Final Report of the CSR Advisory Council Working Group on Peer Review of NRSA Fellowship Applications

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Background

The NIH Center for Scientific Review has the mission of seeing that NIH grant applications receive expert, timely and fair scientific review, free of inappropriate influences, so that NIH can fund the most promising biomedical science. To that end, CSR is committed to ongoing evaluation of the peer review process and to making changes as needed to improve the effectiveness and fairness of review.

CSR reviews over 80% of the National Research Service Award (NRSA) individual fellowship applications received by NIH. Each year, CSR reviews thousands of applications—and hears the feedback and concerns that those reviews generate. CSR has heard concerns about the fairness and effectiveness of fellowship reviews, and, in response, the CSR Director convened an Advisory Council Working Group (WG) in 2021 to evaluate the fellowship reviews and, if warranted, to make recommendations for change. **The charge to the group was to evaluate NIH peer review of NRSA fellowship applications and make recommendations for change to make that process as effective and fair as possible for all.**

WG members were selected to provide a diversity of views and perspectives. Two current council members were asked to serve, Elizabeth Villa and Narasimhan Rajaram. Each has a strong interest in training and a strong commitment to diversity. Dr. Villa was asked to serve as chair. The WG included three current CSR staff members- Bruce Reed, the Deputy Director, Lystranne Maynard Smith and Cibu Thomas, who are experienced scientific review officers (SRO) running fellowship panels. Additional NIH representation was provided by Erica Boone who is the Director of the NIH Office of Biomedical Workforce Diversity and Allison Gammie of the NIGMS Division of Training, Workforce Development and Diversity. In addition, seven external scientists were invited to serve. Each had been highly recommended by SROs who knew them as reviewers for fellowship applications. Collectively they span a range of career stages, types of institutions, geography and are demographically diverse. Each has experience in the submission of fellowship applications, as well as its review. The WG roster is in Appendix 6.

Process: The WG first met on 9/20/21. Over the next year it met virtually a dozen times and interacted additionally online to share ideas, craft recommendations, and draft this report. An early action of the WG was a set of requests for data and data analyses; CSR compiled the data and issued to the WG findings regarding patterns of NRSA fellowship review and review outcomes. From the Office of Extramural Research (OER) and Office of the General Counsel (OGC), the committee obtained important background regarding the basis for current review criteria in statute and policy. On 1/6/22, members of the WG published a guest blog as part the CSR's "Review Matters" series inviting comments from the public regarding fellowship review. That blog was cross posted on OER's "Open Mike" blog. Analysts from CSR completed a content analysis of the comments received and provided this to the WG. On March 28, 2022, the co-chairs presented an interim report of recommendations to CSR's Advisory Council. The interim report identified major findings and concerns of the working group and outlined a framework that the group was using to develop recommendations. Council was supportive of the direction of the working group and requested that a final version of recommendations be brought to the September council meeting. Subsequently Dr. Reed presented the interim report to multiple NIH-wide stakeholder groups, including the Review Policy Committee, Program Leadership Committee, and Training Advisory Committee. Feedback was obtained from each group and was given to the WG for consideration.

NRSA Fellowship program

The NIH Ruth L. Kirschstein National Research Service Award (NRSA) is intended to help develop the next generation of research scientists, who are diverse in backgrounds and highly trained in appropriate scientific disciplines to address the Nation's biomedical, behavioral, and clinical research needs. The fellowships support trainees at the pre-doctoral and post-doctoral levels of education and are designed to train individuals to conduct research and to prepare for research careers. More information about NRSA programs can be found at the NIH Research Training website.

Statutory basis for peer review criteria used for fellowship applications

When considering changes to review criteria it is important to understand the basis for current criteria in statute and policy. The criteria for the review of NRSA fellowship applications derive from the NRSA regulation at 42 CFR 66. Section 66.106 states:

> *(a)Within the limits of funds available, the Secretary shall make Awards to those applicants:*
>
> *(1) Who have satisfied the requirements of §66.105; and (2) Whose proposed research or training would, in the judgment of the Secretary, best promote the purposes of section 487(a)(1)(A) of the Act, taking into consideration among other pertinent factors:*
>
> *(i) The scientific, technical, or educational merit of the particular proposal;*
> *(ii) The availability of resources and facilities to carry it out;*
> *(iii) The qualifications and experience of the applicant; and*
> *(iv) The need for personnel in the subject area of the proposed research or training.*

Subsection 487(a)(1)(A) of the Public Health Service Act states:

> ***(a) Biomedical and behavioral research and research training; programs and institutions included; restriction; special consideration***
>
> *(1) The Secretary shall-*
> *(A) provide Ruth L. Kirschstein National Research Service Awards for-*
> *(i) biomedical and behavioral research at the National Institutes of Health in matters relating to the cause, diagnosis, prevention, and treatment of the diseases or other health problems to which the activities of the National Institutes of Health and Administration are directed;*
> *(ii) training at the National Institutes of Health and at the Administration 1 of individuals to undertake such research;*
> *(iii) biomedical and behavioral research and health services research (including research in primary medical care) at public and nonprofit private entities; and*
> *(iv) pre-doctoral and post-doctoral training at public and private institutions of individuals to undertake biomedical and behavioral research;*

NIH has the authority to interpret the statutes as part of their responsibility for implementing them. The present peer review fellowship criteria are NIH's interpretation of this regulatory and statutory language. There are five criteria that reviewers are to use in evaluating the scientific and educational merit of each application:

1. **Fellowship Applicant**
2. **Sponsors, Collaborators, and Consultants**
3. **Research Training Plan**
4. **Training Potential**
5. **Institutional Environment & Commitment to Training**

Each criterion is further defined by brief definitional statements (see Appendix 5). NIH also requires an **overall impact score,** intended to "reflect [each panel member's] assessment of the likelihood that the fellowship will enhance the candidate's potential for, and commitment to, a productive independent scientific research career in a health-related field, in consideration of the scored and additional review criteria."

There are "Additional Review Criteria", listed below, which follow from other legal and policy considerations, consistent with the ability to take into consideration "other pertinent factors" under the NRSA regulation.

