Analysis of NIGMS Request for Information on Strategies for Modernizing Biomedical Graduate Education

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Introduction

NIGMS has been actively involved in efforts to catalyze the modernization of biomedical graduate education. These efforts have included hosting a symposium to showcase innovations in biomedical graduate education and providing administrative supplements to T32 predoctoral training grants to enhance rigor and reproducibility, career development and skills development. On June 8, 2016, NIGMS released a Request for Information (RFI; NOT-GM-16-109) to obtain input from the broader community on how to catalyze the modernization of biomedical graduate education through NIGMS' institutional predoctoral training grants program. The RFI, and an accompanying *Feedback Loop* blog post, asked community members to provide input on the following:

- Current strengths, weaknesses and challenges in graduate biomedical education.
- Changes that could enhance graduate education to ensure that scientists of tomorrow have the skills, abilities and knowledge they need to advance biomedical research as efficiently and effectively as possible.
- Major barriers to achieving these changes and potential strategies to overcome them.
- Key skills that graduate students should develop in order to become outstanding biomedical scientists and the best approaches for developing those skills.
- Potential approaches to modernizing graduate education through the existing NIGMS institutional predoctoral training grants.
- Anything else you feel is important for us to consider.

The RFI closed on August 5, 2016, yielding a total of 90 unique responses submitted through an online form, the *Feedback Loop* blog and direct email to NIGMS staff members. Most of the responses were anonymous, but the content indicated that comments were submitted by students, faculty, institutions and professional societies. Stakeholder organizations, including the Federation of American Societies for Experimental Biology, Association of American Medical Colleges, Genetics Society of America, Future of Research, American Physiological Society and Global Biological Standards Institute provided comments.

Analysis Approach

A team of NIGMS staff employed an iterative approach to establish themes and sub-themes reflecting the content in the RFI responses. The first 30 responses were read to develop and refine an initial list of codes. The team conducted two rounds of practice coding (seven to 10 responses each round) to ensure consistent understanding and application of the codes. In each of these rounds, code definitions and application rules were refined, and codes were added or deleted as appropriate. After receiving all responses, three readers independently coded each response, and then the team met to discuss and resolve differences in code application. The response formats were heterogeneous (i.e., some used the web form to provide feedback, while others wrote letters), and many respondents reiterated their main points in multiple sections of their response. Thus, codes were applied on a *per response* basis rather than per prompt.

Results

Twenty-eight major themes were identified in the responses. These themes were grouped into five major categories (each comprised of two to 15 themes): institutional and training-related issues, skills development, systemic issues in the research enterprise, careers, and administrative/review issues. Figure 1 shows how frequently these categories were represented in the responses. Below are the codes and exemplar quotes that represent the breadth of responses.

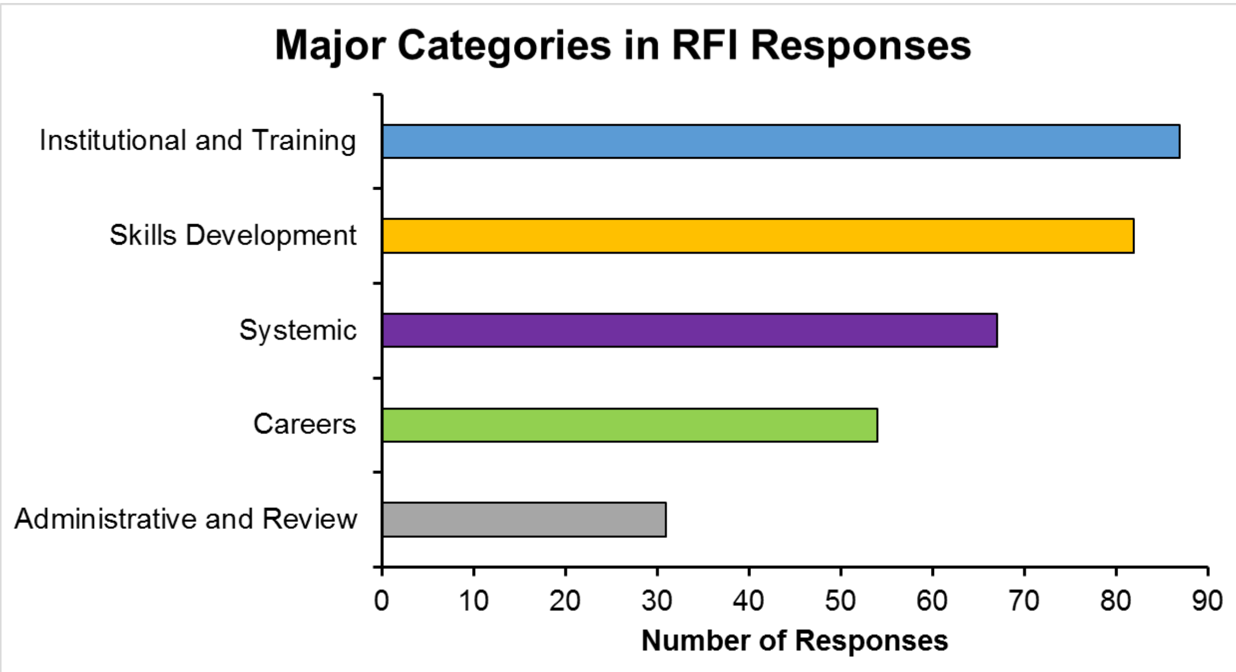

Figure 1: *<u>Major Categories in Biomedical Graduate Education RFI Responses</u>. Bar chart showing the number of RFI responses in which one of the major categories was represented. A total of 90 unique responses were received for the RFI.*

<u>Category #1: Institutional and Training-Related Issues (97% of responses).</u>
Fifteen themes comprised the “Institutional and Training-Related” category, and Figure 2 shows the number of responses in which each code was present.

