiative conducted across 28 universities in California. The foundation invested \$29 million between 2000 and 2006 and deployed multiple strategies to increase access and success of UR students. After six years, 63 percent of institutions in the study achieved increases in the number and percentage of minority students matriculating to the university, and higher six-year graduation rates than other California colleges and universities. Key strategies for improving institutional capacity included establishing a system for monitoring progress toward diversity goals, leadership commitment to change, and aligning diversity efforts with the institution's mission, vision, and culture. Fourteen cross-campus themes were identified as integral to sustaining diversity work, and these are detailed in the evaluation team's final report: <https://www.irvine.org/youth/linked-learning/campus-diversity-initiative> (Smith et al, 2006).

Priorities for Future Research

Additional research will be required to address the gaps in evidence in these areas. Enhanced understanding and implementation of this evidence will enable universities to make greater progress toward diversity goals. The action groups highlighted the following as priorities for future research in the area of leadership, organizational change, and climate:

- **DESCRIBE THE CHARACTERISTICS OF EFFECTIVE LEADERSHIP AND SPECIFIC ACTIONS LEADERS CAN TAKE TO IMPACT DIVERSITY OUTCOMES.** Presidents and other institutional leaders recognize the importance of cultivating diversity and inclusion, but do not always know how their role can best support systemic change. Knowing which actions will help leaders make significant progress toward diversity goals will maximize the return on investment.
- **IDENTIFY EFFECTIVE MODELS OF UNCONSCIOUS BIAS AND DIVERSITY TRAINING, AND IDENTIFY METHODS FOR SUCCESSFULLY IMPLEMENTING SUCH TRAINING.** This information helps leaders consider implementation of training on a broader scale, and ensures that training is efficient, cost-effective and leads to positive outcomes. It is recommended that researchers examine the outcomes of unconscious bias training, and identify which interventions and in which specific contexts they are most impactful.
- **DEVELOP ACCURATE METHODS OR METRICS FOR MEASURING INSTITUTIONAL CLIMATE.** Leaders are challenged to measure climate consistently and accurately, and having validated tools or sets of metrics for doing so across a range of contexts will facilitate change and support greater climate improvements.

DIVERSE STUDENT SUCCESS

Ensuring the success of students from diverse backgrounds will require a multilayered strategy that incorporates student, programmatic, and institution-level interventions. At the undergraduate student level, research has shown that strengthening students' non-cognitive skills such as self-efficacy⁸ and scientific identity increases student retention and persistence—particularly in the STEM and biomedical science fields (Butts et al., 2012; Chemers, Zurbriggen, Syed, Goza, & Bearman, 2011; Estrada, Woodcock, Hernandez, & Schultz, 2011; Byars-Winston, Estrada, Howard, Davis, & Zalapa, 2010). Institutions have piloted specific interventions⁹ to mitigate stereotype threat¹⁰ and increase students' sense of social belonging in school (Walton & Cohen, 2011). For example, brief online “mindset interventions” conducted during freshman orientation help students understand that everyone worries about belonging at first, but those feelings dissipate over time. Increasing students' sense of belonging and fostering a growth mindset has led to accelerated academic achievement¹¹ among students from UR groups, particularly African-American students (Walton, 2016; College Transition Collaborative, 2015; Paunesku et al, 2015; Dweck, Walton, & Cohen, 2014; Yeager et al, 2014; Walton & Cohen, 2011). A pilot project is underway to test similar interventions in the graduate school context, but additional evidence will be required to support bringing these interventions to scale (Walton, 2016).

The aforementioned interventions focus on changing the *student's* perceptions of his or her abilities and sense of belonging in academia. However, a number of researchers have recommended that universities—and science disciplines in general—evolve to become more inclusive (Understanding Interventions, 2014;

7 At the University of Washington, a program to deliver unconscious bias training to faculty search committees is now mandatory and will be deployed institution-wide (Sabin, 2015). Another example of a successful training program is the ADVANCE program workshops on diversity and unconscious bias led by WISELI at the University of Wisconsin-Madison (Carnes et al., 2015). The Ohio State University has used the White Men as Full Diversity Partners workshops, which have been very successful at building awareness and changing attitudes among senior leaders (Juhas, 2015). Finally, an experimental study used video games to mitigate cognitive biases (Clegg et al., 2015).

8 Another study produced a slightly different finding: although self-efficacy predicts student intentions to pursue a career in STEM, “feeling integrated into the scientific community” and “endorsing scientific values” were more robust predictors of persistence (Estrada et al., 2011).

9 Although the specific interventions referred to here are one-time events that occur during the student's freshman year, recurring interventions that are ongoing throughout the student's tenure may be more effective (Williams, 2016).

10 Stereotype threat is a phenomenon in which “individuals who are members of a group characterized by negative stereotypes in a particular domain perform below their actual abilities in that domain when group membership is made salient” (Burgess, Joseph, van Ryn, & Carnes, 2012, p. 506).

11 The intervention cut the minority achievement gap in half over a three-year observation period (Walton & Cohen, 2011).

Mutegi, 2013). This anti-deficit approach (Harper, 2012) shifts the responsibility for change from students to the university. For example, students may not be motivated by the intrinsic value of research, but rather the opportunity to solve important problems facing our world and to give back to their communities (Understanding Interventions, 2014). Changing the way science is taught in order to accommodate these differences will not only increase student interest and persistence, but also enrich the discipline as a whole. Furthermore, addressing more pervasive social constructions of race and ethnicity that affect how universities and their faculty and staff interact with UR students may work to reduce the disparities in self-efficacy and scientific identity observed in these students (Mutegi, 2013). However, it will be difficult for universities to make these changes without access to evidence-based interventions.

Two main factors that contribute to graduate student persistence are self-efficacy and scientific identity (Chemers et al., 2011). However, there are other critical factors affecting retention for graduate students including financial support,¹² personal motivation and determination, and an inclusive climate (Sowell, Allum, & Okahana, 2015). A recent qualitative study conducted by the Council of Graduate Schools found that 80 percent of UR doctoral students surveyed

thought that financial support affected their degree attainment “to a great extent,” while 78 percent thought that their work responsibilities (both on-campus and off-campus) interfered with their research (Sowell, Allum, & Okahana, 2015). A majority of doctoral candidates surveyed thought that program climate affected their ability to succeed, and nearly half felt isolated from other students. As part of the study, UR doctoral students suggested interventions¹³ to remedy these issues, including more one-on-one meetings with advisors, networking opportunities (both formal and informal), increasing awareness of diversity issues among faculty, and improving campus climate by promoting diversity and inclusion (Sowell, Allum, & Okahana, 2015).