- Protections for Human Subjects
- Inclusion of Women, Minorities, and Individuals Across the Lifespan
- Vertebrate Animals
- Biohazards
- Resubmissions

NIH may modify the existing criteria (e.g., rename the criteria, re-define criteria, or add or subtract criteria) as matters of policy, so long as those modifications are a reasonable interpretation of the 4 factors codified in the regulation, and so long as the interpretation is not prohibited by law. NIH may also change the scoring of criteria by policy because scoring is a matter of policy. Currently the criteria are scored using the same 1-9 integer scoring system used for research project grant (RPG) applications.

Fellowship application materials

Guidance for preparing an NIH NRSA fellowship application are contained in the publication linked here. The most pertinent section of the application for present purposes is the PHS Fellowship Supplemental which is presented in condensed form in Appendix 4. These materials are the primary source of information used by reviewers in evaluating the applications.

Key Findings of the Working Group

Analysis of comments in response to blog

CSR performed a content analysis of comments from the external community received in response to a Review Matters blog published by CSR soliciting feedback for strengthening the review of fellowship applications. CSR received approximately 110 comments from the Review Matters blog post, the Open Mike blog reposting, as well as additional comments emailed directly to CSR. Commentors included applicants, mentors/sponsors, reviewers as well as group responses from various societies and organizations. Societies and organizations that provided feedback include the American Society for Biochemistry and Molecular Biology, the Cold Spring Harbor Laboratory, and the Federation of American

Societies for Experimental Biology. Below we summarize the prominent themes found in the content analysis.

Concerns about bias

- Overall, respondents felt that institutional bias towards large universities with ample resources perpetuated the idea that the rich get richer, and the poor get poorer in NIH funding.
- Many respondents said that the current review process for fellowships deeply biases awards to senior mentors/sponsors and extremely well-funded labs.
- Multiple respondents voiced concern that there is bias against junior faculty mentors as well as faculty who are women or from under-represented groups – often these groups are criticized for not having enough “experience" in an area, despite evidence to the contrary.
- Concerns were noted about positive bias benefitting senior faculty.
- Some respondents argued that the actual benefit of a "senior" mentor is minimal compared to the mentorship they receive from a junior faculty mentor. Some junior faculty are more involved and supportive than larger labs with more significant track records.
- Senior mentors may be supported on the basis of reputation or track record alone and use the awards as budget relief rather than focusing on the training.

Concerns about the criteria/information by which applicants are evaluated

- There was strong consensus among the external scientific community that the requirement for undergraduate grades should be eliminated from the application process. Multiple respondents noted that requiring undergraduate grades could potentially pose a disadvantage to applicants from diverse and disadvantaged backgrounds.
- Several respondents noted that the emphasis on candidate publications should be de-emphasized, and applicants should not be critiqued for the lack of publications. It was noted that publication life cycles vary by scientific fields and having an unspoken requirement for publications can cause bias against entire fields.
- Some argued that review criteria should also account for non-linear career paths and trainees wanting to enter fields other than academia post-graduation.
- It was suggested that reviewers should put more emphasis on the alignment between an applicant’s training goals and their sponsor’s training plan. Reviewers should also focus on if the sponsor has demonstrated a commitment to the applicant’s training.

Comments regarding the need for enhanced training across multiple review stakeholders

- Reviewers need to be trained to provide constructive feedback to trainees and not just harsh comments.
- Many respondents noted that guidelines need to be more clearly defined for the applicants. Current guidelines may disadvantage applicants who have less access to successful applications and faculty mentoring, with potential implications for underrepresented minorities.
- Reviewers should be trained so that fellowship reviewers are not assessing trainee research plans as they would evaluate an R01.

Concerns about application/review burden

- Many respondents found the overall application to be too long and cumbersome, saying that it places undue burden on the applicants as well as the review panel.
- Several commented that the information that reviewers need to assess an application is hard to find, poorly organized and includes documents that they do not require to score an application.
- Other respondents argued that shortening the application would help eliminate sections that feel redundant and would make the applications seem less "boilerplate" – criticisms of boilerplate language about the training environment were viewed as disincentivizing trainees.
- Respondents suggested that the fellowship application instructions be revised with the goal of providing specific documents that speak to the review criteria.

Additional Suggestions

- Mandate the bias awareness training module for all CSR reviewers, chairs, and SROs.
- Explore creating a separate bias awareness training module specifically for fellowship review.
- Many respondents also noted a need for CSR to diversify its panels in career stages and the schools from which reviewers hail (larges schools vs. small schools) – this also ensures that applicants from schools with less resources have a competitive chance of being funded.

Data regarding the review of fellowship applications

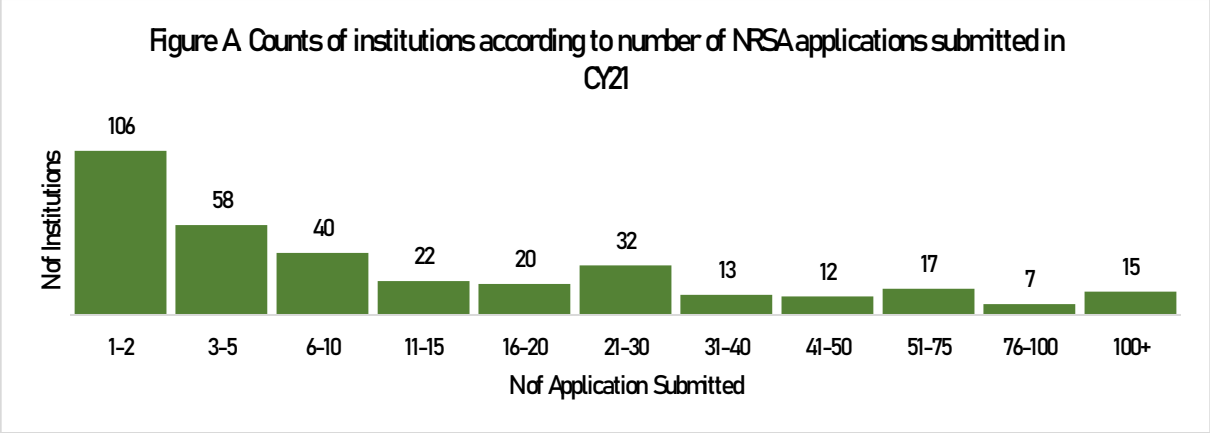
An early action of the CSRAC working group on the review of fellowship applications was to request review data. Data on fellowship applications for council year 2021 (CY21) including information on applications, applicants, institutions, MSI indicators, FOAs, and review outcomes were pulled from QVR. The WG requested a series of analyses regarding who submits NRSA fellowship applications and review outcomes in relationship to applicant and sponsor characteristics. In CY21 a total of 6,676 fellowship applications were submitted and reviewed at NIH. Approximately 27.2% of those were resubmissions while the rest were first submissions (Table 1).

