Ripple Effect
COMMUNICATIONS, INC.

INTELLIGENT PROJECT MANAGEMENT™

NIH Request for Information:

Strategies to Enhance Diversity in the Physician-Scientist Workforce

Final Analysis of Public Comments

March 30, 2016

Executive Summary

Physician-Scientist Workforce Working Group

A robust biomedical workforce is essential to the future of US competitiveness and innovation in biomedical research. In 2011, the National Institutes of Health (NIH) Advisory Committee to the Director (ACD) established the Biomedical Research Workforce Working Group (WGDBRW). The working group was tasked with developing a model that would inform decision-making about training the optimal number of individuals for the appropriate types of positions to advance science and promote health. One of the WGDBRW's recommendations in its June 2012 report was to further the understanding of the unique challenges and needs of the physician-scientist.

In response to this recommendation, NIH established the Physician-Scientist Workforce Working Group (PSW-WG). Dr. Francis Collins, NIH Director, charged the PSW-WG with analyzing the composition and size of the PSW[1] and with responding to the recommendations in the June 2012 report. In June 2014, the PSW-WG released a report that contained nine recommendations. The eighth recommendation stated that NIH should intensify its efforts to increase diversity in the PSW. An internal implementation group suggested that the most efficient way to do this would be to develop an evidence base that identifies unique trajectories, potential systematic or structural barriers, and successful strategies for enhancing the diversity of the PSW.

Although individuals from underrepresented backgrounds do successfully negotiate the physician-scientist career pathway, optimal diversity of the PSW has yet to be achieved. For example, women, particularly at senior levels, continue to be underrepresented in the PSW. An informed analysis of the scope of the problem is difficult, however, because of the scarcity of literature on the subject of underrepresented populations in the PSW. In particular, there is very little research regarding the presence of Hispanics, Native Americans/Alaska Natives, and Pacific Islanders in the PSW, and research on individuals with disabilities and those from economically disadvantaged backgrounds is essentially non-existent.

Request for Information

In November 2015, NIH published a Request for Information (RFI) titled "Strategies to Enhance Diversity in the Physician-Scientist Workforce" (NOT-OD-16-027). The RFI requested input on three key components along the physician-scientist pathway: 1) educational pathways, 2) institutional and programmatic characteristics of degree programs, and 3) career decision points and pathways.

An analysis team reviewed 123 submissions using both deductive and inductive approaches. Specifically, the team developed a coding scheme based on the structure of a literature review on diversity in the PSW and the pathway components. The scheme was further organized into three conceptual levels: topic (the key components identified in the RFI), subtopic (which represented a general idea), and code name (which identified a specific idea within a subtopic).

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[1] "Physician-scientist" is here defined as scientists with professional degrees who have training in clinical care and who are engaged in independent biomedical research, including those with MD, DO, DDS/DMD, DVM/VMD degrees, and as nurses with research doctoral degrees who devote the majority of their time to biomedical research.

The responses overwhelmingly supported NIH's role in efforts to enhance the diversity of the PSW. Respondents identified barriers to participation, including educational, social, and institutional factors, which discourage a more diverse PSW; many suggestions offered ways to improve diversity.

Early Education

Respondents expressed concern that the early educational experiences of some individuals from underrepresented backgrounds may inhibit their interest in, and progression along, the PSW pathway. Throughout K-12 education, individuals with low socioeconomic status may have limited exposure to quality science education or scientific role models. Respondents called for increased exposure to science, technology, engineering, and mathematics (STEM), both inside and outside the classroom, during middle and high school. This exposure would increase awareness of STEM fields and interest in pursuing STEM careers. Respondents viewed summer research programs that provided research opportunities at the high-school level as important, and they provided examples of existing programs and best practices. Respondents further suggested that exposing members of the PSW, particularly physicians without a PhD, to research at all educational stages will potentially enhance the diversity of the PSW.

Mentorship

About a quarter of respondents mentioned the significance of mentorship as a tool to enhance the recruitment and retention of persons from underrepresented backgrounds in the PSW. Early mentorship and the availability of role models in scientific fields were seen as crucial to raising awareness and early interest in science. Respondents thought that early access to effective role models would have a considerable impact on educational and career decision points along the PSW pathway. Respondents identified mentorship at later stages of the physician-scientist pathway as a way to lessen institutional and social isolation among underrepresented physician-scientists. Respondents suggested ways to improve and formalize the mentoring experience, from the perspective of mentors and those receiving mentoring. Some respondents noted the lack of dedicated, formal support or training for potential mentors in NIH programs, and suggested that NIH may not be taking this approach as seriously as it should.

Partnerships

Several respondents encouraged NIH to partner with educational associations and institutions, such as historically black colleges and universities (HBCUs) and professional associations, as a way to diversify the PSW. Respondents viewed institutional partnerships as important at all stages of the physician-scientist pathway, as a way to generate initial interest in K-12 students and to prepare college students for dual-degree programs and careers as physician-scientists, among other reasons. At later career stages, professional associations can promote awareness of NIH funding opportunities for early career physician-scientists.

PSW Pathway

Individuals from underrepresented backgrounds with low socioeconomic status may have limited science education and few opportunities for training. NIH should explore and promote multiple pathways to provide alternatives to the traditional educational pathway (e.g., dual-degree programs). Certain characteristics of dual-degree (MD/PhD) programs may attract or deter students from entering the pathway. Respondents noted concerns that were specific to individuals from underrepresented and disadvantaged backgrounds, but could be applicable to others entering training to become physician-

scientists. Respondents recommended fostering non-traditional or alternative pathways that facilitate transitions from community colleges into dual-degree programs and STEM fields in general. Additionally, respondents indicated there should be more formalized research opportunities along the PSW pathway. This could include new programs and funding opportunities for non-dual-degree physicians during medical school at early and late stages in the physician's career.

Suggestions also addressed potential modifications to dual-degree programs. Respondents were concerned that overreliance on Medical College Admission Test (MCAT) scores may have a disparate impact on individuals from underrepresented backgrounds who may not have the resources to adequately prepare for the test. Overall, respondents were supportive of a more holistic approach to admissions requirements. More funding could also increase the number of available slots in dual-degree programs and provide novel approaches to training that might attract and retain applicants from underrepresented backgrounds, such research opportunities during the last two years of clinical training, and expansion of dual-degree eligibility to other degree types (e.g., PharmD/PhD).

Financial Considerations

Financial considerations at the individual and institutional level were a recurring theme throughout the responses. In terms of personal finances, physician-scientists from underrepresented backgrounds may have more student debt and be otherwise less able to accommodate the low salary offered to researchers. Opportunities to defer or pay off student loans and to receive increased salary support during career research phases or increased stipends during training would help create a more diverse physician-scientist workforce. Responses about financial issues also encompassed concern about the general research funding climate. Securing funding for research has become increasingly competitive, and physicians see themselves at a disadvantage compared to researchers with PhDs and significant research experience.

Institutional Support

While not directly within the purview of the NIH, the need for greater institutional support for aspiring physician-scientists at all stages of the pathway, including undergraduate career advising, recruitment into dual-degree programs, and transitions to career independence featured in many responses. Suggestions for institutional support included networking, mentoring, career development opportunities, ensuring protected time, more support for international students and physicians,[2] and scholarships and other financial support. Respondents cited many model programs.

Barriers to Participation

Barriers to participation exist at all stages of the PSW pathway. Institutionalized discrimination, as well as conscious and unconscious bias, were among those mentioned. Additionally, respondents identified four major deterrents to selecting, and persisting in, the physician-scientist career path: personal or family financial status, lack of family-friendly policies and support, length and structure of dual-degree programs, and overall institutional funding climate. These factors influence all individuals in the career path, but may disproportionately impact individuals from underrepresented backgrounds.

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[2] Although support for international students and physicians was mentioned in the RFI responses, these responses addressed issues beyond the scope of the RFI.

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Background

In 2013, National Institutes of Health (NIH) Director Dr. Francis Collins convened the Physician-Scientist Working Group (PSW-WG) to analyze the composition of the physician-scientist workforce (PSW) and provide feedback on how to strengthen it. In June 2014, the PSW-WG released a report that included several recommendations for action. Recommendation 8 of the report stated that the NIH should "intensify efforts to increase diversity in the physician-scientist workforce." The PSW-WG recognized major deficiencies of the workforce with regard to diversity, and strongly endorsed the recommendations of previous Advisory Committee to the Director (ACD) working groups addressing the biomedical workforce and diversity.

NIH leadership tasked its staff to develop plans to implement the recommendations in the PSW-WG's report. Lisa Evans, JD, Scientific Workforce Diversity Officer, Division of Biomedical Research Workforce, Office of Extramural Programs (OEP), Office of Extramural Research (OER), led the Diversity Implementation Working Group (WG). Kafui Dzirasa, MD, PhD, Assistant Professor, Resident, Psychiatry, Duke University Medical Center, and Kenneth D. Gibbs, Jr., PhD, MPH, National Institute of General Medical Sciences, provided substantial assistance with the development of the conceptual framework for the diversity implementation plan. The Diversity Implementation WG met several times with a focus on prioritizing key tasks and identifying structural impediments to engaging and retaining individuals from underrepresented backgrounds in the PSW. The NIH Notice of Interest in Diversity identifies the populations that are underrepresented for the purposes of extramural program participation.

Ripple Effect Communications, Inc., (Ripple Effect) was tasked to assist with analysis of these issues to help NIH increase its understanding of the impediments and the solutions to increase diversity in the physician-scientist workforce. The task involved supporting the development and analysis of a Request for Information (RFI) to help gather public input on ways to increase diversity in the physician-scientist workforce. The results of this analysis will be used to inform an environmental analysis and best-practices research study, and to provide updates to strategic planning efforts in the Division of Biomedical Research Workforce (DBRW).

Request for Information

In November 2015, the Diversity Implementation Working Group published the RFI, "Strategies to Enhance Diversity in the Physician-Scientist Workforce" (NOT-OD-16-027). The purpose of the RFI was to gather input from the research community and other interested stakeholders on the subject. A web-based form was made available to capture responses submitted between November 19, 2015 and December 28, 2015. Although the RFI requested response submission via the web-based form, comments were also received via email. NIH encouraged the public to comment on the following:

1. **Educational Pathways**. Beyond the factors listed in the background section, please comment on other factors critical to successfully moving individuals from underrepresented groups through the educational pathway.
2. **Institutional and Programmatic Characteristics of Degree Programs**.
   - Institutional or programmatic characteristics of model dual-degree programs not mentioned in the background section.

- Best practices and examples of alternative pathways for obtaining a Doctor of Medicine (MD) (or equivalent) and Doctor of Philosophy (PhD) (or equivalent) degrees beyond the existing dual-degree structure.
- Best practices and examples of alternative pathways for individuals with the MD (or equivalent) to gain research experience without obtaining a PhD (or equivalent) degree (including but not limited to MD [or equivalent] degrees with Master's of Public Health or Master's of Science training).

3. **Career Decision Points and Pathways**. Beyond the factors listed in the background section, please comment on other physician-scientist career-related decision points and pathways that may impact whether individuals from underrepresented groups pursue the physician-scientist education pathway.
4. **Additional Comments**. Please provide any additional comments or novel insights on strategies to enhance the diversity of the physician-scientist workforce.

After 40 days of public comment, NIH received 123 responses to the RFI. This report summarizes and analyzes these comments.

Methods

Ripple Effect received 111 submissions via the web-based form and uploaded them to a central SharePoint database. Emails (n=12) were forwarded to the analysis team and added to the database. The combined email and web submissions totaled 125. Data were subsequently cleaned. Of the 125 submissions, 2 (1%) responses were submitted through both email and the web. In those instances, the responses submitted via the web were recorded as the non-duplicate response. Thirteen (10%) submissions were deemed non-responsive and were not assigned any codes. Thus, 110 (89%) were deemed responsive and coded by analysts in SharePoint. **The total number of responsive submissions (n=110) is referred to as the total number of respondents (total number of comments), and is the denominator used throughout this report to calculate proportions.** Additional data on responses are available in Appendix A.

The majority of respondents (76% [n=84]) provided comments from an individual perspective, while approximately one quarter of respondents (24% [n=26]) provided comments on behalf of an organization (Figure 1; see Appendix B for the list of respondent organizations).