At the programmatic level, the use of “High-Impact Practices” has consistently led to improved academic achievement among all undergraduate students. The following practices have been classified as “high impact”: undergraduate research,¹⁴ first-year seminars and experiences, learning communities, writing-intensive courses, collaborative assignments and projects, global, service, and community-based learning, internships, and capstone courses (Kuh & O’Donnell, 2013; Kuh, 2008). Although these practices benefit all students, the results of a recent study suggested that participation in High-Impact Practices has a differentially positive effect on academic performance

HIGHLIGHTS FROM THE FIELD

CSU Northridge cross-referenced its own National Survey of Student Engagement (NSSE) data on High-Impact Practices with student outcomes in order to evaluate effectiveness for underrepresented students (Huber, 2010). The University of South Carolina’s Beyond the Classroom Matters (BCTM) program has begun cataloging non-academic programs and student experiences that align with High-Impact Practices, allowing them to include information about student involvement in experiential learning on an official supplemental student transcript. The BCTM program also requires common data collection methodology and centralized data storage in the registrar’s office. Since the program is still in its early phases, additional time will be needed to assess outcomes and the feasibility of bringing this data-collection and reporting system to scale at other campuses (Bowers, 2015a; Bowers, 2015b).

12 The most effective support packages contained fewer loans, were sustained over the course of a student’s education, and eliminated the need to work or take on additional debt burdens. In addition to financial support, increasing the availability of student support services such as childcare, mental health care, and legal assistance may aid retention of non-traditional and first-generation undergraduate and graduate students (National Academy of Sciences, 2011; Hurtado, Milem, Clayton-Pederson, & Allen, 1998).

13 The study also noted that many national and state-level programs exist to support UR graduate students (e.g., the National Science Foundation’s Louis Stokes Alliances for Minority Participation (LSAMP) Bridge to the Doctorate program, and Alliances for Graduate Education and the Professoriate (AGEP), the Sloan Minority PhD program, and the Florida Education Fund’s McKnight Doctoral Fellowships, among others). However, fewer institution-level programs exist; the University of Maryland Baltimore County’s Meyerhoff Scholars Program is a notable example (Sowell, Allum, & Okahana, 2015).

for UR students (Huber, 2010). The impact on time to degree was significantly higher for UR students as well. These findings suggest that participation in High-Impact Practices benefits UR students even more than it does their majority-community peers.

Alexander, Chen & Grumbach (2009) noted that UR students receive significantly lower average grades in college “gateway courses” (required courses for entry into STEM and pre-health majors), even after adjusting for measures of prior academic preparation (Alexander, Chen, & Grumbach, 2009). A review of the research around 2-year and 4-year STEM degrees found that the normative culture¹⁵ of science fields—which views intelligence as innate and fixed rather than malleable—and a highly competitive classroom climate are obstacles to UR student success (National Academies of Sciences, Engineering, and Medicine, 2016). This suggests that ability and pre-college preparation may matter less for student success in gateway courses than their experiences in the college classroom once they arrive (Bonsangue & Drew, 1995). However, empirical evidence for these climate-related factors is limited to a handful of studies with small sample sizes (Gainen, 1995; Seymour & Hewitt, 1997). Pedagogical methods may also play a role, as faculty usually deliver gateway courses via a traditional lecture format. A meta-analysis

of student exam scores in STEM fields found that average scores improved by 6 percent in course sections that use active learning, and students in traditional lecture courses were 1.5 times more likely to fail (Freeman et al., 2014). Addressing these pedagogical challenges and classroom climate in gateway courses may help boost UR student achievement.

Mentored undergraduate research experience is a High-Impact Practice known to support student success through both cognitive and non-cognitive skill development in STEM and biomedical science disciplines (Valantine & Collins, 2015; Schultz et al., 2011). However, empirical evidence around the mentoring process itself is mixed. Although scholars agree that having a mentor is a prerequisite for student success, not all mentors are equally effective,¹⁶ and few receive formal training—particularly training that will help them understand the unique needs of UR students (Pfund, 2015). Research experts suggest that universities can improve institution-level mentoring interventions by establishing an office or program that provides culturally appropriate mentoring training,¹⁷ “mentoring the mentor” workshops, and partnerships with other colleges and universities—particularly Historically Black Colleges and Universities (HBCUs) and Minority Serving Institutions (MSIs)—to increase the pool of

HIGHLIGHTS FROM THE FIELD

The Meyerhoff Scholars Program at the University of Maryland, Baltimore County, has been widely recognized for its successful development of many UR students in the sciences. An evaluation of the program found that the key levers of success were financial support, identity formation as a member of the community of Meyerhoff scholars, summer research activities, and professional network development (Stolle-McAllister, Domingo, & Carillo, 2010). For the past 25 years, the National Science Foundation’s Louis Stokes Alliances for Minority Participation (LSAMP) program has facilitated the seamless transition of underrepresented undergraduate students into STEM graduate programs. For institutions that have been allied more than 10 years, the LSAMP Bridges to the Doctorate program (BD) prepares students from underrepresented racial and ethnic groups to persist and complete STEM doctoral degree programs. A longitudinal evaluation of the program found that 65 percent of LSAMP students pursued graduate degrees compared to 45 percent of students in a comparison sample. LSAMP students also exceeded the national rate of graduate degree completion for both UR and non-UR samples, and they are more likely than their peers in those groups to enter STEM fields (Urban Institute, 2005).

¹⁴ Undergraduate research in particular has been shown to increase student persistence in STEM fields (Estrada, 2015; Posselt & Black, 2012).

¹⁵ A number of STEM “communities of transformation” (e.g., BioQUEST, Project Kaleidoscope, the POGIL Project, and SENCER) were formed with the aim of fundamentally altering disciplinary norms to increase representation of women and minorities in science fields. A mixed-methods study found that these communities have met with some success, and participants reported climate improvements within their departments and across the institution (Kezar & Gehrke, 2015).

mentors for UR students (Bennett, 2015; Ghee, 2015; Pfund, 2015). In addition, assigning staff to support students in non-research areas, such as professional development and career coaching, allows faculty to specialize in research mentoring and may improve the overall quality of mentoring provided to students (McGee, 2015; McGee, Saran, & Krulwich, 2013).