Table 1. Type of Fellowship Applications that were reviewed by NIH in CY21

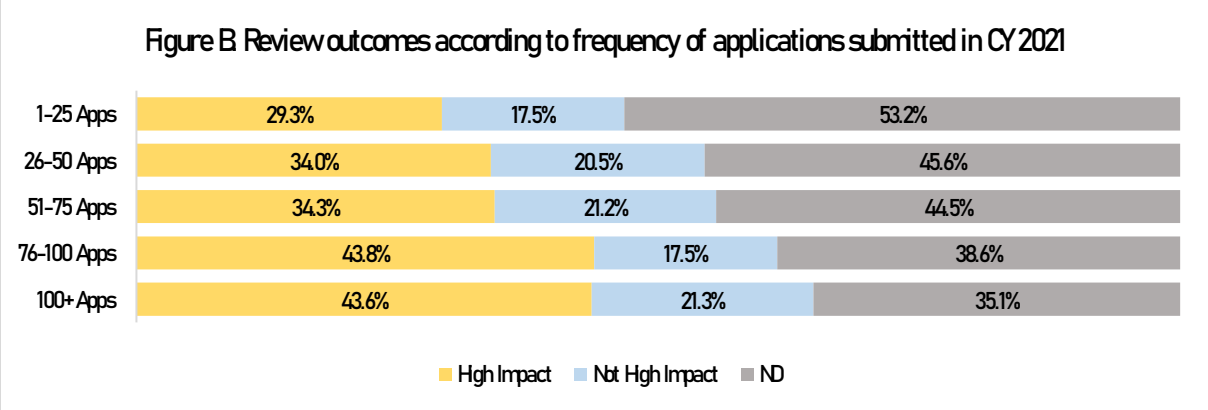
	Council Rounds			
F Type	1/2021	5/2021	10/2021	Grand Total
F30	222	262	281	765 (11.5%)
F31	1311	1453	1277	4041 (60.5%)
F32	621	715	534	1870 (28.0%)
Total	**2154**	**2430**	**2092**	**6676**
Resubmission				
No	1632	1786	1440	4860 (72.8%)
Yes	522	644	652	1818 (27.2%)
Total	**2154**	**2431**	**2093**	**6676**

Applicant organizations

Applications are highly concentrated in a small number of institutions. Fifteen institutions submitted over 100 applications each, accounting for 28.8% of all applications, while 106 institutions submitted only one or two applications (Figure A). Out of the 15 institutions that submitted over 100 applications each, 12 receive over $500M/year in NIH funding. NIH reviewed fellowship applications from a total 342 institutions, including 37 minority-serving institutions (MSI). There were 504 applications from MSIs (7.5% of all applications).

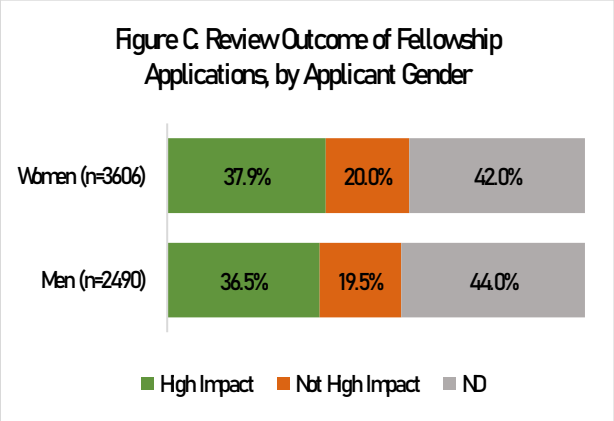


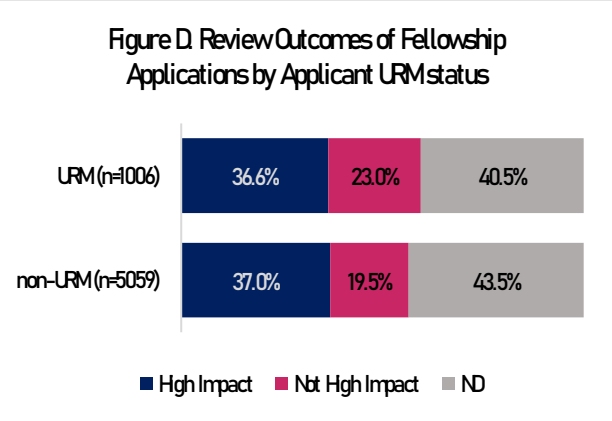
Applications from institutions that submitted more fellowship applications in CY 2021 were more often discussed and scored in the high impact range compared to those from institutions that submitted a lower number of fellowship applications.

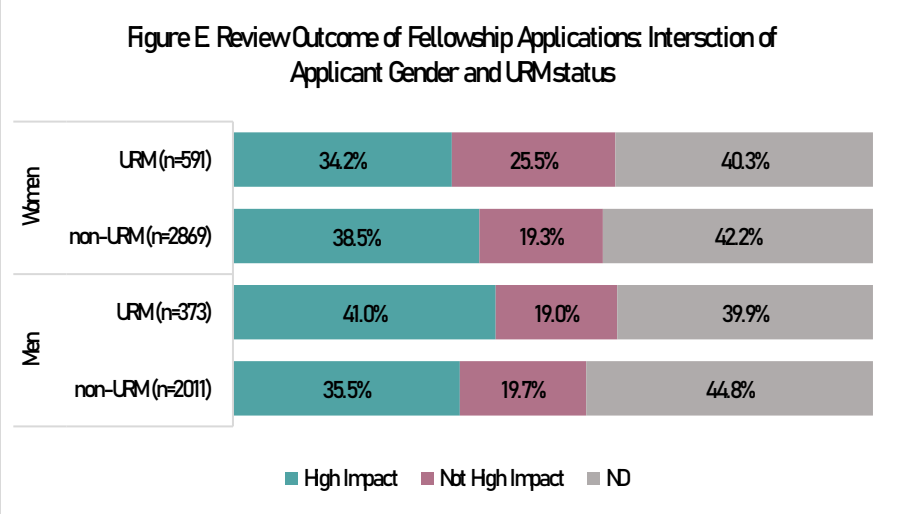


Applicant characteristics

Applicant gender distribution was 54% women, 37% men, and 9% not stated. About 15% came from under-represented minority (URM[1]) applicants. Review outcomes were similar for men and women and for URM compared to non-URM applicants overall. However, applications from URM women received high impact scores less often than others, even though they were discussed with comparable frequency.