Figure 1. Composition of Individual and Organizational Perspectives
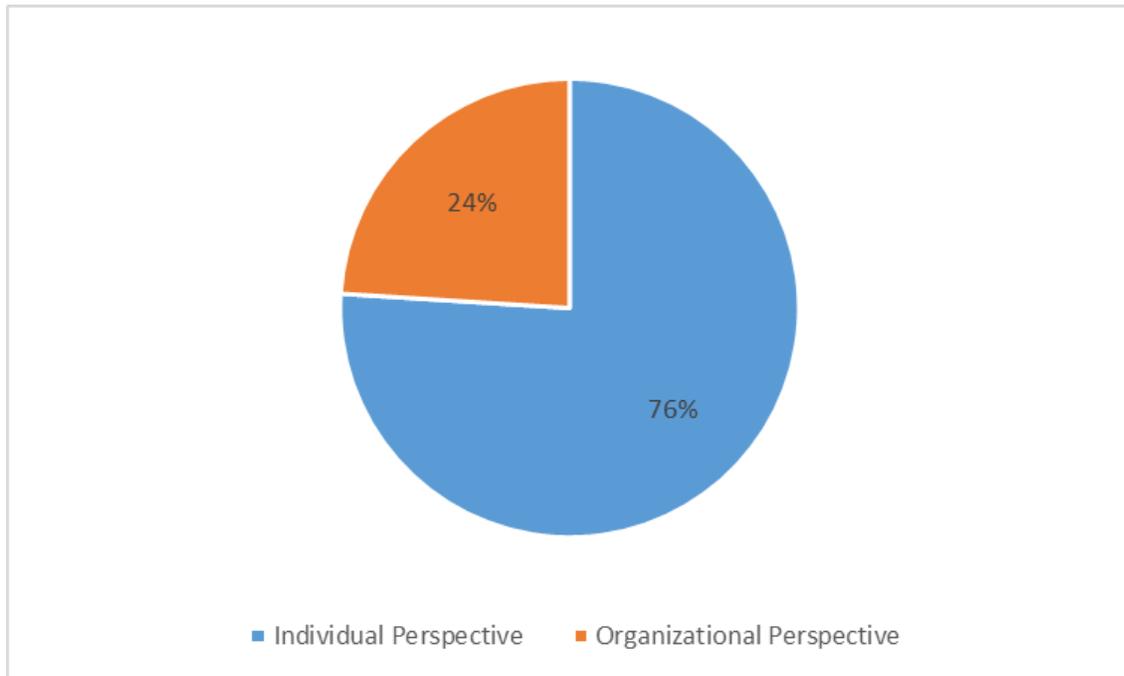
Coding and Analysis

Figure 2 presents the conceptual levels used for coding throughout this report. Code development, analysis, and presentation of the findings section are structured in the conceptual pattern of Primary Topic -> Subtopic -> Code Name. *Topics* represent the key components along the pathway to becoming a physician-scientist, as listed in the RFI (i.e., Educational Pathways, Institutional or Programmatic Characteristics, Career Decision Points). *Subtopics* represent general ideas (e.g., mentorship), and *Code Name* is a specific idea within a subtopic (e.g., mentors shape career growth).

Figure 2. Conceptual Levels of Code Organization
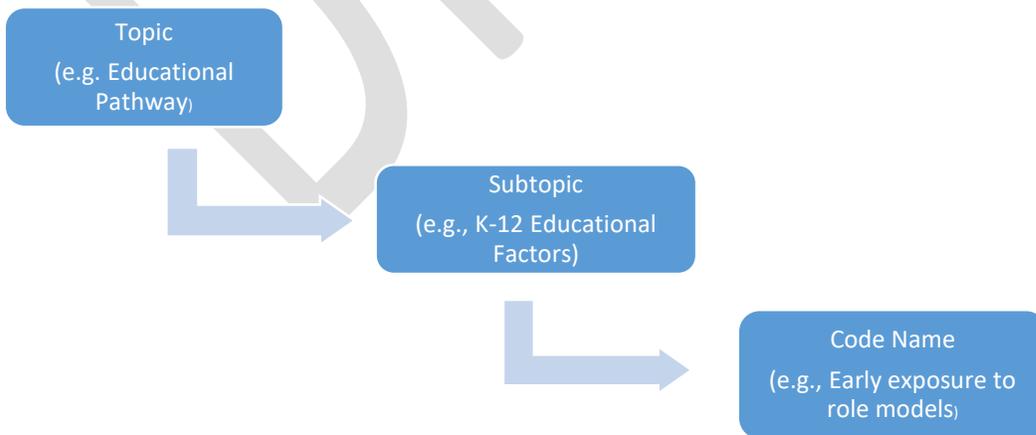
Code Development

Ripple Effect developed a coding scheme based on a literature review of the physician-scientist workforce and diversity. Due to the overlapping subject matter of the literature review and the RFI, the literature review coding scheme was adapted to fit the RFI responses. Code development involved both deductive and inductive approaches—the former focused on using existing hypotheses and theories to drive the analysis and the latter focused on drawing themes from the data. Codes evolved through an iterative process. The first iteration of a coding scheme was informed by a small number of randomly selected submissions (n=10).

Based on coder feedback and comment content, the coding scheme was refined and used to train coders for subsequent coding. Analysts extracted quotes from each comment reflecting a single sentiment. Codes were then applied to each quote. Multiple codes could be applied to a given comment, but only one code could be applied per quote. Coders had the flexibility to suggest, and manually enter, new code names and relevant subtopics into an open-text field when coding sentiments, ideas, and suggestions that did not fit within the existing coding scheme. This allowed additional codes and sub-codes to emerge using an inductive grounded theory approach.

Figure 3 presents a general overview of the major topic areas, and the proportion of coded quotes by individual and organizational responses. Of the 404 coded quotes, 65 percent were attributed to individual respondents, compared to 35 percent of quotes attributed to responses on behalf of organizations. This distribution is relatively similar across all 3 major topic areas.

Figure 3. Comparison of Quotes between Individual and Organizational Respondents

	Individual	Organization	Total
Educational Pathways	57 (66%)	29 (34%)	86 (100%)
Institutional Characteristics	123 (62%)	77 (38%)	200 (100%)
Career Decision Points	77 (68%)	36 (32%)	113 (100%)
Miscellaneous	4 (80%)	1 (20%)	5 (100%)
Total	**261 (65%)**	**143 (35%)**	**404 (100%)**
Average Quotes per Comment	3.1	5.5	3.6

Figure 4 presents the subtopics, and associated codes for each subtopic. The full coding scheme is included as Appendix C. In total, 73 codes were applied to 404 data quotes. Ripple Effect reviewed all codes within each subtopic to analyze common themes and patterns.

Figure 4. Coding Scheme Summary

Topic	Subtopic	Number of Codes	Number of Quotes
Educational Pathways	Social and Environmental Factors	1	8
	K-12 Educational Factors	7	55
	Supplemental programs	2	23
Institutional and Programmatic Characteristics	Program Demographics	2	2
	Program Admission Limitations	3	9
	Institutional Support	10	30
	Role of Mentorship	4	53
	Track, Assess, and Evaluate	1	8
	Existing NIH Grant Mechanisms	1	15
	Partnerships	2	18
	Suggested Changes to Dual-Degree Programs	6	32
	Non-Traditional Pathways	11	33
Career Decision Points and Pathways	Cultural Barriers	4	11
	Deterrents to Physicians Choosing Research	8	56
	Incentives Motivating Physicians to Choose Research	1	4
	Program Expansion	4	15
	Institutional Support	5	27
Miscellaneous	RFI recommendations	1	5

Limitations

As with any request for information, the feedback received cannot be assumed to represent all opinions and ideas associated with diversifying the physician-scientist workforce. Those aware of, and motivated to respond to, the RFI represent a biased sample.

The coding process involved a team of coders. There was one coder per response except in instances where there was uncertainty regarding the content or additional clarity was needed during the analysis and reporting stage. The duplication of factors across the educational and career pathway presented some coding challenges; specifically, a similar sentiment may have been captured by more than one code depending on the stage of the pathway. Therefore, the number of comments (generally noted with "n=") reflect the analysis team's best understanding and interpretation of the comments and context in which they were given.

Qualitative Analysis

The discussion of the RFI responses is organized according to the three primary topics identified in the RFI: 1) Educational Pathways, 2) Institutional or Programmatic Characteristics, and 3) Career Decision Points. Key concepts are presented under each of these headings and generally follow the chronological order of the physician-scientist pathway. Certain concepts may be repeated if they emerged as important at different steps in the pathway. For instance, institutional support was identified as an

important factor at all levels of the physician-scientist pathway, beginning in early education and extending throughout one's career.

This report assumes the following definition of physician-scientist identified by the PSW-WG:

> *The PSW-WG defined physician-scientists as scientists with professional degrees who have training in clinical care and who are engaged in independent biomedical research. The PSW thus includes individuals with an MD, Doctor of Osteopathic Medicine (DO), Doctor of Dental Surgery/Doctor of Dental Medicine (DDS/DMD), Doctor of Veterinary Medicine/Veterinariae Medicinae Doctoris (DVM/VMD), or nurses with research doctoral degrees who devote the majority of their time to biomedical research.*[3,4]

Additionally, this report focuses on the definition of underrepresentation contained in NIH's Notice of Diversity (NOT-OD-15-053). This definition includes individuals from underrepresented racial or ethnic groups, individuals with disabilities and individuals from disadvantaged backgrounds (e.g., low-income, rural educational environments).

Educational Pathways (n=86)

Quotes related to educational pathways made up approximately 21 percent of the codes. Figure 5 depicts the difference in quotes between individual respondents and respondents on behalf of an organization as they related to educational pathway quotes. In general, quotes were proportionately dispersed among individual and organizational respondents.

Figure 5. Number of Quotes by Subtopic and Respondent Type on the Topic "Educational Pathways" (n=86)

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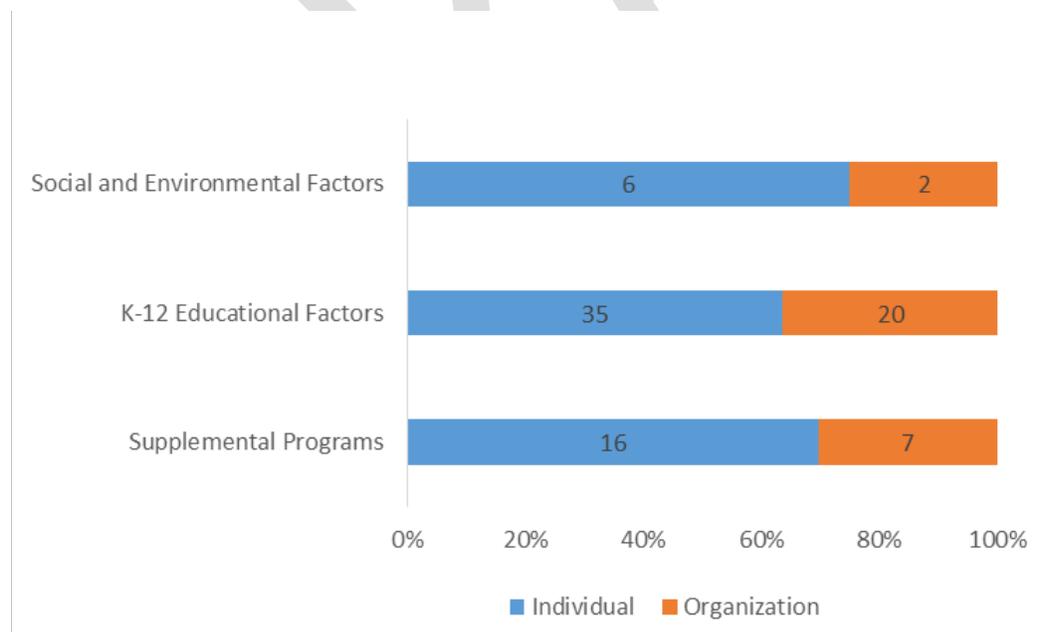
[3] Physician-Scientist Workforce Working Group Report. 2014. National Institutes of Health.
[4] Although the NIH definition of the physician-scientist workforce includes individuals with degrees other than an MD, some respondents specifically requested that those with degrees other than an MD be considered within any discussion of physician-scientists.

Figure 6 shows the number of quotes attributed to each code. The number of quotes per code ranged from 2 to 21. Quotes related to research experience gained through undergraduate programs occurred the most frequently (n=21).

The traditional physician-scientist educational pathway entails entering a dual-degree program upon completion of a bachelor's degree at a four-year institution. However, many individuals, particularly from disadvantaged and underrepresented backgrounds, may face challenges at the earliest levels of education, thus making it difficult to enter the physician-scientist pipeline. This section is focused on comments and findings related to the educational path from kindergarten to college, including social and environmental factors during that time period.

Social and Environmental Factors
Code: Societal factors influence desire to join or remain in the PSW
Barriers to joining the physician-scientist workforce can start early in life and include social and environmental factors that may or may not be related directly to education. Although such barriers exist throughout the physician-scientist pathway, the comments suggest that challenges that begin early can persist through educational and career trajectories in later life.