At the institutional level, many schools have developed summer bridge programs to encourage and guide students into graduate school. These programs often feature partnerships between research-intensive institutions and minority-serving institutions.^{18, 19} Positive outcomes reported by summer bridge programs include increased likelihood of UR student admission²⁰ into a doctoral program and increased UR student persistence in STEM and biomedical science fields (American Speech-Language-Hearing Association [ASHA], 2015; Strayhorn, 2011; Maton, Hrabowski, & Schmitt, 2000). Students have also reported feeling better prepared for graduate school and experiencing an enhanced sense of belonging (Tomasko, Ridgway, Waller, & Olesik, 2016). However, few summer bridge programs have been tested using control groups, and further empirical research will help to determine whether these programs are robust enough to improve student success and persistence on a broader scale.²¹

Priorities for Future Research

Additional research will be required to address the gaps in evidence in these areas. Enhanced understanding and implementation of this evidence will enable universities to make greater progress toward diversity goals. The action groups highlighted the following as priorities for future research in the area of diverse student success:

- **DEVELOP AND EVALUATE INTERVENTIONS FOCUSED ON STRENGTHENING KEY NON-COGNITIVE ATTRIBUTES IN STUDENTS AND REDUCING STEREOTYPE THREAT.** A number of different interventions have been tested at the institutional level, but have not been evaluated across institutions or in different contexts (e.g., adapting undergraduate interventions for graduate students). Improving evidence for pilot interventions will help leaders build a case for adoption of those shown to be effective at many institutions.
- **LEARN MORE ABOUT HOW UR STUDENTS ARE ACCESSING HIGH-IMPACT PRACTICES AND DEVELOP STRATEGIES FOR IMPROVING ACCESS.** Although High-Impact Practices are supported by a robust body of research, less is known about how well UR students are accessing these experiences. Most High-Impact Practices occur beyond the classroom (Kuh, 2008), and it is difficult to track students' participation and tie their experiences to academic outcomes. This lack of data and data collection mechanisms obscures the impact of such practices on UR students. Learning more about potential barriers to access will help university leaders improve pathways into these experiences and track student outcomes more effectively.
- **IDENTIFY EFFECTIVE TEACHING AND LEARNING METHODS THAT WILL BOOST UR UNDERGRADUATE STUDENT PERFORMANCE IN REQUIRED GATEWAY COURSES.** Student performance in gateway courses is impacted by classroom climate, instructional methods, and the characteristics of the instructors themselves. These variables predict success regardless of prior academic preparation. However, we lack data on strategies

16 Measures of mentorship quality include psychological support, instrumental support, and networking (Estrada, 2015).

17 Institutions involved in the National Research Mentoring Network (NRMN) funded by NIH are piloting “culturally aware” mentoring (Pfund, 2015). The Sloan Center for Exemplary Mentoring at the University of Iowa has developed mentoring workshops and requires faculty to submit individualized mentoring plans for each student (<http://sloancenter.uiowa.edu/>).

18 Research-intensive institutions may be able to glean best practices for improving UR students' transition from undergraduate to graduate school by examining the success of HBCUs. The National Science Foundation found that 54 percent of Black/African American PhDs received their undergraduate degrees from HBCUs (Working Group on Diversity in the Biomedical Research Workforce, 2012, p.p. 149-150).

19 Kezar (2000) describes the characteristics of model bridge programs as tied to institutional mission, supported by senior leadership, and incorporating collaborative learning techniques, among other things.

20 However, the impact may be inflated as high-achieving students often self-select into these programs (Estrada, 2015).

21 When designing bridge programs, institutions must take care not to send a message that students in these programs are deficient or need remedial education, as this may further isolate UR students and reinforce negative stereotypes. Framing these programs in terms of excellence rather than diversity (e.g., “fellowship” program) may help mitigate the effect of race and class-based stereotypes (Posselt, 2015).

that will effectively mitigate these factors across a variety of institutional contexts. Further research is needed to evaluate exemplar gateway courses and the determinants of their success in order to bring promising strategies to scale.

RECRUITMENT AND ADMISSIONS

Within the higher-education community, it is often said that graduate programs have difficulty recruiting UR candidates because of insufficient diversity in the applicant pool (Krantz, 2015), or because the university is unable to provide sufficient financial support to match competing offers from other schools. However, there is evidence to suggest that these perceptions are largely inaccurate (Posselt, 2015; Bersola, Stolzenberg, Fosnacht, & Love, 2014; Harper, 2012; Nora, 2004; Smith, 1990). Although program cost and reputation are factors, personal contact and positive interactions with faculty also influence institutional choice. A recent study found that UR students' preferences differ from those of majority students when viewed as a group: faculty, student, and community diversity,²² cost of living, availability of childcare and housing, and urbanity were statistically significant drivers of UR student enrollment (Bersola et al., 2014).

However, the recruitment process is complex, and universities lack evidence-based strategies or methods for leveraging these influential factors during the

recruitment process. Cross-institutional partnerships are one strategy universities have used to increase UR student enrollment in STEM fields. Research institutions have collaborated with community colleges located in disadvantaged communities, minority serving institutions (e.g., HBCUs, tribal colleges), and undergraduate teaching institutions (Working Group on Diversity in the Biomedical Research Workforce, 2012; National Academy of Sciences, 2011; Urban Institute, 2005; George, Neale, Van Horne, & Malcom, 2001). In recent years, a number of national alliances involving many institutions have developed to help students across the country access potential mentors and advisors. Myriad partnerships serve as successful examples; however, the field lacks empirical data on program outcomes and characteristics of effective partnerships.