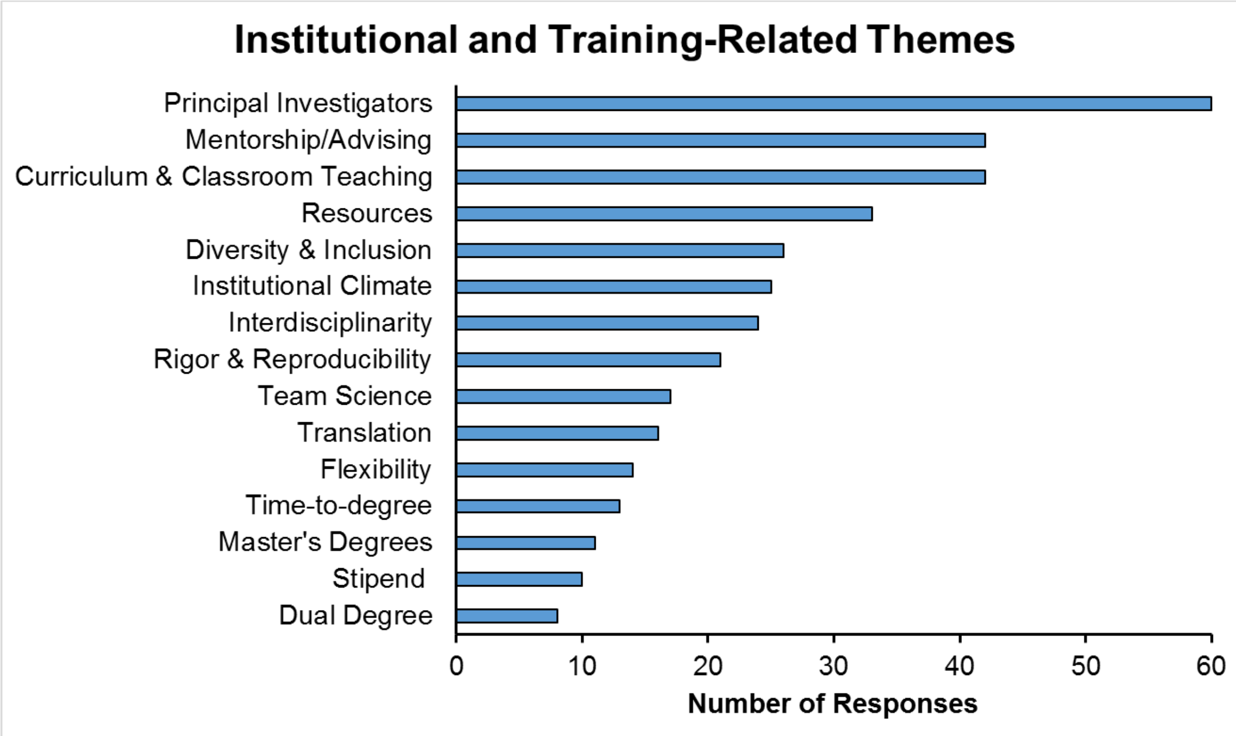

Figure 2: *<u>Institutional and Training-Related Themes in Biomedical Graduate Education RFI Responses</u>. Bar chart showing the number of RFI responses in which each theme that was part of the Institutional and Training-related category was represented. A total of 90 unique responses were received for the RFI.*

The roles that **principal investigators** (PIs), and **mentorship/advising** play in graduate education were prominent themes in this category. One respondent described the potential positive and negative impacts that PIs and mentorship can play in the training experiences of students:

> "The greatest strength of US graduate education is the apprenticeship experience that is provided by the best faculty advisors, i.e. those that have the best interests of the student at heart. Having both advised many Ph.D. biomedical students, and then served as a department and Graduate School leader at an [American Association of Universities] institution, I have seen the very best and the very worst advising. When the advising works, then the student is prepared for the career track that they have chosen, and have the advisors support for whatever this should be. In many ways, I would argue that a good advisor is very similar to a good parent. You "raise" them to succeed in life, often in ways that you had not imagined.
>
> The greatest weakness of US graduate education is the apprenticeship experience when this results in an almost serflike relationship of the graduate student to the advisor – especially common with foreign-nationality graduate students, and foreign-born faculty advisors. I have seen too many exploitative relationships where students never leave the lab, have few opportunities to learn and experience anything besides their lab research, and are considered to be 100% "owned" by the advisors because they and not the university is paying their stipend – even though the students are clearly on 40% appointments. I have had faculty refuse to allow their students to take Preparing Future

> courses and other ‘non-research’ activities that will help with the student’s future careers. And while every advisor agrees that ethics is important, few address it in the lab, and lead by example…”

In addition to the impact faculty members have on individual trainees, responses also addressed the need to ensure that PIs have the skills necessary to excel in student training. For example, managing large data sets is becoming increasingly important in biomedical science, as is the ability to effectively mentor and advise trainees from increasingly diverse backgrounds. However, responses indicated that not all PIs have the skills to excel in these areas.