According to the RFI responses, for individuals from disadvantaged backgrounds, social and environmental issues may limit the awareness of career options as physician-scientists, or even of careers in science in general. Factors such as race, gender, parental occupation and education, familial proximity to enhanced learning opportunities, and a host of other determinants may negatively affect access or exposure to science and medicine as academic fields. One respondent articulated the point this way:

Parental or family member educational attainment, occupation, and exposure to the physician-scientist career pathway are individually important factors, but the combination of these factors underpin a nuanced understanding of how culture shapes career path choice. (ID 74)

Respondents identified economic factors as a primary barrier to access enhanced learning opportunities, including test preparation programs. The lack of access to grants and scholarships to attend research programs was also identified as an impediment. Additionally, some respondents noted that underrepresented individuals, particularly those from underrepresented racial and ethnic backgrounds, tend to have close family ties and may be reluctant to participate in programs far from home. One respondent noted:

Being geographically close to family can be very important and these types of factors should be respected. (ID 61)

K-12 Educational Factors

Codes: Limited access to a high quality K-12 education; Limited exposure to PSW opportunities prior to high school; Early exposure to PSW opportunities prior to high school; Limited exposure to PSW opportunities prior to college; Early exposure to PSW opportunities prior to college; Limited access to post-secondary opportunities

Underfunded schools and issues of poverty were identified as a root cause of limited exposure to careers in science. Without proper local funding, school-age children receive poor or limited science education and therefore may not be exposed early enough to be aware of it as a viable academic subject or career choice. The limited exposure to scientific opportunities and the lack of awareness of physician-scientists throughout the K-12 system was considered a major problem.

Five comments suggested increased exposure to science, technology, education, and mathematics (STEM) prior to high school and nine comments suggested exposure should begin in middle or high school. Six respondents took a more holistic approach and did not identify a stage. For example, one respondent noted:

Many school-age, minority youth abandon early their academic interest in the sciences because of a lack of exposure to career applications within the field. Often, extracurricular STEM enrichment programs introduced in schools or community settings are the catalysts that foster long-term interest in careers in science for these students. (ID 106)

Respondents suggested that experiences outside of the regular classroom were key to encouraging interest in research careers. Ideas offered by respondents to increase exposure to STEM fields and better prepare individuals from underrepresented backgrounds for college and careers included:

- Partner with community-based private sector labs to provide research experience for high school students and summer internships, and make the research topic relevant to their lives/interests;
- Expose students to transdisciplinary health research pathways (e.g., complementary and alternative medicine [CAM], community science);

- Provide supplemental grants for programs to create or maintain teaching partnerships with K-12 institutions (e.g., American Society for Biochemistry and Molecular Biology [ASBMD] Hands-on Opportunities to Promote Engagement in Science [HOPES] seed grant);
- Increase and enhance early STEM pipeline programs;
- Train K-12 science teachers to provide students early exposure to statistics, study design, scientific writing, grant writing, and literature review;
- Pair minority students with mentors at an early age (6th or 7th grades) and provide continuous support through college and graduate school with mentorship, scholarship or stipends, resources (e.g., books, field trips), and internships; and
- Increase the visibility of successful minority physician-scientists to provide role models.

Code: Exposure to Role Models

Mentorship and exposure to role models at the K-12 level was identified as a key factor in cultivating an interest in research and STEM careers. Six quotes suggested that the dearth underrepresented physician-scientists and mentors is one of the main reasons young people do not choose to go into scientific careers. One respondent wrote:

> I don't think we can underestimate the need to encourage, mentor, and provide guidance to students long before college if we are to significantly improve the pathways to scientific careers. (ID 16)

One suggestion was for scientists to mentor school children, especially children of parents with low education levels, on school science fair projects. This would teach students critical thinking skills at a young age, provide them with personal connections to scientists, and could stimulate interest in science as a possible career path. Another suggestion was to send inspiring scientists into elementary schools to conduct experiments. One respondent suggested using social media and other advertising targeted to young students to increase awareness of the physician-scientist pathway.

Mentors, and other types of advocates such as high school guidance counselors and career advisors, are also important for recruitment and retention of individuals from underrepresented backgrounds in dual-degree programs; for successful career transitions, especially during early career stages; and ultimately, for general retention of minorities in the physician-scientist workforce.

One respondent suggested that national organizations of "pre-health" advisors should enable their members to speak knowledgeably about the goals of MD/PhD training; thus, mentors and advocates would come not only from educational institutes but also from professional organizations. Another respondent focused on creating financial planning training so that undergraduate students considering careers as physician-scientists can learn about the complex financial aspects of medical training.

Supplemental Programs

Codes: Undergraduate programs contribute to research experience; Undergraduate programs need improvement or restructuring

Respondents reported positive perceptions around programs that provide high school and college students the opportunity to conduct research. These included summer enrichment programs as well as programs to support undergraduates who want to pursue research careers. Respondents highlighted over 10 programs (see list below) geared toward underrepresented students that have demonstrated success in recruiting individuals from underrepresented backgrounds into research science and

providing the skills to become a physician-scientist. Although DVM and DDS degrees are specifically mentioned in the PSW-WG's definition of physician-scientist, one respondent suggested that such programs be expanded and geared toward Doctor of Veterinary Medicine (DVM), Doctor of Dental Surgery (DDS) and other non-MD physician-scientist career tracks, mentioned below:

> *Programs such as the MARC (Maximizing Access to Research Careers) Undergraduate Training program should be expanded to support students who are tracking toward the DVM-PhD dual-degree program. The MARC program has a long history of producing physician-scientists and the program should be expanded in line with workforce considerations. (ID 74)*

Programs aimed at those who are already certain they want to pursue a physician-scientist career or who have less research experience than other undergraduates were viewed as very helpful for increasing diversity in the physician-scientist workforce. While there are many more programs that were not mentioned, examples of specific high school, secondary school, and post-baccalaureate programs provided in the comments included:

- American Society of Nephrology's Minority Kidney Initiative
- American Society of Nephrology's Kidney Tutored Research and Education for Kidney Scholars
- Meyerhoff Scholars Program at the University of Maryland-Baltimore County
- Freshman Research Initiative at the University of Texas at Austin
- Gateways to the Laboratory
- Johns Hopkins University's Doctoral Diversity Program
- National Institutes of General Medicine Sciences (NIGMS) MARC Undergraduate Student Training in Academic Research (U-STAR) Awards (T34) program
- The American Dental Education Association (ADEA) Summer Medical and Dental Education Program (SMDEP)
- The Summer Research Medical Internship (SRMI) at the University of Virginia

Respondents suggested that NIH expand support for programs similar to these to improve support for helping diverse groups gain equal footing in the research field. As one respondent noted:

> *The NIH needs to improve support of pipeline programs. Summer diversity programs are supported by some institutions but not enough. Underrepresented students benefit greatly from laboratory and clinical experience spent during the summers of their undergraduate training however without resources to pay stipends for such students the students may be unable to work in these settings due to financial pressures. (ID 72)*

Another respondent suggested that certain programs, such as the NIGMS-funded PREP and MARC U-STAR, should use "authorship of scientific publications in a STEM field" as an indicator of program success rather than "enrollment in a PhD or MD/PhD program."

A common theme among comments was the importance of NIH partnerships with historically black colleges and universities (HBCUs) in diversifying the physician-scientist pathway. These relationships target a diverse student body and raise awareness of and interest in the physician-scientist career choice. As one respondent suggested:

> *I would recommend creating a funding mechanism whereby MSTP [Medical Scientist Training Program] program directors, associate directors, and administrators could be reimbursed for*

travel to HBCUs and largely minority-serving institutions. This might be done through FASEB in a manner similar to the travel fund support for T32 directors to attend the most recent TWD meeting in Virginia. This would allow them to meet early stage college students and inform them of the career path and the steps to pursue so that they become competitive applicants. It would also help to inform the pre-health advisors at these institutions about the career path and the steps needed to achieve successful admission. (ID 53)

Some respondents suggested providing financial mechanisms to support and maintain existing formal, partnerships with professional organizations. NIH could leverage this model and support similar partnerships across the country.

In addition to forming partnerships with minority-serving institutions, two comments suggested forming partnerships with educational associations or councils, such as the Council for Higher Education Accreditation, to help improve commitment to diversity and contribute to policies and guidelines that would lead to a more supportive environment.

Selected Recommendations for NIH Action

Respondents suggested a number of actions that could be taken to improve diversity along the educational pathway. Actionable recommendations that NIH could support include:

- Expand and continue to provide supplemental research programs to improve support for diverse groups to gain equal footing in the research field.
- Provide financial mechanisms to support and maintain formal partnerships with professional organizations and associations.
- Emphasize the role of the mentor by offering formal support, training, and/or financial incentives.
- Consider partnerships with minority-serving institutions and educational associations or councils to help improve commitment to diversity. Institutional and Programmatic Characteristics of Degree Programs (n=200)

Quotes related to institutional and programmatic characteristics (n=200) made up approximately 50 percent of the codes. Figure 7 depicts the difference in the numbers of quotes, by subtopic, between individual respondents and respondents on behalf of an organization.

Figure 8 shows the number of quotes attributed to each code related to institutional or programmatic characteristics. Quotes related to the need for diverse mentors were mentioned the most frequently (n=37) and eleven codes were mentioned just once.

Figure 8. Number of Quotes by Code on the Topic "Institutional and Programmatic Characteristics" (n=200)

Program Demographics
- Demographics of program - females are underrepresented: 1
- Demographics of program - minority groups are underrepresented: 1

Program Admission Limitations
- Programs should broaden admission requirements to increase diversity: 2
- MCAT scores do not predict success: 4
- Standardized testing thresholds is an admission limitation: 3

Institutional Support
- General support for researchers: 3
- Program makes efforts to recruit diverse populations: 1
- Programs make effort to retain diverse populations: 1
- Programs should make more effort to recruit diverse groups: 9
- Programs should make more effort to retain diverse groups: 2
- Institutional culture values diversity: 2
- Facilities are inadequate to move research forward: 1
- Programs support for transition to independence: 1
- Post-Baccalaureate or post-Doctoral programs provide research experience: 6
- Programs should partner with community organizations: 4

Role of Mentorship
- Program offers formal mentorship/training program: 4
- Program should create, train, and provide support to foster mentorship: 11
- Diverse mentors are available in programs: 1
- Diverse mentors are needed in programs: 37

Track. Assess. Evaluate
- Ongoing and systematic measures are required to diversify the PSW: 8

Existing NIH Grant Mechanisms
- Expand/raise awareness of existing programs and grant mechanisms: 15

Partnerships
- Programs have relationships with outside organizations (e.g. AMA): 10
- Model diversity recruitment efforts on other successful, non-degree programs: 8

Suggested Changes to Dual-Degree Programs
- Expand funding: 7
- Create financial incentives to attract and retain physician-scientists: 7
- Program has limited funding opportunities: 2
- Programs should offer specific services for minorities: 2
- Programs should expand eligiblity to other specialities: 13

Non-Traditional Pathways
- Funding for non-MD specialties: 1
- Integrate community colleges into the pipeline: 1
- Non dual-degree research opportunities: 7
- Integrate research into residency: 1
- Howard Hughes Medical Institute funding promotes research experience: 2
- Non dual-degree professionals encouraged to pursue degree based on mentorship: 2
- MD gains experience without PhD: 6
- Alternative degree/certification programs: 2
- Physician-scientist obtains degrees sequentially: 4
- Length of obtaining dual degree through alternative pathways: 1
- Foreign born cannot apply to some grants: 3
- Dual-degree programs should expand internationally: 4

Dual-degree programs are the traditional pathway taken toward becoming a physician-scientist. Certain characteristics of these programs may attract or deter students from entering the pathway. This section addresses those characteristics in more detail and describes non-traditional pathways that may be useful for individuals from underrepresented backgrounds seeking entry into the physician-scientist workforce through non-traditional routes.