The admissions committee is the gatekeeper for access to many STEM and biomedical science graduate programs and subsequent research careers. Graduate program admission processes vary by discipline and are often opaque (Kent & McCarthy, 2015). However, we know that two of the three strongest predictors of *admission* to graduate school are GRE scores and the selectivity of the student's undergraduate institution (the third strongest predictor of admission being undergraduate GPA) (Posselt, 2016; Attiyeh & Attiyeh, 1997).²³ The Educational Testing Service (ETS) itself, which

HIGHLIGHTS FROM THE FIELD

The Fisk-Vanderbilt Master's-to-PhD Bridge Program aims to address the barriers facing UR students in matriculating to doctoral programs. The program has produced a number of high-profile graduates, including Fabienne Bastien, the first African-American woman to be published in *Nature*, and the first African-American recipient of the NASA Hubble Fellowship. Half of the program's PhD graduates are female, and 83 percent are minority-community individuals (Szrom, n.d.). National consortia of institutions such as the National GEM Consortium and the Leadership Alliance engage UR students directly in summer bridge programs and research experiences, and help them prepare for applying to graduate programs. The Leadership Alliance reports that their participating students' interest in graduate school increased after completion of the program across all academic disciplines. They attribute much of their success to relationship-building across Tier 1 research universities, minority-serving institutions, and private industry, ensuring each member has an equal voice in the Alliance, and identifying champions on campus who are committed to improving the participation of UR students in graduate programs that lead to careers in research (Bennett, 2015; Ghee, 2015).

²² In addition, students need to be aware of climate-related factors early in their academic careers (i.e., during their high-school years or earlier). The university needs to develop a reputation for inclusion and establish a brand that highlights an inclusive climate. Most HBCUs have been very successful at accomplishing this objective (Avery, 2015).

“The GRE is a better indicator of sex and skin color than of ability and ultimate success.”

—Miller & Stassun, 2014, p. 303

produces the GRE tests, cautions departments against relying too heavily on GRE scores alone, stating that the test “does not and cannot measure all the qualities that are important in predicting success in graduate study or in confirming undergraduate achievement” (Educational Testing Service [ETS], 2011).

A number of studies have shown that GRE scores correlate strongly with race, ethnicity and gender, and that over-emphasis on the GRE disadvantages UR students²⁴ (Posselt, 2016; Miller & Stassun, 2014; Kuncel, Hezlett, & Ones, 2001). For example, applying a 64th percentile GRE cut-off would reduce the number of women admitted by 25 percent, and the number of underrepresented minorities by 47 percent, compared to the demographics of test-takers, and these race and gender disparities persist regardless of undergraduate GPA (Miller, n.d.). Although the GRE is a convenient measure, it is insufficient for assessing merit and potential for success (Sedlacek, 2011; Sedlacek, 2004). Evaluating critical non-cognitive factors students need for success as independent researchers (e.g., grit, motivation, self-efficacy, scientific identity) may result in a more robust process that helps schools build a diverse class of students (Posselt, 2015; Posselt, 2014).

Prior research has supported the use of “holistic review” in admissions (Witzburg & Sondheimer, 2013; Price & Grant-Mills, 2010). Holistic review, a university admissions strategy that assesses an applicant’s unique experiences alongside traditional measures of academic achievement such as grades and test scores, is designed to help universities consider a broad range of factors reflecting the applicant’s academic readiness, contribution to the incoming class, and potential for success both in school and as a professional. When used

in combination with a variety of other mission-based practices, holistic review contributes to a “holistic admissions” process (AAMC, 2013b).²⁵ Holistic review has been evaluated most extensively in the health professions, particularly medicine. A recent survey conducted by Urban Universities for HEALTH showed that schools using many holistic review practices report greater incoming class diversity, with no negative impact on student success metrics such as graduation and the number of attempts needed to pass licensing exams (Urban Universities for HEALTH, 2014).

Evidence-based practices associated with holistic review include developing a mission statement for admissions that includes diversity, providing admissions committees with diversity training, and assessing non-cognitive attributes predictive of success in the field alongside academic metrics (e.g., GPA, GRE score) in the initial screening process, among other practices (Urban Universities for HEALTH, 2014). Non-cognitive attributes are difficult to assess consistently and accurately unless procedures are in place to guide admissions committees. Currently, committees are using a combination of interviews, essays, and letters of recommendation (Miller, n.d.; Sedlacek, 2004).²⁶ Using standardized interview rubrics, a set of common questions to be asked of each applicant, and multiple interviewers have all been shown to improve equity during admissions to schools that use interviews as part of their process (Posselt, 2015).

However, most of the literature supporting holistic review applies to undergraduate and professional admissions. A recent Council of Graduate Schools study found that graduate programs associate a wide variety of procedures with the term holistic review, and that details regarding the practical application of these approaches are scant (Kent & McCarthy, 2015). Further empirical research will illuminate holistic admission practices that are appropriate and effective for graduate programs.

23 In addition to the advantage that attending a selective undergraduate institution confers, several researchers noted that admissions committees also favor students from institutions where members of the admissions committee have established existing relationships—that is, institutions that employ prominent scholars from their professional networks. Further empirical research is needed to determine the extent of impact of these factors on admissions outcomes (Posselt, 2015; Avery, 2015).

24 GRE scores are also impacted by stereotype threat, test anxiety, and racial/ethnic alignment between student and test proctor (Posselt, 2015).

25 The AAMC has published a core conceptual framework and set of core principles for holistic review, as well as resources for implementing the practice in medical school admissions (AAMC, 2013b).

26 Situational Judgement Tests (SJTs) assess how applicants would approach situations common within academia and the workplace, and produce a simple numerical score. Because SJTs are so infrequently used, evidence to support their effectiveness is still being generated (Lievens & Sackett, 2012).

Priorities for Future Research

Additional research will be required to address the gaps in evidence in these areas. Enhanced understanding and implementation of this evidence will enable universities to make greater progress toward diversity goals. The action groups highlighted the following as priorities for future research in the area of recruitment and admissions:

- **IDENTIFY COMPELLING FACTORS THAT DRIVE INSTITUTIONAL AND PROGRAM CHOICE AMONG UR STUDENTS APPLYING TO GRADUATE SCHOOL.** Many UR students are deeply concerned with issues such as climate, community, relationships with potential advisors, and feeling a sense of belonging on campus. These factors may have an impact on their choice of discipline, institution, and graduate program. However, more in-depth research is needed to understand how students are making these decisions, how they can be encouraged to pursue graduate education and enter high-needs career pathways in STEM and the biomedical sciences, and what supports their eventual success.
- **EVALUATE THE FEASIBILITY AND EFFECTIVENESS OF HOLISTIC REVIEW IN GRADUATE PROGRAM ADMISSIONS.** Although holistic review has been widely used in the health professions, the extent of its use among graduate programs is less well known. Even less is known about how holistic review might be successfully implemented in graduate admissions broadly. Piloting new models and conducting additional testing will help to determine whether this promising practice can be brought to scale, and

how it should be deployed across a variety of disciplinary contexts.