> “The faculty teaching these topics also do not have this inherent understanding of big data, modeling and statistics. You cannot teach students new ways of thinking if you do not understand and value the tools and approaches as the instructor.”

> “Mentoring and management skills of the professoriate…may be limited, understandable as they themselves have been trained almost exclusively in bench science.”

Curriculum and classroom teaching also represented a major area of attention. Many comments focused on the need to ensure that modern pedagogical techniques are employed, and that the curriculum addresses the range of skills (technical, operational and professional) that biomedical trainees need to succeed. In response to the prompt asking what changes could enhance graduate education, one respondent wrote:

> “Provide funding for departments to hire educators/career counselors to improve the graduate coursework quality (less didactic, more active learning) and teach non-traditional course topics (writing, presenting, job search, interviewing, etc.).”

Others commented that current “graduate biomedical education practices are not generally informed by research” on adult teaching-and-learning, and that “faculty members are busy, are not incentivized to change their teaching, and are not themselves versed in evidence-based active learning or online education.” Thus, responses indicated the need to update the curriculum in graduate programs, as well as to support faculty to enhance their ability to effectively teach and mentor trainees.

The **resources** required to conduct biomedical research and research training were also discussed. Responses noted that facilities in the U.S. are high quality, and that there is generally good financial support for students. However, a tough funding climate for principal investigators may limit their ability to fully engage in training-related activities. As described in a professional society’s response, “Increased competition for federal grant dollars and decreased funding for state institutions have forced advisors to spend more time writing grants and less time supervising their trainees.”

Issues of **diversity and inclusion**—especially with respect to race, ethnicity and gender—and the role that **institutional climate** plays in shaping student experiences were also prominent. As one respondent noted, “Efforts to modernize and enhance graduate education must take into account the environments in which training occurs and the relationships which impact the training experience.” All of the responses that mentioned diversity and inclusion (except two) indicated support for NIGMS’ efforts in these areas, and encouraged additional efforts:

> “Gender and racial diversity remain a significant problem in science. Deeper commitment to graduate training is an opportunity to address some of these disparities, and I urge to consider how they can be interwoven into the reforms you enact.”

> “Lack of diversity continues to be an alarming problem in biomedical research. Given our changing demographics, this is no longer a “minority problem,” but rather a national emergency.”

> “Diversity should not be considered as an add-on to graduate education, but rather, a vital and necessary element to endure innovation and scientific excellence. It should be incorporated into all academic training protocols (perhaps even ethics trainings) so that students understand that to be an excellent scientist, diversity is a professional element where they must gain knowledge and work to master. Working to eliminate bias and preference in the lab is vital for the biomedical workforce to move forward in a progressive and authentic way.”

There was also strong support for **interdisciplinary training** in Ph.D. programs. As described by one of the institutional responses, “In addition to discipline-specific knowledge that is needed in order to train the next generation of scientists, it is becoming increasingly important that trainees have exposure to areas that extend beyond their traditional area of inquiry.” Another response noted, “Science is no longer a single discipline act anymore. Innovative students need to be able to reach into other areas of research and combine ideas in new ways.” Comments also emphasized that student training should prepare them to conduct **rigorous and reproducible** research; work effectively in **team science** environments; and **translate** their basic research discoveries into therapies, products or intervention approaches that directly impact patients or the public.

Other themes in the institutional and training-related category included:

- **Flexibility**. These comments encouraged NIGMS to allow flexibility in the use of training grant funds “to integrate new modes of preparing trainees,” and focused on ensuring that Ph.D. programs have flexibility so that students can tailor their course of study to their professional goals.
- **Time-to-degree.** These comments were split between those encouraging efforts to make it shorter (“The time to graduate is too long”), and those who felt too strong a focus on shortening time to degree may adversely impact efforts to enhance career preparation during Ph.D. training.
- **Stipends**. Many comments argued that student stipends should be increased (either across the board or adjusted for cost of living), while a few recommended eliminating stipends altogether.
- o **Master’s degrees**. These responses pointed to the need to consider the role that master’s degrees play with respect to modernizing biomedical graduate education (either as a prerequisite to, or an alternative for Ph.D. training).
- o **Dual degrees**. These responses focused on issues specific to those in M.D.-Ph.D. training programs, or proposed the creation of other dual degree programs (such as Ph.D./M.B.A. or Ph.Ds. combined with other master’s degrees).

<u>Category #2: Skills Development (91% of responses)</u>
Consistent with the RFI prompts, many of the responses focused on skills. Figure 3 shows the frequency with which major skills categories were described.