Program Demographics

Codes: Demographics of program – females are underrepresented; Demographics of program – minority groups are underrepresented

Generally, respondents agreed that diversity in the physician-scientist workforce, including dual-degree training programs, is lacking, with regard to women and racial and ethnic groups such as Hispanics, African Americans, Native Americans/Alaska Natives, and Pacific Islanders. It was pointed out that the ethnic and racial demographics of MD/PhD programs do not reflect the demographics of the United States. One respondent specified that NIH should explicitly add gender and sexual orientation to any discussion of diversity. Further, a culture of institutionalized discrimination and unconscious bias may affect hiring decisions, promotions, and institutional support for faculty members, and can prevent individuals from underrepresented backgrounds from succeeding as physician-scientists. As one respondent noted:

> *Another striking barrier is that underrepresented minorities [URM] and women (of all racial/ethnic groups) in MD-PhD programs reported racist and sexist comments from peers and faculty and a lack of peer and mentor support...Statements made by white students that URM students would not have to try as hard to succeed in the program or to secure residency or faculty positions because URMs are in such high demand were perceived by URM students as barriers to their success, and they felt they had to try even harder to do better, even if their qualifications were as high or higher than other students in the program. (ID 60)*

Program Admission Limitations

Codes: Programs should broaden admission requirements to increase diversity; MCAT scores do not predict success; Standardized testing thresholds is an admission limitation

Twelve respondents identified additional educational and social barriers during the application process to medical school and dual-degree programs. Three respondents took issue with traditional admissions criteria, arguing that the criteria often place too much emphasis on standardized test scores and expect dual-degree applicants to follow conventional educational pathways before applying. One respondent noted that individuals from underrepresented backgrounds tend to have lower MCAT scores, which negatively impacts their ability to meet standard admission thresholds. This might be attributed to a lack of financial resources that limits their ability to enroll in exam preparation classes. As one respondent noted:

> *One of the persistent barriers to building the pipeline is the performance of URM students on standardized tests. The performance is a barrier at every level from the SAT/ACT, MCAT and USMLE. Students who perform well frequently are able to afford training and preparation for these tests. At the secondary school level and college level, URM students would have greater opportunities to enter colleges and medical schools with assistance through tutoring/test preparation. ... Building this pipeline will require tutoring assistance and test preparation for URMs. (ID 23)*

Four respondents indicated that research has shown that standardized test scores, such as the MCAT and the GRE, are not predictive of success after medical school admission. Further, they note that the admission of otherwise well-qualified applicants from diverse backgrounds has been negatively affected by application limitations, particularly those taking non-linear educational pathways. Respondents suggested that programs should broaden or adjust their admission application review process to accept

a more diverse group of students, regardless of MCAT scores. One respondent suggested using contributions to diverse populations as an admission criterion:

> *...make contributions to diversity part of admissions evaluation. Applicants with demonstrable evidence of service to underrepresented groups are more likely to come from underrepresented groups, and will eventually themselves contribute to the next generation of diverse students. (ID 39)*

Institutional Support

Codes: General support for researcher; Program makes efforts to recruit diverse populations; Programs make effort to retain diverse populations; Programs should make more effort to recruit diverse groups; Programs should make more effort to retain diverse groups; Institutional culture values diversity; Facilities are inadequate to move research forward; Programs support transition to independence; Post-baccalaureate or post-Doctoral programs provide research experience; Programs should partner with community organizations

Twenty four respondents noted aspects of institutional support (regardless of dual-degree program status) that could be leveraged to increase the diversity of the physician-scientist workforce. These included calls for institutional support at all stages of training, from undergraduate career advising, to recruitment into dual-degree programs, to transition to independence.

Post-baccalaureate and post-doctoral programs were also mentioned as particularly important in providing professional development for students from disadvantaged backgrounds. In fact, two respondents mentioned that new post-baccalaureate and post-doctoral programs, geared toward recruitment of minority students, are currently under development at their respective institutions.

Respondents frequently listed model programs without going into detail about their characteristics. However, one respondent from the University of Pittsburgh described in detail the efforts to recruit and retain minority students in its dual-degree graduate program. The program sends officials to research conferences with a high number of individuals from underrepresented backgrounds to increase the visibility of the graduate program and to establish direct contact with program officers from undergraduate summer research programs. The University of Pittsburgh's program also provides both one-on-one mentoring for students who need help developing critical thinking skills in order to successfully obtain the PhD and intensive tutoring from senior students.

Aside from recruitment into dual-degree programs, individuals from underrepresented backgrounds might also benefit from institutional support later in the degree-granting program. There was an overarching sentiment that minority students are particularly prone to feelings of isolation, and suggestions to minimize this sense of isolation were numerous.

> *Develop a strong sense of community and support within training programs and among diversity trainees. This will likely require identification of tutors, counselors, and financial advisors. In addition, programs may need to reach out to family members who play a vital role in a trainee's life. (ID 119)*

It was noted that the success of minority students and fellows could potentially be greatly enhanced if they meet other minority faculty and take part in local minority communities. This concept is institutionalized in two programs at the University of Pittsburgh: the Career Education and

Enhancement for Health Care Research Diversity Program, which targets anyone with a doctoral degree; and the Office of Student Affairs and Diversity's programs within the School of Medicine.

Role of Mentorship

Codes: Program offers formal mentorship/training program; Program should create, train, and provide support to foster mentorship; Diverse mentors are available in programs; Diverse mentors are needed in programs

More than 35 responses cited the importance of role models and good mentors. The overall sentiment was that mentors are important at all stages of a physician-scientist's education and career. Mentoring, as well as personal relationships with role models in a chosen field, were mentioned as one of the most important factors for underrepresented students to succeed in rigorous academic settings.

> *The role of the mentor is especially important to the [underrepresented minority] physician-scientist, whose academic and professional journey is often lacking in role models upon which to pattern a career in the [physician-scientist workforce]. Importantly, these mentors do not necessarily need to be underrepresented minorities themselves: they only need to demonstrate a genuine interest and commitment to the personal and professional development of their mentee. (ID 106)*

Although many respondents called for a general increase in mentors for individuals from underrepresented backgrounds, a phenomenon which could come about only with increased numbers of minority physician-scientists in the workforce, many were also more specific about what is needed. Although mentoring is seen as important for a trainee's success, respondents expressed concern that NIH may not be taking mentoring activities seriously as there is a lack of formal support and training for it. Suggestions to improve the state of mentoring were numerous and targeted both people receiving mentoring and mentors themselves.

For the benefit of students, trainees, and junior faculty:

- Establish cross-institutional mentorship programs that provide minority mentors to students at institutions with few underrepresented minority faculty;
- Create teams of mentors, composed of, for example, a diversity mentor, a scientific expert mentor, and peer-to-peer mentors. Later in the career path, mentor teams would address different issues, including grant and manuscript writing, discussing research opportunities, balancing research and patient care, and negotiating job opportunities; and
- Involve professional and specialty societies to provide mentorship to dual-degree minority students and to raise awareness of physician-scientist career paths among younger students.

For the benefit of the mentors:

- Formalize the mentorship role by funding mentors, especially minority mentors, for time spent mentoring. Funding could come from either specific supplements to research grants to the mentor or from additions to training grants;
- Provide training for non-minority mentors on engaging and supporting minority students and creating an inclusive environment;
- Develop mentor training including teaching skills, effective mentoring approaches, and empathy for challenges faced by diverse student groups; and

- Fund physician-scientists to engage in outreach activities to young students, such as participating in student clubs and speaking at school events.

While the majority of respondents who commented on mentoring suggested a need for more minority physician-scientist mentors, some also warned against possible negative consequences. Since there are few minority faculty at a given institution, these faculty are often asked to serve on a disproportionate number of committees and to mentor many more students compared to their non-minority counterparts. These responsibilities could take away from protected time, thus negatively impacting the faculty member's career and research competitiveness.

Track, Assess, Evaluate

Code: Ongoing and systematic measures are required to diversify the PSW

With many programs already aimed at increasing the diversity in biomedical education and career pathways, respondents brought up issues of program evaluation. Nine respondents suggested that diversity efforts (current, past, and present) be tracked, assessed, and evaluated to determine whether programs are working. One respondent suggested that institutions need to better evaluate their programs, especially to identify reasons why dual-degree trainees may drop out of that career trajectory.

Existing NIH Grant Mechanisms

Code: Expand/raise awareness of existing programs and grant mechanisms

Fifteen respondents focused on better leveraging existing grant mechanisms to increase the diversity of the physician-scientist workforce. Suggestions included calls to both increase awareness and scope of existing programs (at all points of the pathway, including summer programs, undergraduate levels, early-career, mid-career, etc.). Specific proposals[5] included the following, presented in order of increasing career stage:

- Create more T32 grants that focus specifically on minorities and provide a research core curriculum training;
- Lengthen/expand T32 awards to include a minimum of three years of research funding or to include summer research experiences for undergraduates;
- Increase awareness of the availability of career development awards;
- Increase the number of K12, K23, and R25 awards;
- Increase salary support for K08, K23, and K99/R00 awards to be more aligned with physicians' median salaries. For the K99/R00, also include funding to hire a research technician to assist with laboratory operations and support the trainee's research;
- Expand the scope of K24 awards to provide support for mentors and to provide support for physician-scientists who perform basic science research;
- Create a special fund for new K99/R00 specifically for underrepresented minorities;
- Increase awareness of NIH's R01 Research Supplement to Promote Diversity and expand participation to all NIH ICs (and standardize the applications across the various participating institutes);

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[5] Not all program suggestions may be feasible due to grant limitations.

- Create supplements to R01s to support post-K minority scientists making the transition to independence;
- Increase awareness of health disparities research programs, which will encourage minorities to pursue research; and
- Increase NIH's Building Infrastructure Leading to Diversity (BUILD) program.

Partnerships

Codes: Programs have relationships with outside organizations (e.g., AMA); Model diversity recruitment efforts on other successful non-degree programs

Respondents had suggestions for building local and national communities of minority physician-scientists. These communities would increase the visibility of the profession among minority students and could raise awareness of existing opportunities, including NIH grants and research programs, as well as other national and local grants and programs. Four respondents suggested that this could best be accomplished through partnerships with national and local organizations, such as professional groups. As one respondent noted:

> *Utilize national organizations to create a sense of larger community among underrepresented physician-scientist trainees. APSA [American Physician Scientists Association], AAP/ASCI [Association of American Physicians/American Society for Clinical Investigation], the MD/PhD section of AAMC [Association of American Medical Colleges], [and] the National [Association] of MD/PhD Programs are such organizations. (ID 119)*

As an example of a successful professional organization's effort to promote diversity in the biomedical workforce, one respondent cited the American Dental Education Association's Minority Dental Faculty Development (MDFD) program, which awards grants to develop, mentor, and support underrepresented dental students and faculty entering academic careers and supports advanced training, career development, and community outreach. Respondents suggested that NIH should use such programs as models to expand or build upon these recruitment efforts.

Other programs or groups described by respondents encourage involvement with dual-degree programs, either by promoting them, collaborating with them, or providing mentorship and career development to trainees. Respondents pointed out that societies have access to local or special interest populations and expertise, and are thus uniquely situated to promote diversity within the biomedical workforce. These programs include:

- Robert Wood Johnson Foundation's Harold Amos Medical Faculty Development Program (mentioned by three respondents)
- American Society of Hematology
- American Society of Nephrology
- 100 Black Men of Metro Houston
- Houston Medical Forum
- industry organizations that partner with biomedical researchers
- American Academy of Pediatrics
- American Heart Association
- American Thoracic Association
- National Medical Society

- National Dental Association
- American Public Health Association
- National Hispanic Medical Association
- Association of American Indian Physicians
- NIH Black Scientist Association

One respondent suggested creating a national, searchable online database for all grant opportunities geared toward individuals from disadvantaged and minority backgrounds.

Suggested Changes to Dual-Degree Programs

Codes: Expand funding; Create financial incentives to attract and retain physician-scientists; Program has limited funding opportunities; Programs should offer specific services for minorities
Respondents noted that increased funding and redesigning dual-degree programs could increase the diversity of the physician-scientist workforce. Some respondents couched their suggestions for programmatic change in terms of a need for increased funding. Respondents wrote about funding issues related to improving the biomedical workforce as a whole as well as in terms of increasing its diversity.

Respondents pointed out that increased funding to augment the number of MSTP and MD/PhD slots is needed since there are many more qualified applicants than available spots. In addition to increasing slots in traditional programs, respondents noted that funding could be applied to create educational outreach opportunities within dual-degree programs. These programs could provide trainees with practice speaking in public about science as well as a broader exposure to science. Additional funding could also go toward supporting structured research opportunities during the last two years of medical school (in a traditional MD/PhD program) so that trainee interest in research is maintained during the final years of clinical training.

> *Establish funding opportunities for underrepresented trainees to transition into novel programs that prepare them for careers and do so in a time-efficient manner that shortens the usual multi-year gap for training prior to returning to research efforts. This could be a private/public partnership that includes not only pharmaceutical and biotech companies but also foundations (e.g., [Bill and Melinda] Gates [Foundation]) and IT companies. (ID 119)*

Some respondents called for increased mentorship funding in areas pertaining to physician-scientists, such as patient-oriented research, since good mentoring relationships help develop successful physician-scientists. Additionally, it was noted that support for mentors who take on MSTP or MD students is important, and that these mentors should receive funding to hire at least a half-time technician to support the trainee's research.