DIVERSE FACULTY HIRING AND ADVANCEMENT

Empirical research has demonstrated that a diverse faculty body enriches the teaching and learning environment for all students (Piercy et al., 2005). However, many universities have struggled to achieve this diversity, and few evidence-based strategies exist for recruiting candidates from UR populations (Avery & McKay, 2006). Expanding recruitment networks and ensuring diversity in the candidate pool have led to success at some institutions (Johnson, Hekman, & Chan, 2016; Smith, Turner, Osei-Kofi, & Richards, 2004). Many prior efforts have focused on simply achieving a balanced mix of individuals in terms of race, ethnicity, and gender, but limiting diversity efforts to demographics alone is insufficient and may trigger conflicts²⁷ if structural barriers to success are not eliminated (Hurtado, Milem, Clayton-Pederson, & Allen, 1998). To achieve the full benefits of diversity, universities must adjust policies and programs to ensure support for faculty from all backgrounds during the tenure and promotion process (Milem, 2001). A critical transition point for entry into the professoriate is a post-doctoral experience. In the STEM and biomedical science fields, one or more years of work as a post-doc are increasingly required for advancement into tenure-track faculty positions, but only 4 percent of post-doctoral scholars in those fields were from UR backgrounds (NSF, 2011). Moreover, UR post-docs are not entering tenure track positions in sufficient numbers, especially at Tier 1 research institutions, and often pursue careers in industry (Roca,

HIGHLIGHTS FROM THE FIELD

The National Football League (NFL) enacted a policy, popularly called the “Rooney Rule,” which requires consideration of at least one candidate from an underrepresented background for every vacant position. The rule has played a “material role” in diversity gains within the coaching and leadership ranks of the NFL (Avery, 2015; Proxmire, 2008, p. 6). The University of Texas System recently committed to implementing a Rooney Rule for senior positions (dean or above) at its universities and health systems (University of Texas System, 2015). The State University of New York (SUNY) system recently released a new Diversity, Equity, and Inclusion policy that will require all 64 of its campuses to hire a Chief Diversity Officer (CDO) and ensure consideration of diversity during the recruitment and hiring of new faculty, staff, and administrators (State University of New York Board of Trustees, 2015).

27 The risk of conflict may be mitigated by framing initiatives in terms of research excellence rather than race, gender, or diversity (Juhas, 2015).

2010). Lack of advising and mentoring, as well as the long hours and low pay²⁸ associated with many post-doctorate positions are believed to limit opportunities for UR post-docs (Leslie, 2016). Ensuring adequate support for UR post-docs and connecting them with mentors may improve the pipeline of UR scholars into faculty positions; however, few evidence-based strategies exist for addressing these barriers.

The hiring process is another key transition point for UR scholars. Preliminary evidence supports the practice of faculty “cluster” hiring (creating multiple faculty positions around a common interdisciplinary research topic) as a method for hiring a more diverse group of faculty (Urban Universities for HEALTH, 2015; Sá, 2008; Van Hartesveldt & Giordan, 2008). Asking applicants to submit a diversity statement helps hiring committees assess applicants’ potential contributions to diversity and an inclusive environment (Haynes, 2016). Including a “diversity advocate” on the committee, regardless of that person’s identity with an underrepresented group,²⁹ ensures that diversity will be considered during the process while reducing the service burden for UR faculty (Avery, 2015). Providing the committee with diversity and unconscious bias training (Sabin, 2015; Juhas, 2015), developing objective indicators for hiring and

promotion, and conducting structured interviews with standardized rubrics may reduce bias and stereotyping (DiPonio, 2010; Patrick & Yick, 2005). At least some evidence suggests that these practices improve equity and satisfaction with the hiring process. However, the overall effect on diversity outcomes may depend greatly on institutional context and methods of implementation. Ultimately, university leaders may need to employ multiple practices or combine approaches to achieve desired diversity outcomes.

Many institutions struggle to retain UR faculty once they are hired, and those who choose to stay face many hurdles to success and advancement. Reasons why faculty choose to leave an institution vary widely, and exit-survey data is often unreliable or unenlightening (O’Meara et al., 2014). In prior qualitative studies, UR faculty members report that, in comparison to their non-UR colleagues, they have been asked or expected to participate in additional service activities, sit on committees, and advise large numbers of minority students (Rodriguez, Campbell, & Pololi, 2015). These activities are rarely recognized or rewarded during the tenure and promotion process, and reduce time available for research and teaching (Avery, 2015; Urban Universities for HEALTH, 2015; Turner, González, & Wood, 2008). In addition, faculty at institutions that

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The NIH IRACDA program provides mentoring opportunities for post-docs—many of whom are from underrepresented minority groups—and promotes collaboration among research-intensive institutions and minority-serving institutions (<https://www.nigms.nih.gov/Training/CareerDev/Pages/TWDInstRes.aspx>). The University of California Presidents’ Post-doctoral Fellowship Program is a system-wide, regional program offering mentorships, professional development, and research support to UR scholars (<http://ppfp.ucop.edu/info/>). The Carolina Post-doctoral Program for Faculty Diversity (CPPFD) is another exemplary program, and was recognized by *Diverse, Issues in Higher Education* in 2014 for its successful preparation of UR post-docs and faculty. In addition to the University of North Carolina system, the program collaborates with 46 colleges and universities across the country, including Duke University, Yale University, the University of Michigan, the University of California Los Angeles, the University of Maryland, John Hopkins University, Morehouse University and Howard University (<http://research.unc.edu/carolina-postdocspost-docs/>).

28 Another significant factor cited for both post-docs and tenure-track faculty was the availability of childcare and other support services at the institution (Avery, 2015).

29 The clearly defined role and purpose of the diversity advocate may be more important than the identity of this individual. For example, a common practice intended to ensure gender equity during faculty hiring is including women on the search committee. However, research has shown that female faculty apply the same unconscious biases against women that their male colleagues do, resulting in a marginal (if any) impact on gender equity (Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012).

lack diversity report feeling isolated and marginalized from their majority peers, feeling that their research and scholarship is not valued, and experiencing difficulty accessing collegial networks needed for collaborative work and career advancement (Kolade, 2016). Creating informal opportunities for networking and collaboration³⁰ may be helpful for universities to improve UR faculty retention and success.