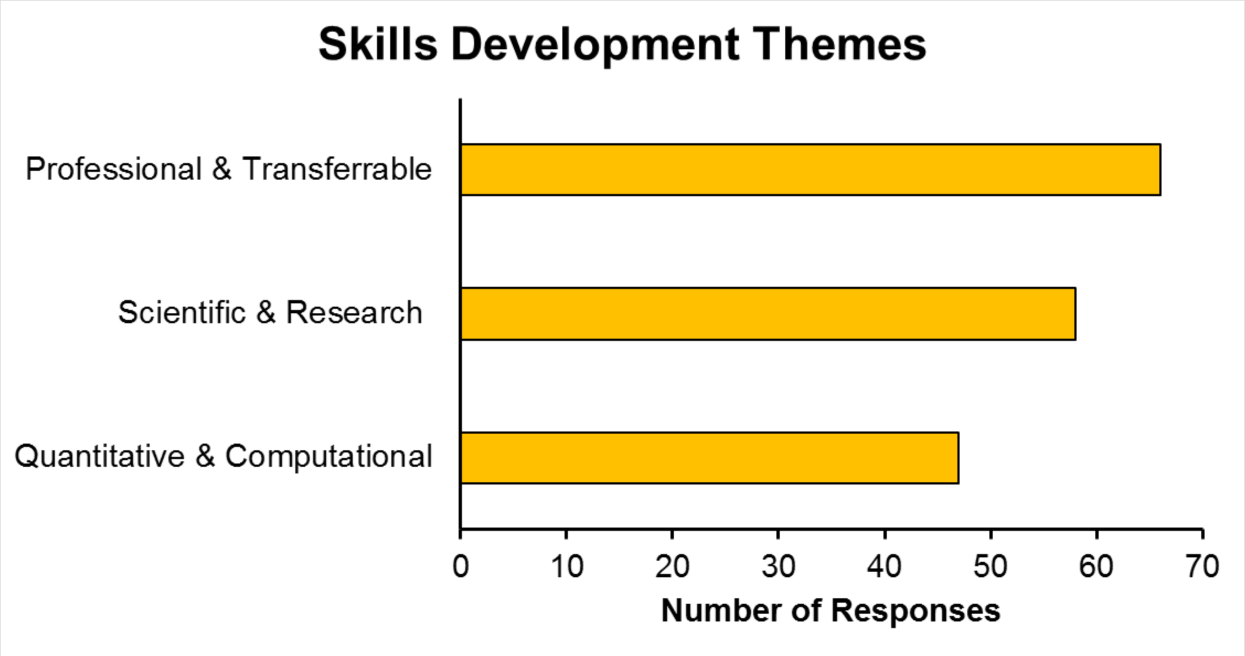

Figure 3: *Skills Development Themes in Biomedical Graduate Education RFI Responses.* *Bar chart showing the number of RFI responses in which each theme that was part of the skills development category was represented. A total of 90 unique responses were received for the RFI.*

There was broad agreement that **professional and transferrable skills** (e.g., communication, teamwork, time management) are important to learn no matter what career path a trainee pursues. In response to a prompt asking the key skills graduate students should develop to become outstanding biomedical research scientists, one respondent wrote,

> "Communication. Time management. Quality writing. These are all skills that will be crucial to long-term graduate student success, whether they stay in the academy or seek out private industry careers."

Another response noted that within interdisciplinary research teams, there is "increasing value on effective communication, interpersonal skills, and time management" and that "intentional training in these skills can enhance the effectiveness of scientists across disciplines and career paths."

Many responses also emphasized the importance of ensuring that trainees continue to develop strong **scientific and research skills** (e.g., experimental design, critical thinking/analysis). As one response stated:

> "To become an independent scientist requires three essential skills – the ability to think critically and to write and speak effectively about science. I would argue that developing and honing these three skills in the context of research-based training remain at the heart of effective graduate education."

Many of the responses expressed the sentiment that the current system does a good job at developing these skills in trainees. In response to the prompt asking current strengths in graduate biomedical education, one respondent said, "Graduate training programs remain a cornerstone of developing rigorous thinking and the development/execution of scientific research projects," while another commented, "We are training students in bench skills, generating hypotheses, designing studies, and analyzing data, such that our trainees have much expertise in their field of study and are quite competent scientists."

Quantitative and computational skills (e.g., statistical analysis, manipulating large data sets, computer programming) were mentioned in over half of the responses. These responses were nearly uniform in indicating the need for "increased focus/training in quantitative/computational biology (rigorous data analysis, computational methods, bioinformatics, how to handle big data)" no matter one's discipline. At the same time, the responses indicated the need to integrate these new quantitative skills with a "good understanding of the underlying science of their system," so that that students can "ask good questions and…design a study that effectively addresses that question."

Category #3: Systemic Issues in the Research Enterprise (70% of responses)
Systemic issues within the research enterprise, and their impact on graduate education, were also mentioned in a majority of the responses. Figure 4 shows the relative frequency with which each theme in this category was represented in the responses.