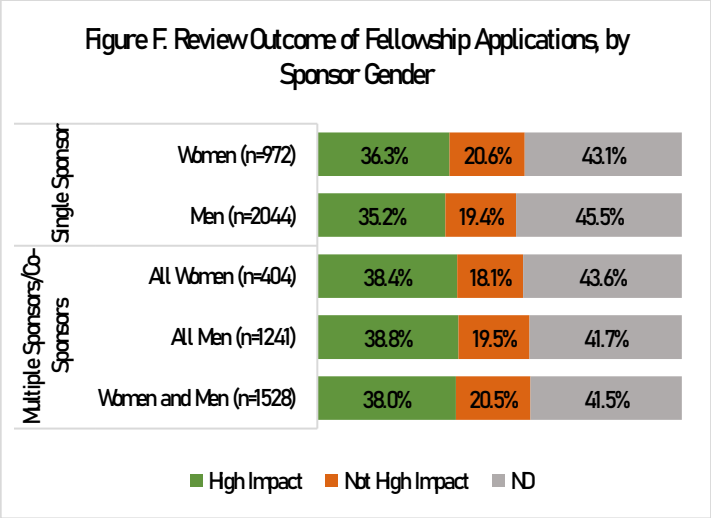


[1] Underrepresented racial and ethnic groups: Blacks or African Americans, Hispanics or Latinos, American Indians or Alaskan Natives, and Native Hawaiians and other Pacific Islanders. (Source: https://grants.nih.gov/grants/glossary.htm)

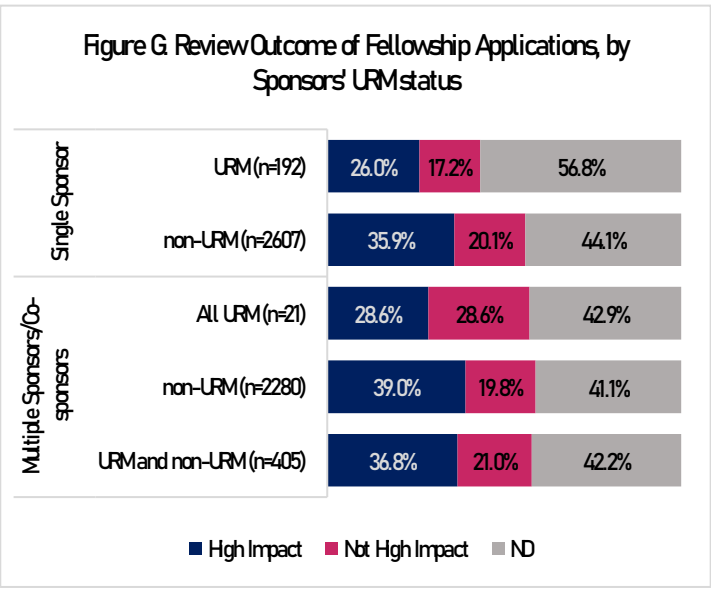
Sponsor characteristics

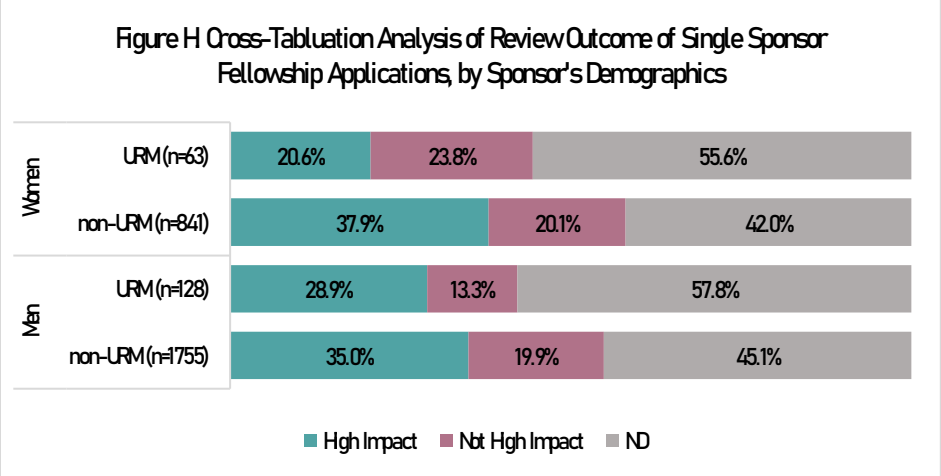
Most applications (54%) have multiple sponsors. Applications were sorted by single sponsor vs. multiple sponsors/co-sponsors, and review outcomes were examined in relation to sponsor or sponsor team demographics. The effect of sponsor academic rank was also examined.

The proportion of applications scored as high impact were virtually identical for sponsors regardless of gender, including women only, men only, all women, all men and mixed-gender sponsor teams.