Codes: Programs should expand eligibility to other specialties; Funding for non-MD specialties
Although additional degrees (e.g., DVM, DDS) are specifically mentioned in the PSW-WG's definition of physician-scientist, respondents were vocal about the inclusion of degree types other than MD/PhDs. Thirteen respondents called for the expansion of dual-degree programs to include a diverse array of degrees beyond the MD and PhD, with the justification that all of the professionals who conduct biomedical research should be considered part of the PSW. Additionally, a suggestion was made to change the term 'physician-scientist' to 'clinician-scientist' to be more inclusive of professionals other than MDs. Respondents suggested a need for increased support (both general institutional support and

specific dual-degree programs) for the following degree and professions: RNs and nurses in general, nutritionists and dieticians, pharmacists (PharmD degree holders), dentists, veterinarians, chiropractors, and naturopathic physicians (ND degree holders).

Respondents noted that although health care professionals may be interested in expanding their career after they have been working for some time, they may not have the financial resources to stop working to pursue research training. One respondent provided a suggestion that those interested in research be provided separate funding mechanisms to avoid competition with MD/PhDs who spend the majority of their time on research and have a clear advantage to funding.

Non-Traditional Pathways

Codes: Integrate community colleges in to the pipeline

Traditional educational pathways are not always practical or accessible, especially for individuals from underrepresented backgrounds. Such individuals could take non-traditional pathways, such as attending community college prior to a four-year university. One respondent stated that many individuals from underrepresented backgrounds attend community colleges, possibly for financial considerations, and that this educational pathway needs to be better developed for transitions into STEM careers. The Stanford School of Medicine's Center of Excellence for Diversity in Medical Education, for example, fosters relationships between community colleges and Stanford pathway programs in order to recruit promising STEM students from non-traditional backgrounds.

Codes: Non-dual degree research opportunities; Integrate research into residency; Howard Hughes Medical Institute funding promotes research experience; Non-dual-degree professionals encouraged to pursue degree based on mentorship

To increase diversity in the physician-scientist workforce, seven respondents suggested that different avenues should be explored to encourage research experiences for non-dual-degree MDs at three levels: 1) within academic MD programs; 2) early in the MD career; 3) and during the later MD career phase.

Two respondents identified early intervention during medical school as a means of recruiting and diversifying the physician-scientist workforce; they suggested that NIH explore educational models and experiences to improve training and research within non-dual-degree MD programs. Because not all MD students realize their interest in research before enrolling in an MD-granting program, MD-only programs could be adapted to include an additional year of research. One respondent noted:

> *One of the most helpful aspects of the MD program at my institution is the possibility for a funded "academic year out" for motivated MD students. These are usually between [the second and third] year of medical school but can be anytime. This gives the students a [fifth] year to explore in a meaningful way a year-long research rotation. The MD-PhD program will occasionally take a motivated MD student who has decided to pursue research, particularly those that have done an academic year out. I find this "alternative" approach to be excellent for students who are developing their vision of themselves during medical school...these points apply even more to others who have come from impoverished backgrounds. (ID 15)*

Physicians may also realize they want to pursue research soon after medical school. Three respondents suggested that programs, such as those run by the Howard Hughes Medical Institute (HHMI), are particularly important to promote and provide research experience for these physicians. One

respondent suggested that NIH implement a similar model to HHMI, where the investigator is funded for a set number of years, eliminating the need to seek grants or additional funding. In return, the scientist would serve in academia or another field upon completion of the research project. One respondent also discussed how funding through HHMI has been instrumental in recruiting underrepresented students earlier in their academic careers. Such programs also provide an opportunity to build positive mentor relationships, with the potential to influence non-MD professionals to pursue a research career.

Physicians may also become interested in research at later career stages. Two respondents discussed the lack of opportunities and funding for "late bloomers" to enter the physician-scientist workforce. Often, funding mechanisms place an emphasis on early investigators, where "early" is defined by age. To mitigate this barrier, one respondent suggested establishing a distinct NIH funding award for mid-career physicians just beginning their research careers. And because many established physicians are accustomed to having a steady income, two respondents suggested providing "late bloomers" with incentives such as stipends, salary support, or loan repayment options. As one respondent noted:

> *It would be great if NIH could design career awards for mid-range and senior MD investigators, who struggle with funding due to decreasing NIH funding. These awards would be relatively easy to secure (success rate of ~[20–30 percent]) and provide these researchers with a "survival package," consisting of [30-percent] salary support and $100,000 (technician salary + reagents) for [five] years." (ID 8)*

Code: MD gains experience without PhD; Alternative degree/certification programs; Physician-scientist obtains degrees sequentially; Length of obtaining dual degree through alternative pathways

Because US dual-degree programs are extremely competitive and particularly challenging to gain admittance to, two respondents suggested different degrees, certifications, or training that MDs could pursue in lieu of a traditional PhD, including:

- Master's of Public Health
- Certificates in Public Health
- NIH T32 grants (for residents in research)
- Residency programs that have research opportunities
- International programs

One respondent reported that advantages to seeking different degrees or training were reduced time commitment and cost of program time. For example, training programs such as the T32 allow physicians to gain rigorous research experience without the need, expense, or time necessary for obtaining a second degree.

Four respondents also described the sequential pathway, in which a person receives an MD and a PhD in two separate programs. This pathway is especially long, but it may be an option for "late bloomers" or for people in particular circumstances, such as people pursuing a PhD in the hopes of improving their chances of getting into an MD program. One respondent suggested that programs should integrate research into non-MD biomedical professional programs (e.g., nursing, physician assistant), which would help diversify the field, and may even inspire non-MD professionals to pursue further education. As one respondent suggested:

Work with nursing, physician assistant, and alternative-medicine degree programs to include biomedical research in the curriculum—providing the necessary resources and supports to ensure students graduate with translational, biomedical, and community research competencies. Though these health professionals are not trained, they can serve to diversify the biomedical research field and general and encourage health professionals to pursue a medical degree. (ID 71)

Code: Foreign born cannot apply to some grants; Dual-degree programs should expand internationally,
Respondents suggested that increasing funding opportunities for international students and physicians could increase the diversity of the biomedical workforce and add value to NIH research projects. Currently, international or foreign students and physicians are not eligible to apply for all grant opportunities. Respondents further noted increased support for international collaborations, such as dual-degree student exchange programs, and support for foreign institutes whose graduates go to the United States to conduct medical and research training. One respondent stated that visa status can be a significant factor in determining whether an individual pursues a career as a physician-scientist in the United States. Another respondent suggested NIH adjust policies to be more inclusive of a diverse pool of researchers with international roots. As one respondent noted:

There is a large and diverse group of potential physician-scientists who are deeply motivated to pursue biomedical research in the [United States] but are mostly excluded from consideration because they have graduated from non-US medical schools. The clinical abilities of these applicants can be difficult to assess for US residency programs, but there are certainly many highly qualified potential physician-scientists in this group. If we could find a more rigorous way to evaluate them and bring them in to US residency programs, we could possibly double the number of physician-scientists in the PSW. This would also increase the diversity of the PSW substantially. (ID 81)

Selected Recommendations for NIH Action

Respondents suggested a number of actions that could be taken to improve diversity at the institutional or programmatic level of training. Actionable recommendations that NIH could support include:

- Explicitly add gender and sexual orientation to any discussion of diversity.
- Formalize the role of mentorship through the following mechanisms:
  - Fund mentors, especially minority mentors, for time spent mentoring. Funding could come from either specific supplements to research grants to the mentor or from additions to training grants;
  - Provide training for non-minority mentors on engaging and supporting minority students and creating an inclusive environment;
  - Develop mentor training including teaching skills, effective mentoring approaches, and empathy for challenges faced by diverse student groups; and
  - Fund physician-scientists to engage in outreach activities to young students, such as participating in student clubs and speaking at school events.
- Involve professional and specialty societies to provide mentorship to dual-degree minority students and to raise awareness of physician-scientist career paths among younger students.

- Build collaborations and partnerships between minority-serving institutions or colleges and medical schools, foundations, professional organizations, or the private sector to strengthen the pathway and assist with diversifying the physician-scientist workforce.
- Expand the number of available MSTP programs and MD/PhD training positions to accommodate the high numbers of well qualified applicants.
- Expand the scope of programs to include community outreach/service or emphasize areas that might be of particular interest to individuals from underrepresented backgrounds, such as health disparities.
- Develop programs geared toward allied health professions to earn a PhD or to have other significant research opportunities or training.
- Increase the scope, availability, and awareness of specific grant mechanisms geared toward improving diversity in the physician-scientist workforce.
- Create/support programs for physicians, either at early stage or late, to gain research experience. Programs should have salary considerations.
- Change "physician-scientist" to "clinician-scientist" to encourage clinicians other than MD-degree holders who are interested in research to pursue research careers.
- Increase funding opportunities for international students.[6]
- Increase support for international collaborations, such as dual-degree student exchange programs, and support for foreign institutes whose graduates go to the United States to conduct medical and research training.

Career Decision Points and Pathways (n=113)

Quotes related to career decision points and pathways represented approximately 28 percent of the codes. Figure 9 depicts the numbers of quotes within the Career Decision Points and Pathways topic, broken down by subtopic and type of respondent.

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[6] Although support for international students and physicians was mentioned in the RFI responses, this subject is beyond the scope of the RFI.
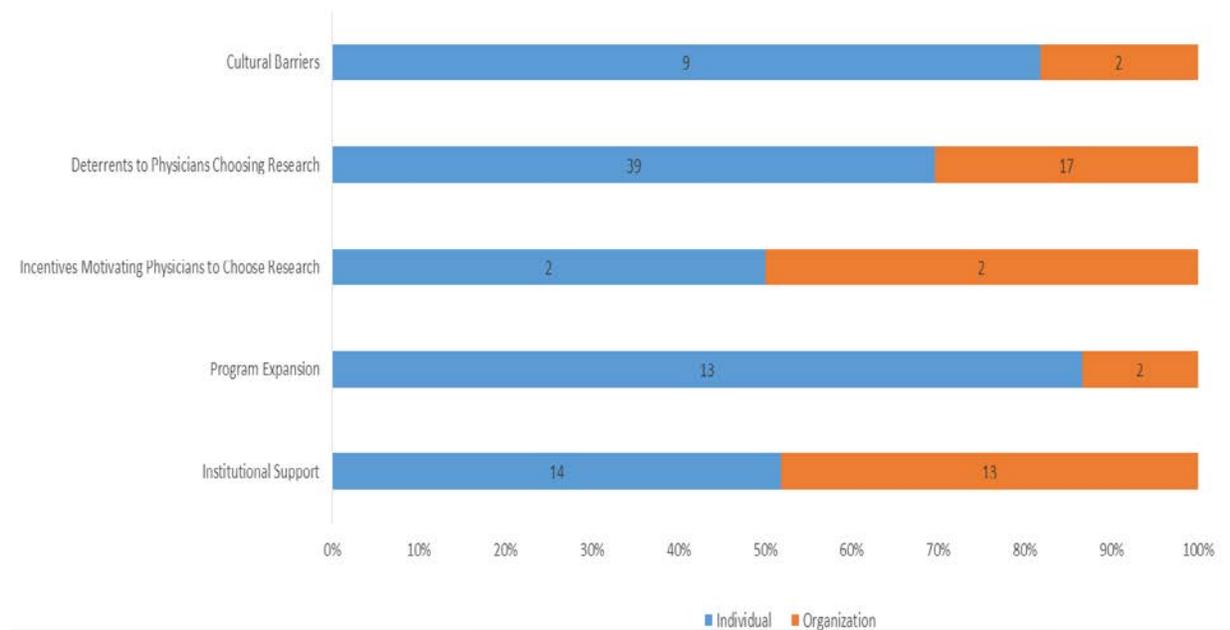
Figure 10 shows the number of quotes attributed to each code related to career decision points. Academic structure and the need for diverse mentors, were mentioned most frequently, with fifteen quotes attributed to each code
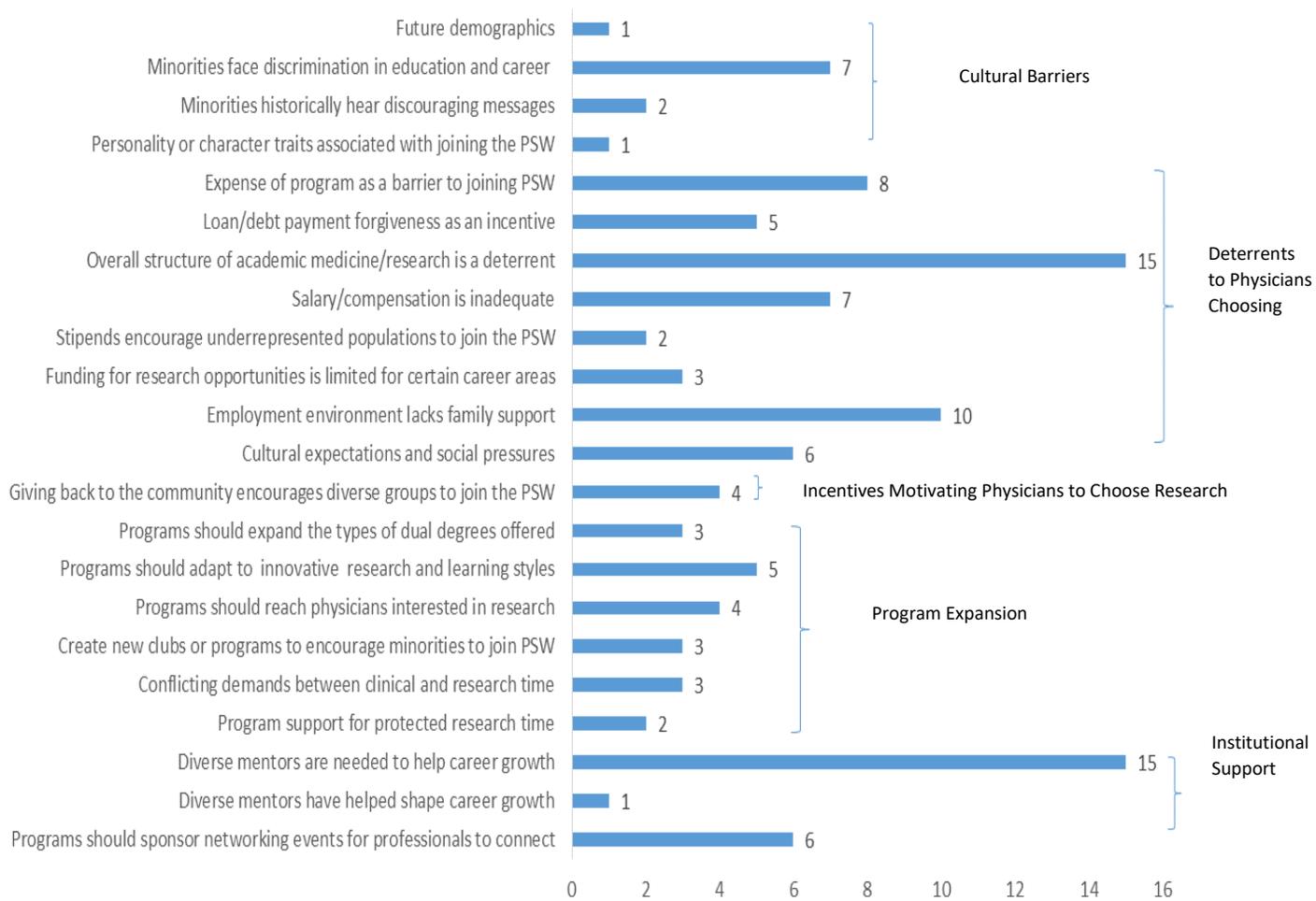
Cultural Barriers