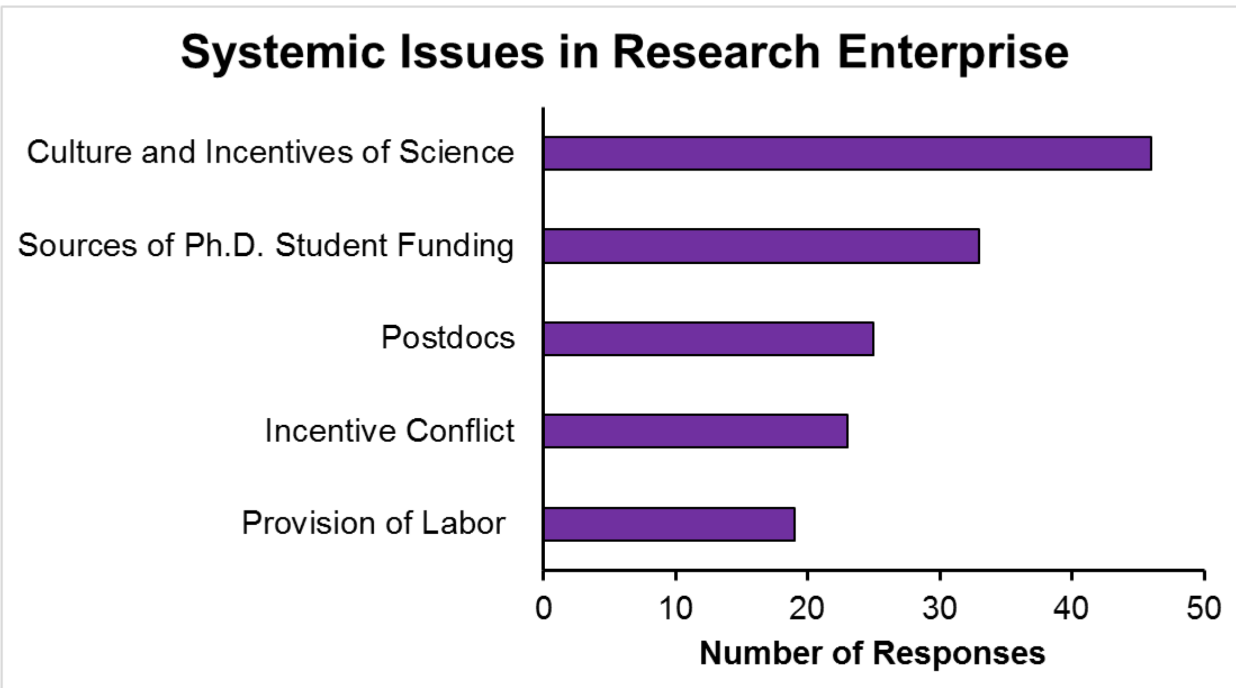

Figure 4: *Systemic Issues in Research Enterprise Themes in Biomedical Graduate Education RFI Responses**.** Bar chart showing the number of RFI responses in which each theme that was part of the systemic issues in the research enterprise category was represented. A total of 90 unique responses were received for the RFI.*

Specifically, the **culture and incentives of science** (i.e., what is or is perceived to be rewarded by NIH and academic institutions; n=46) and **incentive conflicts** (i.e., when the best interests of the faculty member and student are not totally aligned; n=23) were discussed in many of the responses. Quotes from three separate responses below describe this issue:

> “The training model for predoctoral students may present inherent conflict where the student is considered both a trainee and a worker. As a trainee, it is recognized that predoctoral students are still gaining experiences and competencies that are necessary for their development as independent scientists. A major part of this development is the creation of new knowledge and presenting this knowledge in the context of what is known. However, trainees are often tasked with producing a product that is required for the continued funding or advancement of the mentor. If handled incorrectly, this can result in a conflict between the time and resources required for training, be it in discipline content, communication skills, or in expertise not immediately linked to the project at hand, and the completion of a “work product” for the mentor…”

> “Predoctoral biomedical researchers have a recognized dual role as both trainees and employees (NIH NOT-OD-15-008) and in particular the National Institutes of Health have clarified the requirement to “support the development of skills critical to pursue careers as independent investigators or other related careers”. In practice, training is a secondary priority to bench science: bench science productivity is incentivized by rewarding data generation with publications and grants, essential currencies in the research enterprise. Training outcomes, however, are not highly valued in graduate biomedical research except in the production of a dissertation (itself possibly a collection of publications).”

> “Our junior faculty in particular are under tremendous pressure to publish and bring in funding, and they rely heavily on their doctoral students to help them meet expectations. Sometimes the focus on research can get in the way of their support for the student's full educational experience. Anything NIGMS can do to relieve the pressure on junior faculty and support them in developing their research careers will therefore also improve the educational experience of their doctoral students. The most prominent example of the tension between faculty pressures and student educational needs is the reluctance of advisors to support their students in professional development opportunities that broaden their skills and perspectives.”

In addition to issues around incentives, responses also described how the **sources of Ph.D. student funding** (i.e., training grant or individual fellowship versus support on an investigator’s research grants) impact student experiences. Particularly, the comments indicated that when students are supported by an investigator’s grant, their main role may be viewed as labor (coded under the **provision of labor** theme), which can in turn negatively impact their educational experience:

> “The major barrier to radically changing the traditional graduate education model is the ownership that individual faculty advisors have over trainees. Faculty rely on PhD trainees to produce data, papers, etc. needed to secure more grant funding, obtain tenure for junior faculty, etc. To overcome this, trainees should not be “owned” by an individual faculty advisor, but rather they should have more autonomy and be aligned only within a department or within a college or the graduate school. Trainees would obviously need to work within an individual lab to complete their dissertation work, but that lab PI should not see them as their own “employee.” Creating more autonomy would give trainees more freedom to look after themselves in preparing for whatever career they want to pursue.”

Although not part of the RFI prompts, 25 responses referenced **postdoctoral scientists** (postdocs). Most these responses pointed to the fact that many of the systemic issues that impact graduate students also address postdocs (with the phrase “students and postdocs” used in many of these responses).

Category #4: Careers (60% of responses)
Career development also featured prominently in the responses, as shown in Figure 5.