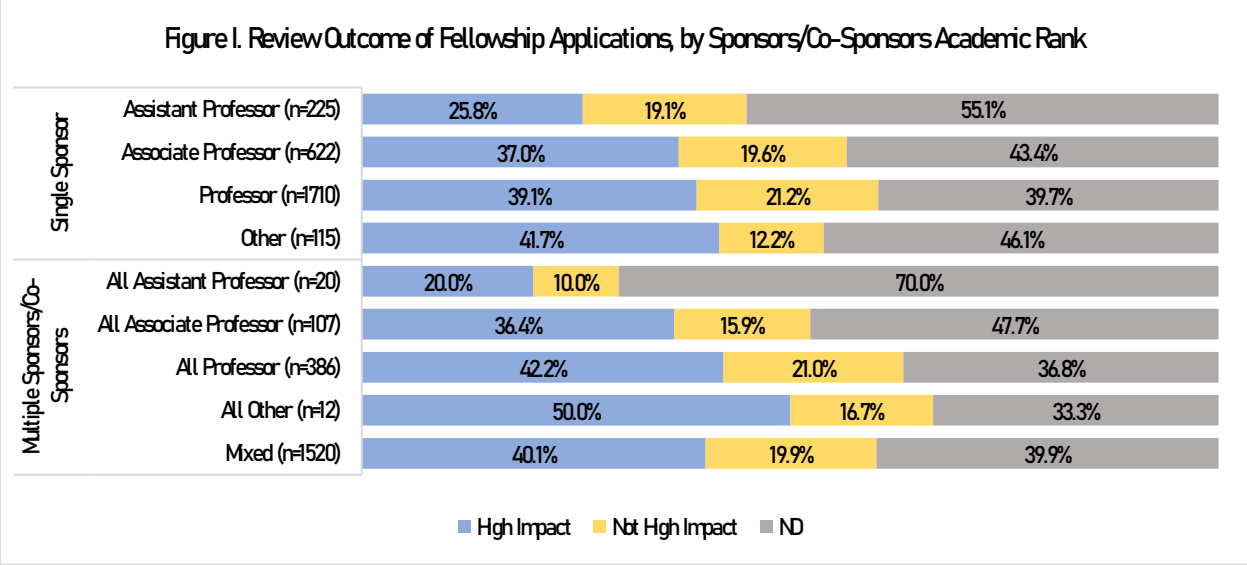


Single-sponsor URM applications were discussed less often and were less frequently scored in the high-impact range compared to other single-sponsor applications. Multi-sponsor applications, where all sponsors were URMs had a lower rate of high impact scores than other multi-sponsor applications. Single-sponsor applications with URM women sponsors fared notably worse than others.





Review outcomes steadily improve as the academic rank of the sponsors rises. Rates of discussed applications and high impact scores are higher for professors than associate professors, and higher for associate than assistant professors. Review outcomes for multi-sponsor all assistant professor applications are particularly poor (Figure I).



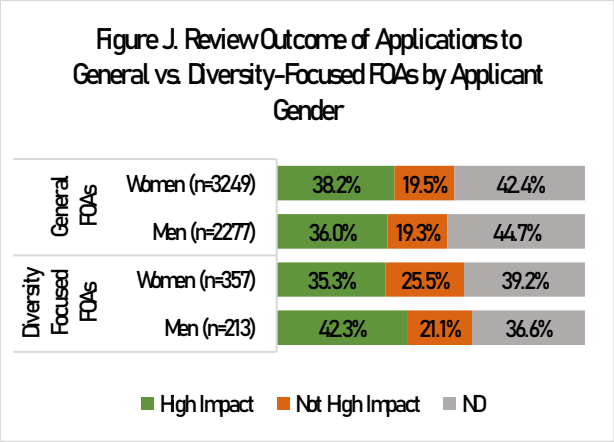
Review Outcomes of General vs. Diversity-Focused FOAs

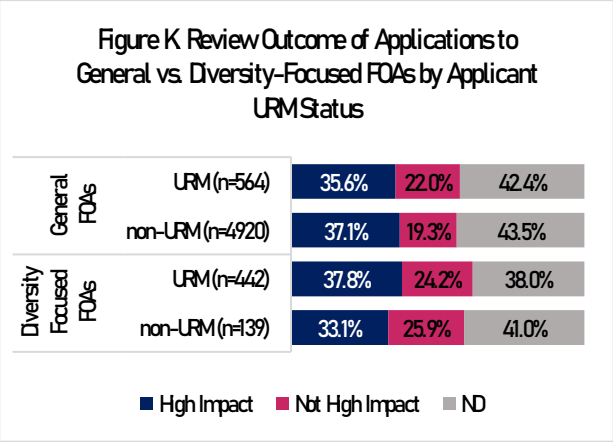
All fellowship applications were sorted according to whether they were received under diversity-focused funding opportunity announcements (FOA) or general fellowship FOAs. Diversity-focused FOAs are solicitations to improve the diversity of the research workforce by recruiting and supporting students, post-doctorates and eligible investigators from groups that have been shown to be underrepresented in health-related research, including people with disabilities, people from disadvantaged backgrounds and underrepresented racial and ethnic groups.[2] Approximately 9.3% of the fellowship applications in the sample were received in response to diversity-focused FOAs (Table 2). Then the review outcomes of these applications were analyzed in relation to demographic data of applicants, sponsors, and co-sponsors.

Table 2. Distribution of applications to general vs. diversity focused FOAs

Type of Mechanisms	N (%)
Non-Diversity	6057 (90.7%)
Diversity	619 (9.3%)
Grand Total	**6676**

Figure J and K show review outcomes of general vs. diversity-focused FOAs by applicant's gender and URM status, respectively. In general, applications to diversity-focused FOAs were discussed at a slightly higher rate than were general applications. Applications to diversity-focused FAOs from URMs had review outcomes similar to that for general applications from URMs.





[2] Source: https://grants.nih.gov/grants/guide/pa-files/PA-21-052.html

Summary and Conclusions

Concerns that the competition for NRSA fellowship awards is played on an uneven pitch led CSR to ask this advisory council WG to evaluate peer review of fellowship applications. The information developed by the WG helped focus those concerns. The WG, demographically diverse and representing different types of academic institutions and different career stages, shared a common, central concern that NIH was potentially leaving out highly-promising young scientists because of a process that too heavily favored elite institutions, senior, well-known scientist sponsors, and an overly narrow emphasis on traditional markers of early academic success. Comments from external stakeholders reinforced this perception. They added concerns about reviewer bias (reputational and other), emphasized the idea that junior sponsors are disadvantaged, and raised concerns about the fellowship application itself, noting that some information was of questionable value, that sections were redundant and not always well connected to review criteria. Although silent on their origins, data from the review of over 6,000 fellowship applications did reveal disparities in review outcome linked to institutional, applicant, and sponsor characteristics. Fellowship applications are concentrated in a small number of institutions, applications from those (highly resourced) schools do better, and applications from senior scientists do better than those from those in earlier career stages. The data did not show differential outcomes according to applicant gender, or whether applicants were from an under-represented minority group. However, various factors intersect to raise concerns regarding URM scientists; MSIs submit relatively few applications, applications with URM sponsors do worse than others, and URM women applicants fare less well.

The WG concludes that substantial changes are needed. The WG recommends changes in multiple aspects of the peer review process; in the criteria, the application, in reviewer training, and in outreach/resources for applicants. By implementing these changes NIH can improve the chances that the most promising applicants, no matter who they are or where they are based, will be consistently identified by peer review.