Codes: Future Demographics; Minorities face discrimination in education and career; Minorities historically hear discouraging messages; Personality or character traits associated with joining the PSW

Within educational and professional environments, individuals continue to experience discrimination based on age, sex, and minority status. According to one respondent, this is particularly alarming since Census Bureau projections show that racial and ethnic minorities will only continue to grow. One physician-scientist who wanted to conduct research stated that the dominant culture was not favorable and no one would hire him based on his age. Another respondent shared some early research findings providing evidence of cultural misperceptions where white students thought that minorities were given advantages purely based on minority status.

In addition to deterring minorities from pursuing careers in or remaining in the physician-scientist workforce, legal barriers may also work against those who actively want to hire a more diverse body of scientists. One respondent stated that he wanted "to hire more Blacks [as research assistants]" but that the law prohibits him from specifying that in a job advertisement. Thus, he can find out whether

someone is African American only during the interview. He concluded that the law itself is the problem with increasing the diversity in the biomedical workforce.

Respondents commented that persons from underrepresented backgrounds may grapple with low self-esteem and a lack of confidence as they struggle to compete with others. Some respondents suggested this was a result of continually being told by media, teachers, friends, and societal norms, that they lack the capacity to succeed. Women, particularly, were perceived as requiring extra time to feel adequately prepared to compete with their peers.

Two prominent concerns were the institution-level unconscious bias against individuals from underrepresented backgrounds and the lack of diverse individuals in positions of power (e.g., on NIH study sections or in institutional leadership). Suggestions encouraged training individuals on decision-making bodies to recognize and manage unconscious bias.

Deterrents to Physicians Choosing Research

Codes: Expense of program as a barrier to joining the PSW; Loan/debt payment forgiveness as an incentive; Overall structure of academic medicine/research is a deterrent; Salary/compensation is inadequate; Stipends encourage underrepresented populations to join the PSW; Funding for research opportunities is limited for certain career areas

Four major deterrents were noted as influencing *all* individuals considering the physician-scientist career path, not just those from underrepresented backgrounds: personal financial considerations, lack of family-friendly policies and support, program length and rigid structure, and overall funding climate.

Many respondents brought up personal financial concerns related to research careers for individuals from underrepresented backgrounds as well as general biomedical workforce issues. These respondents noted that student loans and high tuition costs play a major role in a physician's decision not to pursue an academic medical career. Respondents (n=5) called for increased support and forgiveness for student loan repayment at all points in a physician-scientist's training and career. Post-secondary education, in particular, may incur significant student debt, and individuals from underrepresented backgrounds may be affected by debt more than others. As noted previously, many individuals from underrepresented backgrounds may choose community colleges over four-year institutions because of financial considerations. Thus, these individuals may have already taken a different educational path by the time they apply for MD/PhD programs, making their acceptance into such programs more difficult.

Other respondents couched their financial concerns in terms of low salary support during research phases of one's career. There was general sentiment among these respondents that student loans are one of the reasons physicians remain in more lucrative careers and do not pursue research. One respondent suggested educational debt relief for any MD/PhD who choose research as a career or who spent 50 percent or more of their time doing research. There were also specific calls for the Loan Repayment Program to be expanded, in terms of both eligibility and in the amount of loan repayment; two respondents suggested that eligibility for the Loan Repayment Program[7] specifically be expanded for individuals from disadvantaged backgrounds to include more research areas than just clinical research.

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[7] In exchange for a commitment to conduct biomedical or behavioral research, NIH's Loan Repayment Program will repay up to $35,000 of an LRP awardee's qualified educational debt each year.

Individuals from underrepresented backgrounds may have economic and family situations where the salary gap is more of a burden than for other would-be physician-scientists. These individuals may experience financial pressures to finish their education and training as quickly as possible and begin the more lucrative path of practicing medicine to help support their families. One respondent stated:

> *[An] MD/PhD is a lot of time, and students who come from families that require their income will be discouraged from pursuing this because of financial considerations. (ID 41)*

The prestige of being a physician can also be a deterrent to pursuing research. Even after earning a PhD in a specialty area, one respondent explained that his family's expectation was for him to practice medicine. Overall, research is less valued by some families and the broader culture of some underrepresented backgrounds.

Some respondents called for increases in salary support for MDs pursuing research, either through existing grant mechanisms (as previously described) or by creating new stipends and grants. Respondents were concerned that clinical fellows who pursue research opportunities take on additional clinical responsibilities to earn additional income, thus taking time away from research efforts. Overall, opportunities to defer or pay off student loans; receive increased salary support during career research phases or increased stipends during training; and receive well-supported research training at later points in a biomedical professional's career would help create a more diverse physician-scientist workforce.

For clinical professionals who later pursue research degrees independently of their clinical degrees, student debt can be even higher. One respondent noted that increased funding for biomedical professionals to pursue research later in their careers could also increase the number of diverse physician-scientists. A similar sentiment was echoed for those with MDs, dental degrees, nursing, and veterinarian degrees. One respondent suggested:

> *Establishing a few DVM [Doctor of Veterinary Medicine]/PhD programs parallel to MD/PhD programs that include stipends and tuition waivers during DVM training, even if at lower rates than for MD training periods, would create more access. (ID 22)*

Responses about financial issues also encompassed concern about the general research funding climate. Funding for research has become increasingly competitive to secure, making physicians disinclined to pursue research for which they would also have to secure funding. Often, physicians see themselves at a disadvantage in competition for research funding against researchers with PhDs and significant research experience. One respondent noted:

> *The physician-scientist is being uniquely squeezed from both sides. The scientific imperative to procure extramural funding has become fiercely competitive, because the cost of science at the cutting edge is more expensive, the NIH budget is stagnant, yielding obligate lower funding rates. That and an imperfect review process weigh heavily. Combine that with the accelerating clerical/bureaucratic demands of even part-time practice of medicine on the physician, on top of medicine's increasingly complex imperative, and even the best/brightest are shaking their heads. (ID 75)*

From a funding perspective, respondents noted women and young scientists are perceived to be at a disadvantage in competing for dwindling research funds, noting the NIH review process is biased against

early career scientists. To mitigate such bias, whether real or perceived, one respondent suggested that NIH provide training to review committee members to ensure consistency and avoid unconscious bias.

Code: Employment environment lacks family support; Cultural expectations and social pressures

Values associated with raising a family and maintaining family life further explain why physicians are deterred from the physician-scientist career path. Nine respondents spoke about the persistent disadvantage for women who struggle to raise children during their training and early career and who put off child-rearing until later in their lives. Four respondents were female physician-scientists who lamented the lack of family-related resources at their facilities. One respondent mentioned:

> *Physician-scientists often do not earn enough money to support starting a family until they reach their 40s due in large part to high cost of child care and long hours worked during training. This is a huge burden, especially for women, where postponing starting a family until age 40 poses many problems. (ID 103)*

As previously mentioned, unconscious bias, whether true or perceived, appears to affect females more than males when facing career decisions. One female physician-scientist, and mother of two, reported her path had been extremely difficult and that without a mentor, she felt like she had been in a "cycle of invisibility." One respondent noted:

> *Within my own institution I was encouraged to be a "good soldier" and contribute more clinical time than my grants allowed. Being socialized to be the "good girl" many women will subjugate themselves to these requests to keep the peace while watching men in similar positions be lauded for behaviors that are unprofessional. (ID 101)*

Incentives Motivating Physicians to Choose Research

Code: Giving back to the community encourages diverse groups to join the PSW

In contrast to the barriers discussed above, comments also revealed motivating reasons for individuals from underrepresented backgrounds choose to go into and remain in the physician-scientist workforce. Four respondents noted that these groups are motivated to "give back" to their communities of origin, stressing the geographic influence on chosen training locales. Giving back is perceived as a strong professional motivator. Diverse physician-scientists may feel a sense of social responsibility to bring their professional training and skills back home, or to an area that reflects the demographics of their background.

One respondent suggested NIH work with advocacy groups focused on health disparities research to explore how social responsibility may inspire individuals to become physician-scientists. Others suggested special scholarship, fellowship, or exchange programs designed to foster and support individuals from underrepresented backgrounds in pursuing the physician-scientist career path.

Program Expansion

Codes: Programs should expand the types of dual degrees offered; Programs should adapt to innovative research and learning styles; Programs should reach physicians interested in research; Create new clubs or programs to encourage PSW opportunities

The length of the dual-degree programs and lack of program flexibility in training were hindrances, especially for women. The rigid structure of medical education and research portion of dual-degree programs leaves little room to fluidly move in and out of the physician-scientist workforce as interests

peak or change. Respondents emphasized that program schedule flexibility is key to allowing current physicians to hone their research skills. Respondents also suggested that due to these barriers, programs could expand the types of dual degrees that are offered (e.g., MD/MPH) for those who may not be interested in seeking a PhD.

Respondents discussed the need for programs to adapt to new types of research (e.g., translational research, community-based participatory research) to maintain currency in a changing field. Institutional flexibility would allow physicians to gain experience in new research areas and allow them to incorporate new areas into their existing research. One respondent articulated:

> *Career pathways must respect new forms of research, such as community based participatory research, population health and population management. Promotions committees must respect this area of development as well and support promotions in this area or else there will be a bottle neck and frustration with the academic form of promotions and tenure. (ID 82)*

Respondents also discussed the need to reach current physicians who may not be aware of potential research opportunities. Suggestions included offering trainings, continuing medical education, or providing alternative schedules for physicians to integrate research into their clinical practice. As one respondent suggested:

> *Offer week-long CME programs, night classes, online classes that teach the basics of research for busy clinicians wanting to incorporate clinical research in their practices or those looking to move into a research career. (ID 45)*

Similarly, some respondents proposed the creation of academic clubs for pre- and post-doctoral students to help them gain a fuller understanding of potential career branching opportunities.