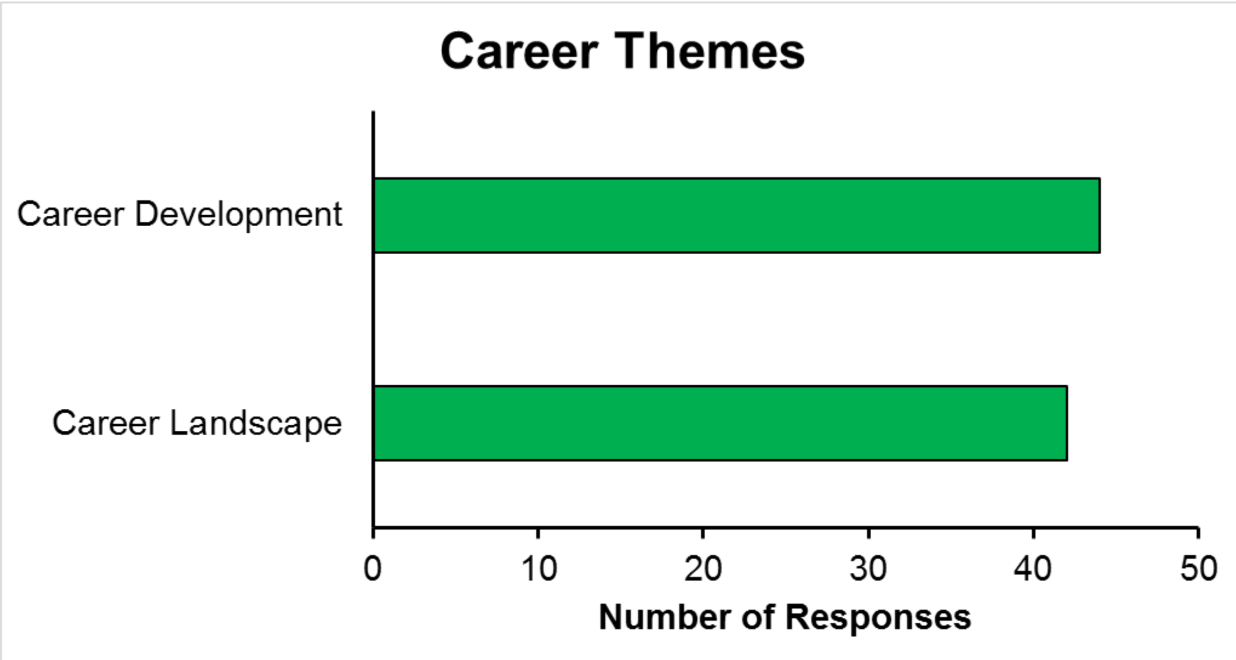

Figure 5: *Career-Related Themes in Biomedical Graduate Education RFI Responses. Bar chart showing the number of RFI responses in which each theme that was part of the career related issues was represented. A total of 90 unique responses were received for the RFI.*

Specifically, the responses described the need for enhanced **career development,** especially the current **career landscape** in which very few trainees attain faculty careers. While most trainees go on to have careers outside of the professoriate, the responses expressed the sentiment that, “graduate school is really not effective preparation for jobs beyond academia,” and that the current system “fails to meet the needs of trainees who are not likely to pursue an academic career.” Multiple responses indicated that “it is still largely taboo to openly prepare for careers outside of the academic track,” and that “many faculty [members] don't know how to advise students to be anything else but PIs.” Responses did concede there has been some movement in the direction of career development (noting the NIH Broadening Experiences in Science Training (BEST) program), but pointed out much more can be done:

> “Although important measures have been taken to prepare students for careers outside the academic track, more must be done. There must be time made available for potential internships and exposure to industry, consulting, data science, science writing, policy, etc. so that students will have the requisite experience in nonacademic fields to be competitive.”

Category #5: Administrative and Review (34% of responses)
Figure 6 shows major administrative and review-related issues present in the RFI responses.