Recommendations

The WG makes two major recommendations to restructure the review of NRSA fellowship applications. Recommendation 1 is to substantially revise review criteria; Recommendation 2 proposes substantial modifications to the components of the PHS 424 that are specific to NRSAs. These two recommendations are interrelated. The WG believes that changes to both the judgments that reviewers are asked to make (criteria) and to the information that they are given on which to base those judgments (the application) are needed if review is to be improved. The working group makes two additional recommendations that are aimed at further improving the fairness of review. Recommendation 3 concerns outreach and training, Recommendation 4 pertains to the make-up of review panels, and Recommendation 5 concerns partially blinded review.

Finally, the working group makes two "suggestions". These are put forward as suggestions because they do not directly pertain to review, and thus are out of scope. However, they were creative ideas proposed to address some of the concerns the group recognized, and the working group would like to forward them for wider consideration.

This set of recommendations is a starting point for broader discussion with stakeholders. The WG recognizes that additional consultation and input from multiple stakeholders, including the Office of Extramural Research, Office of the General Council, NIH institutes and centers, and other NIH advisory and policy bodies is necessary to ensure the recommended changes have wide understanding and support, are well integrated with NIH policies and practices, and will have their intended effects.

Recommendation 1. Revise the criteria used to evaluate fellowship applications

1.1 Simplify the review criteria

In the opinion of the WG, the three major considerations that should determine evaluations of fellowship applications are the qualifications and potential of the applicant, the strength of the proposed science, and the quality of the training plan. It is critical that reviewers clearly focus on those three factors when forming an overall judgment of the scientific and educational merit of the application. Thus, instead of the five current criteria, the WG recommends only three: I) Scientific potential, fellowship goals, and preparedness of the applicant, II) Science and scientific resources, III) Training plan and training resources.

1.2 Eliminate two current criteria: "Sponsors, collaborators and consultants" and "Institutional environment and commitment to training"

This change is intended to reduce bias in review by reducing inappropriate consideration of sponsor and institutional reputation. The sponsor is critical to the success of the fellowship--as an important scientific resource and a central training resource. Similarly, the institution provides important scientific and training resources. However, as distinct criteria, these two criteria invite overly broad, reputational evaluations that gloss over substantive strengths or weaknesses of their contributions. Elite institutions and well known scientists often have wonderful resources to provide trainees. However, that is not necessarily the case and cannot be assumed based on reputation alone. Conversely, lesser known scientists may have wonderful resources and dismissing them based on reputation is harmful. Removing

Sponsor as a distinct criterion pushes reviewers to evaluate specifically what the sponsor (and institution) brings to the proposed science and training plan. Rather than have reviewers rate sponsor and institution as distinct factors, the WG proposes that reviewers evaluate their contributions to the science and to the training plan. Asking reviewers to evaluate specifically what the sponsor brings to the proposed science and training plan gives lesser-known sponsors a chance to present a strong substantive case.

1.3 Eliminate peer review of financial support for the proposed research

The WG viewed the source of support for the proposed fellowship as irrelevant to judging its merit. Because NIH funding is easily documented and a de facto requirement in fellowship applications, the requirement that peer review evaluate financial support for the proposed research has the unintended consequence of favoring big, well-established labs that can reference multiple NIH awards as sources of support. Having adequate financial support is, of course, important for assuring that the fellowship can be completed as planned. However, NIH could require that assurance as an administrative matter prior to funding. Program is better suited to careful evaluation of dynamic funding situations and can do a more thorough and timely assessment of the smaller number of applications that go forward for likely funding. Thus, the WG recommendation is that this be made a “just in time” item and be removed from the peer review criteria.

1.4 Recommended criteria for the review of NRSA fellowship applications

Overall impact score: Score the overall scientific and educational merit of the proposal. Use the three review criteria defined below to judge how much the fellowship will enhance the biomedical research capabilities of the applicant and increase the likelihood they will become a productive research scientist.

1) Scientific potential, fellowship goals, and preparedness of the applicant

- Evaluate the breadth and depth of scientific understanding the applicant conveys in their statements. To what extent does the candidate articulate the importance of their science and demonstrate an ability to study that problem in a rigorous scientific manner.
- Evaluate the preparedness of the applicant to undertake the proposed training and their capacity to benefit from the fellowship. Evaluate their accomplishments in the context of their stage of training and the scientific opportunities they have had.
- Evaluate the applicant's scientific potential. Consider their trajectory in the context of their opportunities. Also consider other factors that bear on their potential to succeed, such as determination, persistence, and creativity.

2) Science and scientific resources

- Evaluate the quality of the proposed science. Assess the depth of understanding of the scientific background and the scientific rigor and feasibility of the approach.
- Evaluate the extent to which needed technical, scientific, and clinical resources are specified and are realistically available to the applicant.
- Assess whether the scientific expertise of the mentorship team is appropriate for the proposed science and whether the role of each mentor is clearly defined.
- Evaluate how well the proposed scientific project serves the applicant's training goals.

3) Training plan and training resources

- Evaluate whether the applicant clearly defines their career goals and whether the training plan is linked to them.
- Evaluate whether the applicant has clearly defined areas of needed growth and/or weakness. These could include specific scientific skills and knowledge and other professional needs such as communication, teaching, and mentorship skills.
- Evaluate the training environment for this applicant. Assess whether the necessary institutional training resources are well-specified and available, specifically the practical availability of resources.
- Evaluate whether the trainee articulated a coherent and cohesive plan for interacting with sponsors and mentors.
- Assess whether the sponsor presents a strong pedagogical plan appropriate to the needs and goals of the applicant. Please include an evaluation of the training philosophy of the sponsor, their approach to training, time commitments and their accessibility.
- Evaluate and comment on what impact completion of the training plan will make in meeting the scientific development needs of the applicant and aid them in achieving their career goals.

Recommendation 2. Revise the Fellowship Supplemental Section of the PHS 424

Review outcomes are determined both by the judgements reviewers are asked to make—the criteria—and the information they are given—the application. Thus, review criteria and the application content should be aligned. Most of the information pertinent to fellowship review is contained in the PHS supplemental form (F.430, page 58). Many concerns voiced by the community involve elements of the application. The proposed revisions have two goals: 1) to provide reviewers information pertinent to the revised criteria, and 2) to allow under-represented and less advantaged applicants, who may have less traditional backgrounds, to highlight their qualifications and strengths alongside those who have excelled in well-established and highly-resourced settings. The goal of the WG was to allow the most promising applicants to shine, no matter where they started or what level of advantage they had experienced.