Institutional Support

Codes: Conflicting demands between clinical and research time; Program support for protected research time

Some respondents discussed conflicting demands between clinical and research time, citing that physicians are not ensured sufficient protected research time, hindering research progress and potentially impacting the transition to career independence. To mitigate this, one respondent suggested that university-affiliated medical institutions should offer supplemental salary support to cover the physician's time for research-related activities, such as grant and publication development. Having protected time may be especially difficult for physicians who do not have specific research funding but who nevertheless may be interested in starting new research projects. As one respondent noted:

> *Protected time for practicing clinicians in pilot project grants: Add max [10 percent] salary FTE to pilot projects for practicing clinicians who don't have research funding and trying to get started on new projects. Current pilot project funding usually excludes salary support. Clinicians without research funding can't get protected time to successfully execute the pilot projects, and the funding can be wasted. This may be the only way they can get some protected time. (ID 104)*

Another respondent suggested the development of an NIH grant dedicated to ensuring protected time for junior researchers who wish to further pursue a career in academic research.

Codes: Diverse mentors are needed to help career growth; Diverse mentors have helped shape career growth

Fifteen quotes emphasized the importance of mentors for the career growth, echoing sentiment discussed earlier in this report that mentors are important at other points along the physician-scientist pathway. Moreover, the lack of available diverse mentors could ultimately inhibit individuals from underrepresented backgrounds from choosing an academic pathway in medicine. Respondents offered suggestions to increase and improve mentorship opportunities through financial support and funding opportunities.

Code: Programs should sponsor networking events for professionals to connect

There was sentiment that programs should sponsor networking events for trainees and faculty. Because junior faculty from underrepresented backgrounds face unique challenges at the beginning of their careers, networking events can connect early-career to late-career professionals, thereby helping to decrease possible feelings of isolation, increasing morale, and promoting the exchange of "tacit knowledge regarding strategies to succeed in academic medicine" (ID 49). NHLBI's Programs to Increase Diversity Among Individuals Engaged in Health-Related Research (PRIDE) and the networking events at the annual meetings of APSA and SNMA were cited as a positive example of this type of support.

There is a need for specific institutional support, especially for junior faculty, in the forms of leadership development seminars, grant writing workshops, mentoring, management skills workshops, and administrative support and training on topics such as IRB submission writing, compliance issues, and progress reports. One respondent highlighted the importance of intense lab-based courses, such as those offered at Cold Spring Harbor, Jackson Labs, and Woods Hole for clinical researchers who may need additional research training.

Selected Recommendations for NIH Action

Respondents suggested a number of actions that could be taken to help reduce career deterrents, and in turn, improve diversity at the career level. Actionable recommendations that NIH could support include:

- Expand loan repayment programs to mitigate financial deterrents (e.g., student loan debt, salary gap) to joining the PSW.
- Improve available funding opportunities for early career scientists and those conducting research on health issues related to minority communities.
- Work with advocacy groups focused on health disparities research to explore how social responsibility may inspire individuals to become physician-scientists.
- Create special scholarship, fellowship, or exchange programs designed to foster and support individuals from underrepresented backgrounds in pursuing the physician-scientist career path.
- Ensure institutional support through continuing to require, and enforcing, protected research time. Institutional support could also encompass research-related workshops for clinicians.

Summary and Conclusions

Individuals from underrepresented backgrounds experience significant challenges to entering the physician-scientist workforce beginning in the earliest phases of education and continuing along the

educational pathway and into the workforce. This section summarizes the major themes and challenges related to improving the diversity of the physician-scientist workforce along the entire pathway.

Early Education Factors Affecting Diversity

RFI respondents identified barriers that first appear early in life, mostly related to early education, that inhibit individuals from underrepresented backgrounds from joining the physician-scientist workforce. Educational barriers continue to affect such students through high school and college.

Respondents identified a lack of access to quality K-12 education, especially with respect to STEM education, and a lack of experience with or exposure to research along the way as significant early barriers to entering appropriate educational channels toward the physician-scientist workforce. These factors combine to inhibit the ability of individuals from underrepresented backgrounds to perform well on standardized tests and gain entry to the next level of academic achievement. At each point along the pathway, and specifically regarding the MCAT, respondents suggested institutions adjust application criteria to place less emphasis on standardized test scores and take a more holistic approach when considering applicants.

Developing interest in science early was viewed as paramount for students to ultimately pursue a STEM career. Extracurricular science-based experiences (e.g., summer programs, lab experience) were perceived as the most influential experiences for students in their early years. Therefore, support for, or the facilitation of, collaborations between programs or scientists who partner with K-12 institutions was perceived as an important method for increasing student exposure to science and medicine as a career. Some respondents suggested that K-12 teachers could incorporate more research-related activities into their science curricula. Involving mentors, role models, family, and community members was another suggestion for ensuring continued interest and strengthening the likelihood of attracting younger students from minority groups to a career in science.

At both the high school and college levels, respondents emphasized the need for programs that expose minority students to research and provide financial support (e.g., stipends and test preparation). It was suggested that institutions increase funding for existing programs geared toward minority students interested in research and medicine, especially for programs that have already proven successful.

In addition, respondents repeatedly emphasized the importance of mentorship. While the significance of mentorship was obvious throughout the responses, respondents suggested that NIH may not take mentorship seriously, as reflected in the lack of formal support or training opportunities to potential mentors. They suggested providing financial support and formal recognition and training for mentors to demonstrate the value of mentorship. Respondents called for continued mentoring involvement by minority educators and researchers, but warned against the possibility of overburdening minority faculty with such responsibilities. It was also viewed as important for mentors to be sensitive to diversity issues in order to be effective.

Program and Institutional Characteristics

In addition to earlier educational factors, respondents commented on educational and institutional factors that affect diversity within the physician-scientist workforce immediately leading up to, during, and after dual-degree programs. Respondents generally agreed that minorities are not well represented

in the physician-scientist workforce and that this problem persists at all stages, including dual-degree granting programs and faculty. At an institution-wide level, respondents spoke of unconscious bias as a factor that may affect all stages of minority participation in the physician-scientist workforce. Minorities continue to experience institutionalized discrimination and unconscious bias. At the institutional level (e.g., medical schools, NIH), respondents called for training of current leadership to begin recognizing these forces at play as a means to reduce bias and create a more inclusive environment. At a cultural level, discrimination and unconscious bias are experienced as negative messaging that asserts minorities are not able to succeed persists.

Because individuals from underrepresented backgrounds are likely to face disproportionate financial challenges, financial issues related to education continue to require attention. Community colleges are important for providing accessible and affordable post-secondary education. There is a general need to facilitate entry into the STEM workforce from community colleges and for larger research institutions to connect their STEM programs with community colleges. These efforts could potentially increase the number of well qualified underrepresented students applying to clinical and dual-degree programs. Building collaborations and partnerships between minority-serving institutions or colleges and medical schools, foundations, professional organizations, or the private sector was commonly suggested to strengthen the pathway and assist with diversifying the physician-scientist workforce.

Changes to dual-degree and MD-only granting programs were also suggested. First, respondents suggested expanding the number of available MSTP programs and MD/PhD training positions to accommodate the high numbers of well qualified applicants. Adjusting admissions criteria for entry into dual-degree and MD programs might also provide greater minority access to this career path, and reasons for this fell along two lines: a) MCAT scores, which respondents felt are relied upon too heavily by admissions committees, do not necessarily reflect how well a student will do as a physician or physician-scientist, and b) many minority students follow non-linear educational and professional paths into the pathway.

Programs could also be expanded in scope to include community outreach/service or emphasize areas that might be of particular interest to individuals from underrepresented backgrounds, such as health disparities. For students enrolled in MD-only programs, integrating exposure to research was suggested as an effective way to increase awareness and interest in clinical research. Programs could also be developed for allied health professions to earn a PhD or to have other significant research opportunities or training. Quick diversification of the physician-scientist workforce could be achieved by adjusting eligibility criteria to allow more foreign students, physicians, and physician-scientists to work and study in the United States.

Respondents emphasized that it is important to provide institutional support to connect minority trainees and early career physician-scientists through intentional professional community building. Networking and mentoring were two common suggestions to ensure the success of trainees and early career physician-scientists. Respondents noted the importance of leveraging local and national organizations, societies, and foundations to build and strengthen the pathway for both minority faculty and students. Overall, mentoring, networking, and community and programmatic partnerships could increase the success of minorities in the physician-scientist workforce by reducing feelings of isolation, providing positive role models, and increasing awareness of funding, educational, and program opportunities.

Respondents were also aware of the existing programs and grant mechanisms making an effort to increase diversity in the physician-scientist workforce. However, suggestions were made to increase the scope and availability of specific grant mechanisms.

Career Factors

There were many concerns regarding the physician-scientist career path, and some of these concerns were specific to minorities, while others were generally about the physician-scientist workforce as a whole. A number of deterrents to joining the physician-scientist workforce were identified. These were: personal financial issues, including student debt and the salary gap between clinical and research responsibilities; a lack of family-friendly policies; a lack of flexibility in regard to educational and training structures; and the current research funding climate.

A major issue that affects all physician-scientists is student loan debt and the salary gap between clinical responsibilities and research efforts. Respondents pointed out that physician-scientists, especially those from underrepresented backgrounds, may have large student debt burden. Physician-scientists who either followed a non-traditional route, perhaps by pursuing their PhD and MD separately, or otherwise had undergraduate student debt, may be particularly sensitive to salary concerns. Moreover, allied health professionals, such as nurses, who have been professionals for a long time before deciding to pursue research, may have to go back to school (e.g., for a bachelor's degree) and incur further student debt just to be eligible for research degrees or opportunities.

Respondents noted the salary gap between a career focused on practicing medicine and a research career. Even for a physician-scientist with both clinical and research duties, respondents noted that salary caps and the traditional grant mechanisms to fund physician-scientists often create situations that are less than ideal. For example, physician-scientists may moonlight to pick up extra salary and may take on additional clinical duties that diminish protected time. For physicians who are trying to pay off student debt, have families to support, or are generally accustomed to a higher salary, the salary drop that accompanies research or being a physician-scientist may make that career choice untenable. In addition, the prestige and financial success minority communities may associate with being a doctor are difficult for individuals to ignore when choosing a professional path.

There was a significant call for increased loan repayment programs. Loan forgiveness programs were described as helpful, and it was generally thought that the amount of forgiveness and eligibility criteria should be expanded.

Respondents wrote about the lack of family-friendly policies as a deterrent to choosing a career as a physician-scientist. The lack of these policies was brought to the forefront specifically in the context of women and childbearing, as they might put off having children to achieve career progression because the physician-scientist workforce pathway does not traditionally accommodate large periods of time off, especially in early stages. Suggestions for improvement included paid maternity leave and on-site day care.

The overall research funding environment is a problem not specific to individuals from underrepresented backgrounds, but potentially more problematic for them. The degree of competition for limited research funding support translates to little job security, which is a deterrent, especially for those with families or debt. There was sentiment that some physicians may be at a disadvantage in

competing for research funding, as they may have less time, resources, and training/background to devote to research compared to their PhD counterparts. Improving available funding opportunities for early career scientists and those conducting research on health issues related to minority communities were suggested to correct the system.

The need for institutional support of protected time was also raised. Often, physicians take on additional clinical responsibilities to generate income or, especially in the case of minority members of the physician-scientist workforce, have too many other activities (serving on committees, mentoring, etc.) that take away from protected research time. Respondents explained that research is not valued at academic medical centers and is often considered an afterthought and less important than seeing patients because it does not generate income. Ensuring that physician-scientists maintain protected time and that the time truly goes toward research activities would strengthen the physician-scientist workforce.

Appendix A: Additional Data

Figure A1. Summary Submission Information

Total Comments Received:	**125**
Duplicates	2[8]
Non-Responsive	13
Unique and Responsive Comments Received	**110**
Quotations Coded	404
Mean Quotations Per Submission	3.6
Maximum Number of Quotes Per Response	12
Minimum Number of Quotes Per Response	1

Figure A2. Submission Method

	Count	Percent
Web	111	9.8%
Email	12	90.2%
Total	**123**[9]	**100%**

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[8] Two respondents sent an email as well as submitted data via the Web form.
[9] Respondents that submitted via the web were recorded as the non-duplicate response.