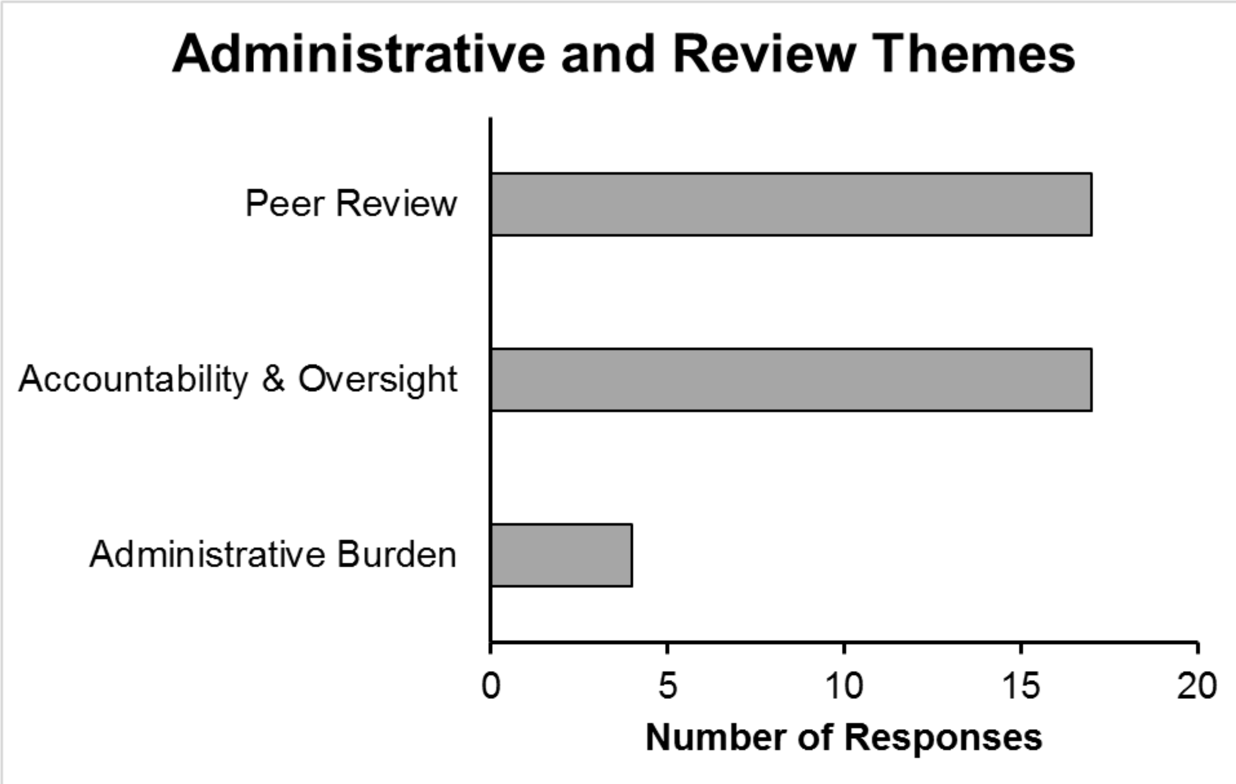

Figure 6: *<u>Administrative and Review-Related Themes in Graduate Education RFI Responses</u>.* *Bar chart showing the number of RFI responses in which each theme that was part of the administrative and review category was represented. A total of 90 unique, responses were received for the RFI.*

Peer review of training grants was discussed in 17 responses. For example, respondents encouraged NIGMS and other institutes to use a broader suite of metrics when determining what constitutes successful training:

> "T32 training programs use the number of first-author student papers, time to degree, and whether students go on to academic careers as metrics of success, making it challenging to shift a culture toward embracing broader career options for students or creating additional courses or activities that would support student professional development. *We strongly encourage NIGMS to look into the issue of what constitutes success of training as measured by peer review of T32 renewal applications."* (emphasis original)

> "[Professional society] supports holistic review of training programs as related to their impact on trainees, institutions, and society, and educating reviewers to define success more broadly than pursuing an academic research career. During evaluation of grant applications, training programs should not be criticized for participation or utilization in institutional training efforts. Rather, programs should be encouraged to partner with existing opportunities on their own campuses. Reviewers should also allow for some variance in time to degree in review of T32s (as noted above, training should be based on competencies, not based on time). [Professional society] also urges NIGMS incorporate the expectation that institutions have a built-in evaluation and dissemination

> plan within the T32 application, to ensure that best practices and outcomes are widely and rigorously shared with the community."

Beyond the criteria for review, responses also suggested enhancing the diversity of the reviewers themselves. A group of university leaders noted that "training grant study sections…are largely populated with people who have spent their lives in universities," and they urged "NIH to include a significant number of PhD scientists and engineers from industry, government laboratories, and nonprofits on the panels that provide critique and rating for training grants, in order to incorporate reality-grounded feedback on how to broaden career perspectives effectively."

Accountability and oversight was also discussed in several responses. Students wrote about the need for university oversight to ensure faculty members' relationships with their trainees remain professional and promote students'/trainees' development:

> "There is essentially no accountability when a PI is abusive or highly inappropriate, and going to the administration or causing problems at HR would ONLY serve to make a student's life even worse while not correcting the situation."

> "My graduate program…did not have any oversight for students…My advisor often just wanted me to do work that was totally unrelated to my thesis. There needs to be some kind of system in every graduate program that keeps abusive (or maybe inexperienced -- my advisor had like 2 trainees before me) advisors in check."

These responses included the need for more uniform standards both across and within programs in a manner that allows flexibility, but also enhances quality of training for all students:

> Graduate biomedical education differs when compared to many fields in that there is essentially no regulation other than agencies involved in general program accreditation. As such, no uniform competencies are required for students in biomedical research fields. While regulation might add considerable burden for programs and program administrators, experience in other graduate level training programs (e.g., the MD degree) indicates that regulations can lead to greater rigor, higher and more uniform standards, and greater institutional resources devoted to achieving those standards. Imagine the world of hospital administration, patient care, residency or medical student education without standards.

Finally, these responses also indicated the need for programs to widely disseminate the outcomes of training investments. In response to the prompt asking about potential approaches that would ensure that trainees have the skills and knowledge needed to enter the biomedical research workforce, one respondent wrote:

> "Track comprehensive, up-to-date metrics on graduate programs (e.g. graduation rate, duration of program, job placement rate and fields). Make this data broadly available and easily visualized. As scientists, we should know that before everything, we must have data. With observations, patterns may manifest themselves and we can measure impact of interventions."

The issue of **administrative burden** was mentioned in only four responses.