Priorities for Future Research

Additional research will be required to address the gaps in evidence in these areas. Enhanced understanding and implementation of this evidence will enable universities to make greater progress toward diversity goals. The action groups highlighted the following as priorities for future research in the area of diverse faculty hiring and advancement:

- **IMPROVE EVIDENCE FOR STRATEGIES THAT REDUCE BARRIERS AND PROVIDE GREATER SUPPORT FOR UR POST-DOCTORAL SCHOLARS.** The lack of diversity in these positions is well known, and experts have hypothesized potential barriers that could be addressed to improve participation. However, prior efforts to diversify the faculty have largely ignored post-docs, who are neither faculty nor students. Further evidence is needed to support

strategies and programs that reduce barriers to entry and facilitate UR student success in these positions, and in their transitions to the professoriate.

- **EXPLORE HOW EVIDENCE-BASED FACULTY HIRING STRATEGIES CAN BE IMPLEMENTED SUCCESSFULLY ACROSS UNIVERSITIES.** Evidence-based hiring strategies exist, but the extent to which institutions are using them is still unknown. Leaders also lack information about how to implement these practices across a variety of institutional contexts. For example, requesting that candidates submit a diversity statement during the hiring process has shown promise at several institutions, but concrete and consistent guidance is needed in order to develop criteria for these statements.
- **IDENTIFY THE DETERMINANTS OF UR FACULTY RETENTION AND SUCCESS, AND IMPROVE EVIDENCE FOR STRATEGIES THAT SUPPORT UR FACULTY PROMOTION AND ADVANCEMENT.** Although barriers to UR faculty retention and advancement have been identified, the evidence for successful strategies to address them is largely anecdotal. Improved evidence will help leaders develop specific policies to address those barriers and increase UR faculty success.

HIGHLIGHTS FROM THE FIELD

Both the University of California, San Diego and the University of California, Irvine have piloted the use of diversity statements during the hiring process and have reported success. These brief statements are submitted by applicants and are intended to help committees assess the applicant's potential contributions to diversity and inclusion. At UC Irvine, the "Inclusive Excellence Statement" was piloted in 2014–2015 and adopted campus wide in September 2015. The percentage of UR faculty at the university increased from 12 percent to 20 percent during the pilot period. UC Irvine notes that the IES was not the decisive factor in hiring, but added value to already strong candidates; the IES itself may also make the campus more attractive to candidates because it signals an institutional commitment to diversity and inclusion (Haynes, 2016; University of California, Office of the General Counsel, 2015).

³⁰ For example, the Women in Science and Engineering Leadership Institute (WISELI) at the University of Wisconsin-Madison conducts research and provides resources to support female faculty retention and advancement. The Comprehensive Equity at Ohio State (CEOS) project—one of more than 70 NSF-funded ADVANCE Institutional Transformation grants—also provides networking, mentoring, informal social opportunities, and career-development support for women faculty (Juhas, 2015).

Proposed Actions

The following actions are proposed as an initial slate of ideas to address gaps in research identified by the working groups. These ideas include collaborative research and pilot projects, cross-institutional studies, and analysis of national datasets. The intended audience for this action plan is the broader alliance of member institutions across the Coalition of Urban Serving Universities (USU)/Association of Public and Land-grant Universities (APLU) and the Association of American Medical Colleges (AAMC). Leaders at these institutions, as well as research partners, funding agencies, and philanthropic organizations, may advance some of these items as a means of strengthening scientific rigor for diversity interventions and spreading practices that we know are effective. Each of these ideas would be feasible to implement through collaborative work, and would advance the goal of broader uptake of evidence-based practices that increase diversity in STEM and biomedical science fields nationally.

LEADERSHIP, ORGANIZATIONAL CHANGE, AND CLIMATE

1. TESTING UNCONSCIOUS BIAS TRAINING:

Adapt and test a promising intervention to mitigate unconscious bias at a number of schools and in different contexts to evaluate its impact on diversity outcomes.

Early data supports the use of interventions to mitigate unconscious bias in certain contexts, such as faculty hiring (for example, at the University of Wisconsin-Madison and the University of Washington). Having more rigorous evidence for the applicability of these interventions across institutions or in other contexts, such as admissions, may help us to understand how unconscious bias training can be used, and to expand adoption of this promising practice.

2. CLIMATE ASSESSMENT STUDY: *Survey a large national group of institutions to determine which climate assessments are being used and how universities are using them to achieve organizational change.*

Climate assessments are time-consuming and expensive, and evidence to support their effectiveness is limited— particularly if schools have no clear way of utilizing the information gathered to improve outcomes. More rigorous studies in this area will help leaders decide which climate tools to invest in, as well as effective strategies for using the data to achieve desired change.

3. TOP 10 LEADERSHIP ACTIONS: *Develop a Top 10 list of the most effective actions presidents and chancellors can take to achieve diversity goals.*

Evidence from business literature suggests that strong leadership is essential to achieving greater diversity and inclusion. Success is achieved primarily through actions that increase visibility, create accountability, and integrate policies into daily operations. Combining this evidence with information from interviews with leaders who have successfully improved diversity and inclusion³¹ on their campuses will provide leaders at other institutions with an easy-to-use list of actions they can implement to make greater progress.

DIVERSE STUDENT SUCCESS

4. MINDSET INTERVENTION PILOT: *Evaluate the impact of mindset interventions on underrepresented students' scientific identity, persistence, and achievement in STEM/biomedical science fields.*

Studies have shown that cultivating a sense of belonging in the university community and addressing stereotype threat improves student

31 Assessing leadership success in this area is difficult, but criteria may include an increase in the percentage of students, faculty, and staff on campus who are UR individuals, an increase in retention and advancement of UR students and faculty, and positive perceptions of institutional climate as measured by regular climate assessments.

achievement, particularly for UR students. However, interventions to foster this sense of belonging have not been tested more broadly in science fields. By piloting these interventions at key transition points (for first-year undergraduate STEM majors and for students entering graduate biomedical science programs) at a diverse group of institutions, we will generate more rigorous evidence to support the use of these interventions in different contexts. Outcomes will include impact on scientific identity, student persistence, and academic achievement. The study may also yield a better understanding of how these interventions mitigate the effects of stereotype threat on UR student success.