Number of Quotes

Code Name	Number of Quotes
Diverse mentors are needed in programs	37
Undergraduate programs contribute to research experience	21
Diverse mentors are needed to help career growth	15
Expand/raise awareness of existing programs and grant mechanisms	15
Overall structure of academic medicine/research is a deterrent	15
Limited exposure to PSW opportunities prior to college	14
Programs should expand eligiblity to other specialities	13
Program should create, train, and provide support to foster mentorship	11
Employment environment lacks family support	10
Programs have relationships with outside organizations (e.g. AMA)	10
Early exposure to PSW opportunities prior to college	9
Limited exposure to PSW opportunities prior to high school	9
Programs should make more effort to recruit diverse groups	9
Expense of program as a barrier to joining the PSW	8
Model diversity recruitment efforts on other successful, non-degree programs	8
Ongoing and systematic measures are required to diversify the PSW	8
Societal factors influence desire to join or remain in the PSW	8
Create financial incentives to attract and retain physician-scientists	7
Expand funding	7
Limited access to a high quality K-12 education	7
Non dual-degree research opportunities	7
Salary/compensation is inadequate	7
Minorities face discrimination in education and career	7
Cultural expectations and social pressures	6
Exposure to role models	6
MD gains experience without PhD	6
Post-Baccalaureate or post-Doctoral programs provide research experience	6
Programs should sponsor networking events for professionals to connect	6
Early exposure to PSW opportunities prior to high school	5
Limited access to post-secondary opportunities	5
Loan/debt payment forgiveness as an incentive	5
Programs should adapt to innovative research and learning styles	5
Specific recommendations for future RFIs or additional suggestions to NIH Diversity workforce	5
Dual-degree programs should expand internationally	4
Giving back to the community encourages diverse groups to join the PSW	4
MCAT scores do not predict success	4
Physician-scientist obtains degrees sequentially	4
Program offers formal mentorship/training program	4
Programs should reach physicians interested in research	4
Programs should partner with community organizations	4
Conflicting demands between clinical and research time	3
Create new c lubs or programs to market PSW opportunities	3
Foreign born cannot apply to some grants	3
Funding for research opportunities is limited for certain career areas	3
General support for researchers	3
Programs should expand the types of dual degrees offered	3
Standardized testing thresholds is an admission limitation	3
Alternative degree/certification programs	2
Howard Hughes Medical Institute funding promotes research experience	2
Institutional culture values diversity	2
Non dual-degree professionals encouraged to pursue degree based on mentorship	2
Program has limited funding opportunities	2
Program support for protected research time	2
Programs should offer specific services for minorities	2
Programs should broaden admission requirements to increase diversity	2
Programs should make more effort to retain diverse groups	2
Stipends encourage underrepresented populations to join the PSW	2
Undergraduate programs need improvement or restructuring	2
Minorities historically hear discouraging messages	2
Demographics of program - females are underrepresented	1
Demographics of program - minority groups are underrepresented	1
Future demographics	1
Diverse mentors are available in programs	1
Diverse mentors have helped shape career growth	1
Facilities are inadequate to move research forward	1
Integrate community colleges into the pipeline	1
Integrate research into residency	1
Length of obtaining dual degree through alternative pathways	1
Funding for non-MD specialties	1
Personality or character traits associated with joining the PSW	1
Program makes efforts to recruit diverse populations	1
Programs make effort to retain diverse populations	1
Programs support for transition to independence	1

Appendix B: List of Organizations Responding on Behalf of a Group

1. 100 Black Men of Metro Houston, Inc.
2. American Academy of Pediatrics
3. American Association for Dental Research
4. American College of Emergency Physicians and Society of Academic Emergency Med Work Group
5. American Dental Education Association
6. American Physician Scientists Association (APSA) and the Student National Medical Association (SNMA)
7. American Society for Biochemistry and Molecular Biology
8. American Society for Bone and Mineral Research
9. American Society of Hematology
10. American Society of Nephrology
11. American Society of Pediatric Nephrology
12. Association of American Medical Colleges
13. Association of American Veterinary Medical Colleges
14. Endocrine Society
15. GLMA [Gay and Lesbian Medical Association]: Health Professionals Advancing LGBT Equality
16. IDSA [Infectious Diseases Society of America]
17. Johns Hopkins University School of Medicine
18. Kaiser Permanente Division of Research
19. National Association of MD-PhD Programs
20. National Hispanic Medical Association
21. Orthopaedic Research Society (ORS Advocacy Committee)
22. Pacific Health Research and Education Institute
23. Stanford University School of Medicine
24. University of California San Diego, MD/PhD Program
25. University of California San Diego, Skaggs School of Pharmacy and Pharmaceutical Sciences
26. University of Pittsburgh

Appendix C: Coding Scheme

Coding scheme used to categorize the comments received through the NIH Request for Information (RFI): Strategies to Enhance Diversity in the Physician-Scientist Workforce (NOT-OD-16-027).

Topic	Subtopic	Code Name	Code Description
Educational Pathways	Social and Environmental Factors	Societal factors influence desire to join or remain in the PSW	Societal pressures (from prejudices, television) affect minorities' desire or ability (conscious or subconscious) to join the PSW
	K-12 Educational Factors	Limited access to a high quality K-12 education	Low SES inhibits adequate education at the K-12 level
		Limited exposure to PSW opportunities prior to high school	PSW/research prep programs are not available to middle school-aged children
		Early exposure to PSW opportunities prior to high school	PSW/research prep programs are available to middle school-aged children
		Limited exposure to PSW opportunities prior to college	PSW/research prep programs are not available to high school-aged children
		Early exposure to PSW opportunities prior to college	PSW/research prep programs are available to high school-aged children
		Limited access to post-secondary opportunities	Low SES inhibits adequate education at the college level
		Exposure to role models	Early exposure to role models encourages minorities to join the PSW
	Supplemental Programs	Undergraduate programs contribute to research experience	Undergraduate programs for underrepresented populations pursuing biomedical science
		Undergraduate programs need improvement or restructuring	Undergraduate programs should be revamped or modified to improve research skills
Institutional and Programmatic Characteristics	Program Demographics	Demographics of program - females are underrepresented	Demographic information about programs – related to females
		Demographics of program - minority groups are underrepresented	Demographic information about programs - related to minority populations

Topic	Subtopic	Code Name	Code Description
	Program Admission Limitations	Programs should broaden admission requirements to increase diversity	Admission requirements should be broadened to increase diversity
		MCAT scores do not predict success	MCAT scores tend to be lower in minorities but do not predict success in medical school
		Standardized testing thresholds is an admission limitation	Minorities more likely to have lower MCAT scores; schools reluctant to accept applicants with low MCAT scores
	Institutional Support	General support for researchers	Institutions should continue to improve and provide support to researchers by way of adequate facilities, increased funding, increased salary support, etc.
		Program makes efforts to recruit diverse populations	Ways programs recruit for underrepresented groups
		Programs make effort to retain diverse populations	Ways programs retain underrepresented populations
		Programs should make more effort to recruit diverse groups	Ways programs can improve efforts to recruit diverse groups
		Programs should make more effort to retain diverse groups	Ways programs can improve efforts to retain diverse groups
		Institutional culture values diversity	Institution values and supports cultural diversity and diversity in physician specialties
		Facilities are inadequate to move research forward	Adequacy of laboratory facilities at different institutions
		Programs support for transition to independence	Programs do or should provide support to help researchers transition to independent investigators
		Post-Baccalaureate or post-Doctoral programs provide research experience	Post-bac or post-doc programs provide opportunities to obtain additional research experience
		Programs should partner with community organizations	Programs should partner with diverse community organizations to encourage minority participation in the PSW
	Role of Mentorship	Program offers formal mentorship/training program	Formal mentorships among dual-degree programs
		Program should create, train, and provide support to foster mentorship	Programs should invest in mentors by creating programs, providing training, and support to foster improved and diverse mentorship
		Diverse mentors are available in programs	Diverse mentors are available within program

Topic	Subtopic	Code Name	Code Description
		Diverse mentors are needed in programs	More diverse mentors are needed within program
	Track, Assess and Evaluate	Ongoing and systematic measures are required to diversify the PSW	More research is needed to identify and understand barriers minorities face
	Existing NIH Grant Mechanisms	Expand/raise awareness of existing programs and grant mechanisms	Programs should consider expanding the scope and raising awareness of grant mechanisms
	Partnerships	Programs have relationships with outside organizations (e.g. AMA)	Relationships with outside orgs that might have info or mentorship opportunities for underrepresented populations
		Model diversity recruitment efforts on other successful, non-degree programs	Successful programs that can act as a model for diversity recruitment and retention efforts
	Suggested Changes to Dual-Degree Programs	Expand funding	Funding should be expanded to include more applicants, grant types, etc.
		Create financial incentives to attract and retain physician-scientists	Financial incentives would help attract people to join the PSW
		Program has limited funding opportunities	Funding opportunities are not available to encourage underrepresented participation
		Programs should offer specific services for minorities	Programs offer specific services or support groups for minorities or underrepresented groups
		Programs should expand eligibility to other specialties	MD/PhD programs should expand to include additional specialties such as PharmD
		Funding for non-MD specialties	Funding is not adequate for non-MD specialties (DVM, RN, DDS, etc.)
	Non-Traditional Pathways	Integrate community colleges into the pipeline	Programs should partner with community colleges to attract minority students, who often start at community colleges
		Non dual-degree research opportunities	Professional research opportunities for MDs or PhDs without dual degree
		Integrate research into residency	Suggestions to integrate research in to residency or extend residency to offer more research time
		Howard Hughes Medical Institute funding promotes research experience	Research funding for promising MD students
		Non dual-degree professionals encouraged to pursue degree based on mentorship	Mentorship that might encourage underrepresented populations to pursue additional degree

Topic	Subtopic	Code Name	Code Description
		MD gains experience without PhD	Ways MDs gain research experience without a PhD
		Alternative degree/certification programs	MD/PhDs can earn credentials through certifications or other programs
		Physician-scientist obtains degrees sequentially	MD program then PhD program, or vice versa
		Length of obtaining dual degree through alternative pathways	Length of consecutive programs is a deterrent to joining the PSW
		Foreign born cannot apply to some grants	Foreign-born applicants are excluded from eligibility criteria for some grants
		Dual-degree programs should expand internationally	Dual-degree programs should expand to include international students
Career Decision Points and Pathways	Cultural Barriers	Future demographics	Emerging changes in the demographics characteristics of the PSW
		Minorities face discrimination in education and career	Minorities face discrimination when applying to programs or job solely based on racial/ethnic/minority status
		Minorities historically hear discouraging messages	Minorities have historically been discouraged from obtaining higher education through friends, family, teachers, etc.
		Personality or character traits associated with joining the PSW	Personality traits or characteristics improve likelihood of joining the PSW
	Deterrents to Physicians Choosing Research	Expense of program as a barrier to joining the PSW	Heavy debt load discourages underrepresented populations to join the PSW
		Loan/debt payment forgiveness as an incentive	Payment forgiveness plans act as incentive to join the PSW
		Overall structure of academic medicine/research is a deterrent	Barriers that exist within the standard structure of academic medicine (e.g., timeframes, competing demands, lack of research funding and poor salary combine to deter people from joining the PSW)

Topic	Subtopic	Code Name	Code Description
		Salary/compensation is inadequate	Salary and/or compensation deters from joining the PSW
		Stipends encourage underrepresented populations to join the PSW	Stipends encourage underrepresented populations to join the PSW
		Funding for research opportunities is limited for certain career areas	Funding opportunities are not available to help shape career decisions
		Employment environment lacks family support	Concern about the lack of policies to support family leave and/or childcare; Perceptions of unbalanced work-life; includes not enough time at home, childbearing years as an obstacle, etc.
		Cultural expectations and social pressures	Cultural expectations and social pressures deter underrepresented groups from obtaining further education
	Incentives Motivating Physicians to Choose Research	Giving back to the community encourages diverse groups to join the PSW	Giving back to their disadvantaged community encourages underrepresented populations to join the PSW
	Program Expansion	Programs should expand the types of dual degrees offered	Programs should expand the types of dual degrees offered (e.g. MD/MPH)
		Programs should adapt to innovative research and learning styles	Programs should allow flexibility and encourage new learning styles and new types of research (e.g. participatory based research)
		Programs should reach physicians interested in research	Programs should offer trainings or courses to help further careers for physicians interested in research
		Create new clubs or programs to market PSW opportunities	New clubs or graduate programs should be created to help current MDs get involved in research
	Institutional support	Conflicting demands between clinical and research time	Physician-scientists face conflicting demands for research vs clinical practice
		Program support for protected research time	Programs do or should support protected time for research
		Diverse mentors are needed to help career growth	Mentors help shape career decisions

Topic	Subtopic	Code Name	Code Description
		Diverse mentors have helped shape career growth	Mentors have helped shape career decisions
		Programs should sponsor networking events for professionals to connect	Programs should sponsor networking events for professionals to connect and maintain relationships
Miscellaneous	RFI recommendations	Specific recommendations for future RFIs or additional suggestions to NIH Diversity workforce	General recommendations about the RFI and how to improve it or build upon it next time.