The Fellowship Supplement includes the following sections: Fellowship Applicant, Research Training Plan, Sponsor(s) Collaborator(s) and Consultant(s), Institutional Environment and Commitment to Training. The WG recommends substantial changes to the Fellowship Applicant and Sponsor/Collaborator/Consultant(s) sections. It recommends no changes to the Research Plan. A complaint from the community was that the applications are long and redundant. While not a primary driver of change, the WG did attempt to address those concerns. The proposed fellowship supplement would be modular, a series of questions each of which must be answered within a constrained space. For reference, an NIH application page is 800-900 words, a double-spaced manuscript page is around 250-300 words.

2.1 Recommended Applicant Section of the Fellowship Supplement

Applicants would be asked to submit 5 statements; a statement of professional and fellowship goals, one on fellowship qualifications, a self-assessment, a statement of scientific perspective, and a detailed account of activities planned under this award. **These are further defined as shown in Appendix 1.** The current 424 allows 6 NIH pages or ~4800 words. The proposed revision would total a maximum of 3350 words, or about 4 NIH pages. Applicants would be asked to include courses taken, but grades would not be required or allowed.

2.2 Recommended Sponsor and Co-sponsor Section of the Fellowship Supplement

Sponsors and Co-sponsors would be asked to submit 4 statements- one regarding previous fellows/trainees; another that is an account of the training plan, environment, and research facilities; a third explaining the number of fellows/trainees to be supervised during the fellowship; and one regarding the applicant's qualifications and potential for a research career. **The full text of the revision is in Appendix 2.** The current 424 allows 6 NIH pages or ~4800 words. The proposed revision would total a maximum of 4400 words.

2.3 Recommended Instructions for letters of support

Current instructions ask writers to, in 2 pages, "describe the qualities and potential of the fellowship applicant for the research training…" further requesting attention to research ability, scientific background, communication skills, perseverance, originality, and need for further training. The WG believes that the letters would be more helpful in differentiating candidates, and would be easier to evaluate, if they were more structured. They also thought that requiring structured letters would

discourage the use of generic letters of recommendation. **The recommended instructions are in Appendix 3.**

2.4 Recommended statement of special circumstances

A scientific society responding to the blog proposed that applicants have the option of submitting a statement of special circumstances in which they could address situations that might have hindered their progress such as harassment, the COVID-19 pandemic, or other personal or professional circumstances. While noting that there are complexities in implementing this idea, the working group endorses it. For example, it would allow applicants who had been forced to change labs because of harassment, to make reviewers aware of the situation. The working group felt steps should be taken to make certain this did not become an expectation for applicants. A companion proposal was to allow an institutional letter in support of the candidate's statement.

Recommendation 3. Improve NIH outreach and reviewer training

3.1 Outreach

The WG is concerned that the level of institutional knowledge and resources to support the writing of fellowship applications differs vastly between those schools that regularly submit many fellowship applications versus those which occasionally submit. It therefore recommends that NIH target its outreach to help address the imbalance. The group is cognizant of the fact that advice regarding writing applications more appropriately comes from program officials rather than review. However, the review process provides important background information to writing an application. The WG therefore recommends close collaboration between CSR and program officials at the ICs in creating resources and programs especially directed at potential applicants least likely to be well-informed about what makes for a competitive NRSA fellowship application. Resources could be greatly leveraged through the use of online workshops, which can serve multiple institutions at the same time without the need for the target trainees to attend national conferences. Creating and publicizing digital resources, demystifying the process of preparing applications and the review process is another approach. Samples of well-reviewed applications could be useful.

3.2 Reviewer Training

CSR should consider creating a version of its peer review bias awareness and mitigation training that specifically addresses issues of bias in fellowship review. In the absence of that, SRO training of reviewers should emphasize sticking to review criteria and apply the same standards regardless of institutional or sponsor reputation. In addition, greater efforts should be made to avoid hurtful or discouraging language in reviews.

Recommendation 4. Further Diversify Fellowship Review Panels

The same general guidance CSR applies to creating standing study section panels should also apply to fellowship panels. All panels should have appropriate subject matter expertise and be appropriately diverse across multiple dimensions. The WG recommends increased attention to the diversity of fellowship panels with respect to the career stage and institution.

Career Stage:

A well-balanced panel includes scientists across the career spectrum. While fellowship panels certainly benefit from the presence of established investigators with extensive mentoring and research track records, there is value in including early-stage investigators, who are likely to be highly motivated to have successful trainees and who are themselves closer in years to the training experience.

Recommendation: The fellowship review panel should reflect the full range of career stages, inclusive of assistant professors, associate professors, and professors.

Institutional diversity
NRSA fellowship grant applicants come from a diverse spectrum of institutions, including research-intensive institutions, research-active institutions, and institutions with smaller research programs. Groups under-represented in science are often highly represented schools with smaller research footprints. It is therefore important to have reviewers who represent a broad spectrum of research institutions. In addition to providing a valuable perspective in review, the experience of serving on fellowship panels will give reviewers from schools that submit few fellowship proposals valuable knowledge about what makes for a strong fellowship application, knowledge that they can bring back to their institution.

Recommendation: Reviewer representation would reflect the full spectrum of NRSA participating institutions.

Recommendation 5. Make changes in the review process to make review more fair

5.1 Cluster applications to allow appropriate framing of criteria for early career sponsors and less-resourced institutions

Although the same review criteria must apply to all, sometimes applicant circumstances are so different that fairness requires different framing or expectations. For example, in review of R01s, applications from new investigators are evaluated in a separate cluster because these investigators are unlikely to have the extensive preliminary data and publication records as more seasoned investigators. Analogously, the WG favors clustering fellowship applications to allow appropriate framing of criteria for early career sponsors and less-resourced institutions. The approach most favored was to cluster on the basis of the sponsor's prior success as a sponsor of NRSA fellowships. Those who had not previously been awarded an NRSA would be reviewed separately, the rationale being that these individuals would have different kinds of qualifications to serve as mentors compared to those with a track record. Acknowledging that this did not address well the disparate levels of institutional capability for writing NRSA applications, other ideas were proposed, for example, to cluster on the basis of institutional NIH support, example, or some other NIH designation such as R15 schools or schools in IDeA states.