Innovative Ideas
In addition to these categories, the analysis team looked for comments that proposed innovative ideas that have not been raised during NIGMS' earlier efforts to obtain input. For example, one respondent suggested adding experimental aims to the T32 program to drive innovation:

> "Establishing a clear expectation that training programs fund the innovative development and implementation of approaches to address specific training challenges can recast T32's as experimental tools. Perhaps the inclusion of an experimental "aim" in T32s that applies a specific intervention against a training challenge, with an appropriate plan of assessment and refinement, should be accepted as a requirement for this granting mechanism. Overall, the use and acceptance of training grants and training grant supplements to drive innovation should be expanded."

Another respondent suggested that NIGMS give broader consideration "to who can serve as PI" of any new training programs, saying, "It should not be just R-level holding faculty. Career advisors should also be allowed to be PI," with the idea that doing so would allow programs to better build upon the BEST models.

Conclusion

NIGMS received a diverse set of responses to its Request for Information for strategies for modernizing biomedical graduate education. These responses covered institutional and training-related issues, skills development, systemic issues within the research enterprise, career development, and administrative/review issues. NIGMS recognizes that those who responded to the RFI are unlikely to represent a random subset of the entire stakeholder community impacted by graduate biomedical education. However, these responses provide insights regarding how members of the extramural community view the current challenges and opportunities in graduate biomedical education, and will inform NIGMS' ongoing efforts to catalyze its modernization.

Acknowledgement

Austin Oh, Christa Reynolds and Kris Willis contributed analysis to this report.

Graduate Education RFI Themes

Institutional and Training-Related Issues

1. Principal investigators (aka, advisors or mentors)
    - Definition: References the impact of PIs/advisors/mentors in student training.
2. Mentorship/advising
    - Definition: References to the advising or mentorship relationship (positive or negative).
3. Curriculum and classroom teaching
    - Definition: References to coursework (content and structure for delivery), and classroom teaching in graduate programs.
4. Resources
    - Definition: References to the physical (e.g., buildings, equipment, etc.) and financial (e.g., funding), and other resources (e.g., time) necessary to conduct biomedical research.
5. Diversity and inclusion
    - Definition: References to race/ethnicity or gender with respect to training environment or career development.
6. Institutional climate
    - Definition: the social, cultural aspects of a university training environment (either positive or negative). Includes mentions of student wellness/mental health.
7. Interdisciplinarity
    - Definition: References to training students to think across disciplines (either favorable or those encouraging greater focus within single disciplines).
8. Rigor and reproducibility
    - Definition: References to efforts to improve scientific rigor and reproducibility.
9. Team science
    - Definition: References to team science, and/or the need for scientists to be able to work successfully in multidisciplinary teams.
10. Translation
    a. Definition: References to the development or commercialization of basic research discoveries into therapies, products or approaches that directly impact the public (e.g., patients, public health).
11. Flexibility
    - Definition: References to the need for flexibility, personalization, tailoring, customization, etc., in Ph.D. programs that allow trainees to better meet their career and professional needs.
12. Time-to-degree
    - Definition: reference to the time it takes to complete a Ph.D. program.
13. Master's degrees
    - Definition: References to the role that master's degrees play in graduate education.
14. Stipend
    - Definition: References to the stipends Ph.D. students.
15. Dual degree
    - Definition: References to combined degree programs (e.g., M.D.-Ph.D., or other Ph.D. combined degrees).

Skills

16. Professional & transferrable skills
    - Definition: References to the skills (and the development of those skills) that are important in many professional settings such as communication, teamwork, management, finance, etc.
17. Scientific & research skills
    - Definition: References to the skills needed to be a capable research scientist such as experimental design, critical/analytic thinking, etc.
18. Quantitative & computational skills
    - Definition: References to quantitative skills and/or computational biology. Examples include computer programming, data science, statistical analysis, etc.

Systemic Issues

19. Culture and incentives of science
    - Definitions: References to broader issues and reward/incentive structures within biomedical science and academic institutions. For example, references to what is (or is perceived to be) rewarded by NIH and institutions.
20. Sources of Ph.D. student funding
    - Definition: References to the funding source of Ph.D. students (e.g., training grant and fellowships versus a PI's research grant). Also, includes discussion of restriction of NRSA awards to citizens.
21. Postdocs
    - Definition: References to postdoctoral scientists and their roles within the research enterprise.
22. Incentive conflict
    - Definition: References to the conflicting incentives for PIs/advisors and their trainees.
23. Provision of labor
    - Definition: refers to students and/or postdocs as a source of (cheap) labor for PIs; includes discussion of abuse, slavery or ownership, may overlap with discussion of conflicting incentives.

Careers

24. Career landscape
    - Definition: References the current career prospects for biomedical Ph.Ds. Often coupled with the fact that most Ph.Ds. do not go on to pursue faculty careers, or references to the number of Ph.Ds. trained relative to the number of faculty positions.
25. Career development
    - Definition: References to training Ph.D. students for a breadth of careers, including careers beyond academia (e.g., industry, "alternative careers," science writing, science policy, etc.). Also includes specific references to internships, or other work-based manners to gain career relevant skills during Ph.D. training.

Administrative and Review

26. Peer review
    - Definition: References to the peer review or training and research grants.

27. Accountability/oversight
    - Definition: References to (i) oversight by funding agencies of grantees, or of faculty members at universities, or (ii) accountability for grantees to follow through on the terms of their grants and disseminate their outcomes.
28. Administrative burden
    - Definition: References to the number of requirements for the administration of federal training grants.