- 5. DATA SYSTEMS FOR TRACKING HIGH-IMPACT PRACTICES:** *Convene a national learning collaborative with offices of institutional research to develop processes for data collection and analysis to track UR student participation in High-Impact Practices.*

Evidence suggests that High-Impact Practices increase student success, but we lack the ability to track student access to these practices—particularly those that are applied beyond the classroom, such as undergraduate research and internships. The ability to track student participation in these activities will provide opportunities for universities to intervene in a systemic way to improve the quality of education. It will also provide better data to assess the impact of these activities on key outcomes, including time to degree and persistence in science majors.

- 6. STUDY OF HIGH-IMPACT PRACTICES IN STEM:** *Conduct a national study to determine the effectiveness of High-Impact Practices for UR students in STEM majors using data on student outcomes combined with data from the National Survey on Student Engagement (NSSE).*

Early data has shown that when students participate in two or more High-Impact Practices, academic outcomes (e.g., student GPA, persistence, time to graduation) improve. This multi-institution study would examine outcomes for UR students in STEM/biomedical science disciplines to determine the extent to which UR students are accessing these opportunities, and the impact on their academic achievement and persistence in STEM

fields. Evidence from this study will help leaders make better-informed decisions about investment in these practices.

- 7. LEARNING COLLABORATIVE FOR GATEWAY COURSE IMPROVEMENT:** *Convene a national learning collaborative to evaluate effective delivery methods for gateway undergraduate STEM courses that support success of UR and non-traditional students.*

Prior research has shown that UR student performance in undergraduate STEM gateway courses varies greatly depending on how the course is structured, pedagogical techniques, and the personal characteristics of the instructor. The learning collaborative would evaluate course-level data and identify best practices that support UR student success. Evidence from this project will help university leaders improve delivery of their gateway STEM courses.

RECRUITMENT AND ADMISSIONS

- 8. HOLISTIC REVIEW PILOT:** *Pilot an experimental model for holistic review in admissions within a cohort of biomedical science graduate programs, and engage research-intensive partners of the NIH BUILD sites.*

The Council of Graduate Schools has recently collected new data on current practices in graduate program admissions. Merging this dataset with our recent work on holistic review would allow us to develop a model for holistic review in graduate admissions (including rubrics and methodologies for evaluating non-cognitive attributes) that could be tested to determine the feasibility and effectiveness of holistic review in biomedical graduate programs. Doing so will enable the expansion of this successful practice and help schools identify a more diverse and prepared group of students.

- 9. MINORITY APPLICANT STUDY:** *In partnership with minority student associations, convene focus groups of minority graduate applicants and matriculates to understand what factors influenced their program choices.*

Students choose to apply to and attend graduate programs for a variety of reasons, including academic factors (e.g., research excellence, experienced faculty) and non-academic factors

(e.g., institutional culture and climate, geography, availability of financial aid, opportunities in the surrounding community). The information from this study will help institutional leaders identify new recruitment strategies for biomedical graduate programs and address barriers to UR student recruitment.

DIVERSE FACULTY HIRING AND ADVANCEMENT

10. ADDRESSING BARRIERS FOR POST-DOCTORAL SCHOLARS: *Partner with national stakeholders to evaluate the impact of diversity programs for post-docs on the institutions participating in such programs, and the impact on larger barriers facing UR post-doctoral scholars.*

UR post-docs are not entering tenure-track faculty positions in sufficient numbers, especially at research-intensive institutions. Further empirical research is needed to understand the barriers that UR scholars face when attempting to enter into post-doctoral positions, and ultimately the professoriate. National and regional programs have been developed to support scholars from UR backgrounds, such as the NIH IRACDA program, the University of California President's Post-doctoral Fellowship Program, and the Carolina Post-doctoral Program for Faculty Diversity. Learning more about how these programs have impacted the university's ability to recruit and retain UR post-docs and new tenure-track faculty members will aid replication and scaling of successful efforts.

11. PILOT OF APPLICANT DIVERSITY STATEMENTS: *Pilot the use of applicant diversity statements in faculty searches at 10 research-intensive universities.*

Several universities are now requiring all applicants for faculty positions to submit a statement on

how they will contribute to campus diversity and inclusion. Preliminary data supports the use of these statements for increasing faculty diversity and improving climate at the department level. Testing the use of an applicant diversity statement at a broader set of universities and departments in biomedical sciences would provide more rigorous evidence and reveal effective methods for replicating this practice broadly.

12. NATIONAL STUDY ON FACULTY HIRING PRACTICES: *Conduct a national study to determine the extent of use of evidence-based practices for diverse faculty hiring.*

Early evidence supports a number of emerging practices for diverse faculty hiring (e.g., utilizing diversity practices in faculty cluster hiring initiatives, having diversity advocates on hiring committees, requiring a diverse pool of candidates, and incorporating ADVANCE practices for gender diversity). This study would give us an accurate view of the state of the field in faculty hiring nationally, and potentially help expand the use of these evidence-based practices among institutions.

13. FACULTY RETENTION AND ADVANCEMENT: *Convene faculty focus groups to identify key determinants of UR faculty retention and advancement in the biomedical sciences.*

We know that turnover is higher for UR faculty, and that advancement through the faculty ranks is more challenging for these individuals. Evidence from the focus groups will help university leaders take action to improve retention of talented UR faculty, as well as to identify potential barriers to UR faculty advancement at their own institutions. Focus groups will include all junior faculty and leaders from institutions, and merge data from institutional exit interviews and surveys.

Conclusion

Research universities and academic medical centers are laboratories of innovation, generating scientific discoveries that lead to new medicines, cures for disease, and improved public health. The urgent national challenge to diversify the scientific workforce calls for equally rigorous methods of inquiry. This report has identified current gaps in knowledge and proposed some actions that research universities, academic medical centers, and national stakeholders can take to improve the quality of evidence in

high-priority areas. Ensuring that university strategies are backed by evidence will drive further change and support leaders in their efforts to recruit and prepare our nation's future scientists. These actions represent an initial step in the direction of our shared goal of strengthening evidence for diversity efforts. It is our hope that these actions will contribute toward the monumental tasks of diversifying the biomedical research workforce, ensuring scientific excellence, and advancing equity across higher education.

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Appendix A

ACTION GROUP LEADERSHIP AND MEMBERS

NAME	TITLE	UNIVERSITY NAME
Executive Committee		
Stephen Aley	Associate Vice President for Research	University of Texas at El Paso
David Burr	Associate Vice Chancellor for Research	Indiana University – Purdue University Indianapolis
David Conover	Vice President for Research	Stony Brook University
James Dias	Vice President for Research	University at Albany, SUNY
Norman Drinkwater	Interim Associate Vice Chancellor for Research for Biological Sciences	University of Wisconsin – Madison
Mitra Dutta	Vice Chancellor for Research	University of Illinois at Chicago
David Eaton	Dean and Vice Provost, the Graduate School	University of Washington
Andres Gil	Vice President for Research	Florida International University
Erin Golembewski	Senior Associate Dean, Graduate School	The University of Maryland, Baltimore
Crist Khachikian	Associate VP for Research and Graduate Studies and Graduate Dean	California State University, Northridge
Simon Kim	Associate Vice President for Research and Sponsored Programs	California State University, Long Beach
Richard Larson	Executive Vice Chancellor, Vice Chancellor for Research	University of New Mexico
Frances Leslie	Vice Provost, Graduate Education and Dean, Graduate Division	University of California, Irvine
Frank Macrina	Vice President for Research and Innovation	Virginia Commonwealth University
Richard Marchase	VP for Research and Economic Development	University of Alabama at Birmingham

NAME	TITLE	UNIVERSITY NAME
Ambika Mathur	Dean of the Graduate School	Wayne State University
Vickie Mays	Assistant Vice Chancellor for Research	University of California, Los Angeles
Victor McCrary	Vice President, Division of Research and Economic Development	Morgan State University
Marshall “Chip” Montrose	Dean of the Graduate School	University of Cincinnati
Prakash Nagarkatti	Vice President for Research	University of South Carolina
Bill Petuskey	Associate Vice President for Natural and Physical Sciences	Arizona State University
Earl Smith	AVP for Health Initiative	University of Houston
Karl Steiner	Vice President for Research	University of Maryland, Baltimore County
Jay Vadgama	Chief, Center to Eliminate Cancer Health Disparities	Charles Drew University
James Weyhenmeyer	Vice President for Research and Economic Development	Georgia State University
Caroline Whitacre	Vice President for Research	The Ohio State University
Jennifer Woodward	Associate Vice Provost for Research Operations	University of Pittsburgh

Leadership, Organizational Change and Climate Action Group

Caroline Whitacre (chair)	Vice President for Research	The Ohio State University
Simon Atkinson	Vice Chancellor for Research	Indiana University – Purdue University Indianapolis
PonJola Coney	Senior Associate Dean, School of Medicine	Virginia Commonwealth University
Donna Ekal	Associate Provost, Undergraduate Studies	University of Texas at El Paso
Andrew Feig	Associate Dean of the Graduate School	Wayne State University
Brian Gibbs	Associate Vice Chancellor for Diversity	University of New Mexico
Lynn Gordon	Senior Associate Dean for Diversity Affairs, David Geffen School of Medicine	University of California, Los Angeles

NAME	TITLE	UNIVERSITY NAME
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William LaCourse	Dean, College of Natural and Mathematical Sciences	University of Maryland, Baltimore County
Bernadette Melnyk	Dean, College of Nursing	The Ohio State University
Leo Morales	Professor and Chief Diversity Officer, University of Washington School of Medicine	University of Washington
Teri Pipe	Dean and Professor, College of Nursing and Health Innovation	Arizona State University
Laura Schweitzer	President, Union Graduate College	University at Albany, SUNY
Krzysztof Slowinski	Associate Dean in the College of Natural Sciences and Mathematics	California State University, Long Beach
Becky Welch	Program Operations Director, UNM Health Sciences Center	University of New Mexico
Jennie Williams	Research Assistant Professor of Medicine	Stony Brook University
Darlene Zellers	Associate Vice Chancellor for Academic Career Development, Health Sciences	University of Pittsburgh

Diverse Talent Development Action Group

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Ambika Mathur (co-chair)	Dean of the Graduate School	Wayne State University
Sibby Anderson-Thompkins	Director of Post-doctoral Affairs, Carolina Post-doctoral Program for Faculty Diversity	University of North Carolina at Chapel Hill
Ritu Aneja	Director of Graduate Programs, Biology	Georgia State University
Paul Beasley	Director, USC TRIO Programs	University of South Carolina
Elizabeth Bejar	Vice President, Academic Affairs	Florida International University
Chi-Ah Chun	Professor in Psychology and Director of BUILD Student Training Core	California State University, Long Beach

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Michael Dennin	Vice Provost for Teaching and Learning and Dean, Division of Undergraduate Education	University of California, Irvine
Bert Ely	Professor, Department of Biological Sciences; Director, Center for Science Education	University of South Carolina
Jeffrey Engler	Interim Dean, UAB Graduate School	University of Alabama at Birmingham
Berhane Ghebrehiwet	Professor of Medicine and Pathology in the SBU School of Medicine	Stony Brook University
Laurie Kramer	Associate Dean, Academic Programs	University of Illinois at Urbana – Champaign
Keith Lindor	Executive Vice Provost and Dean, College of Health Solutions	Arizona State University
Elebeoba May	Associate Professor, Biomedical Engineering	University of Houston
Christine Pfund	Researcher, Center for Improvement of Mentoring Experience in Research (CIMER) and National Research Mentoring Network (NRMN)	University of Wisconsin – Madison
Luis (Louie) Rodriguez, Jr	Assistant Vice President for Student Affairs	University of Texas at El Paso
Kenneth Simonson	Director, Emerging Ethnic Engineers Program	University of Cincinnati
Dudley Strickland	Assistant Dean for Graduate and Post-doctoral Studies, School of Medicine	The University of Maryland, Baltimore

Recruitment and Admissions Action Group

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Lisa Armistead	Associate Provost for Graduate Programs	Georgia State University
Edward Berbari	Chancellor's Professor and Chairman of Biomedical Engineering	Indiana University – Purdue University Indianapolis
Douglas Boudinot	Dean, Graduate School	Virginia Commonwealth University

NAME	TITLE	UNIVERSITY NAME
Jose Luis Contreras-Vidal	Professor, Electrical and Computer Engineering	University of Houston
Carlos Crespo	Director of Community Health	Portland State University
Paula Davis	Assistant Vice Chancellor for Health Sciences Diversity	University of Pittsburgh
LaRuth McAfee	Assistant Dean, Graduate School Office of Diversity, Inclusion, and Funding	University of Wisconsin-Madison
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