5.2 Withhold institutional identification until the end of the application

The WG recommends withholding identification of the institution until reviewers have reviewed the application without this information. Note that the recommended review criteria does not include a scored criterion for "institution". This recommendation is aspirational in the sense that it hinges on NIH having the capability to conduct two-stage partially blinded reviews. However, the working group thinks such a review structure would have the desirable effect of reducing institutional halo effects.

Suggestions

Suggestion 1. Consider granting honorable mentions to meritorious applicants who do not receive NRSA awards

Many comments from the community described the sharp discouragement of trainees in their first experience as applicants to the NIH system. Pay lines are determined by many factors and a considerable number of trainees get positive feedback, good scores, but do not get awarded a fellowship. The WG welcomes the suggestion from many reviewers, sponsors, and trainees, to consider formally granting "honorable mentions" to proposals that score well but do not make the pay line. This honor is encouraging for trainees that prepared good applications, it communicates that their research and training plans are outstanding, and gives them the ability to include this information in their CV. The WG believes that the review process should be part of the training process for applicants, and notes that a similar mechanism exists in the NSF GRFP, although it recognizes that it is not central to review.

Suggestion 2. Broaden the range of career goals that are welcomed by the NRSA program

Two considerations drive this recommendation. First the practical reality is that only a very small minority of persons obtaining research degrees end up running research laboratories at major research universities. However, because the perception among applicants and the understanding among reviewers is that this is the only target of the NRSA program, applicants believe they must structure their application around the premise that they seek an academic career. This may result in a mismatch between what the applicant needs to pursue their career versus what they specify in the fellowship. Secondly, this narrow career path may appear particularly daunting to underrepresented minorities and other students who come from nonacademic or less well-educated families. Diversification of the Nation's biomedical workforce needs to occur along many career paths.

Appendices

Appendix 1. Recommended 424 Fellowship Supplement; Applicant Statements

1. **Statement of professional and fellowship goals** (250 words)
    a. What are your career goals?
    b. What knowledge, skills, and experience do you hope to acquire through this fellowship?
    c. How do your fellowship goals relate to your professional aspirations?

2. **Fellowship Qualifications** (500 words)
    a. Describe your educational and scientific qualifications for the proposed fellowship. Schools attended and degrees attained should be listed in the biosketch and not repeated in this section. Please describe additional qualifications and attributes, including lab rotations, conferences, internships, employment, and life experiences that contributed to your professional development. Explain how these experiences shaped you as a scientist. If you have scientific publications, annotate them indicating your scientific and intellectual contributions to the work. You may include outreach and science engagement/advocacy work you have done and anything else that demonstrates your passion and commitment to a scientific career.

3. **Self-assessment** (800 words)
    a. Describe 2-4 personal characteristics (e.g. skills, abilities, traits, attitudes) that will contribute most significantly to your success as a scientist. Drawing on your previous/current education, research, work, or outreach experiences, provide examples of how you demonstrated, developed or strengthened each characteristic.

    a. Identify 2-4 specific areas of needed growth for yourself as a scientist. Explain how you will improve in these areas and what resources you will utilize to achieve this growth. Any skill necessary for you to advance your career in biomedical research is appropriate: It may be technical (e.g., new techniques or technical methods, quantitative/computational approaches), operational (e.g., practices that promote rigorous and reproducible science, research safety, animal, or human welfare) or professional (e.g., management, leadership, communication, teamwork) in nature.

4. **Scientific perspective** (800 words)
    a. Explain your interest in the proposed project and the field. Why is this field of science important and why did you select the project you propose?
    b. Describe a pressing scientific problem in your field. Why is it important? What might advance the science?

5. **Detailed Account of Activities Planned Under this Award** (800 words)

    a. Describe, by year, the activities (research, coursework, professional development, clinical activities, etc.) you will be involved in during the proposed award. Estimate the percentage of time to be devoted to each activity. The percentage should total 100 for each year.

b. Explain how the training activities will fill gaps, address the needs, and help you meet the goals you have specified for the fellowship. This section should provide the rationale for the activities and distribution of time described in the previous section.

Appendix 2. Recommended 424 Fellowship Supplement: Sponsor Statements

Each sponsor and co-sponsor statement must address sections A-D.

A. Sponsor's/Co-Sponsor's Previous Fellows/Trainees (200 words/trainee; max = 1000 words)
Select 2-5 recent fellows or trainees (at any level) and for each provide information on what training they received from the sponsor and the impact of the training on their scientific educational or career development.

B. Training Plan, Environment, Research Facilities (2400 words/ 3 pages)
Detail the specific Research Training Plan that you have developed in collaboration with the fellowship applicant. Explain how the sponsors and planned activities will meet the fellowship goals of the applicant. *The applicant's Research Training Plan should be individualized and reflect the candidate's strengths and gaps in needed skills*. The Research Training Plan should be designed to enhance both research and clinical training (if applicable).

- Describe your approach to teaching and mentoring. What preparation supports your ability to undertake the proposed teaching and mentoring? How will you tailor your approach to this applicant?
- Include items such as classes, seminars, opportunities for interaction with other scientists and any professional skills development opportunities.
- Describe the research environment and available research facilities and equipment.
- Describe the day-to-day lab environment with special attention to training; how the trainee will benefit from your lab environment?
- Indicate the relationship of the proposed research training to the applicant's career goals.
- Describe the skills and techniques that the applicant will learn. Relate these to the applicant's career goals.
- What intellectual/training contribution will each co-sponsor make?

C. Number of Fellows/Trainees to be Supervised During the Fellowship (200 words)
How many other pre- and post- doctoral trainees will be in your lab during the proposed fellowship? Make clear how many pre- and/or post- doctoral fellows/trainees each Sponsor/Co-sponsor is expected to supervise during the award period. Co-sponsor statements must also include this information. Address the time you realistically have available to devote to training and to this applicant.

D. Applicant's Qualifications and Potential for a Research Career (800 words/ 1 page)
Address the applicant's qualifications and potential for a scientific career. Do so by answering these questions:

- What are the 2-4 characteristics of this applicant that speak to their potential to benefit from the fellowship and have a productive career in science?
- What are the most important areas for growth with respect to the applicant's scientific skills. What are their main training needs? Any skill necessary for them to advance their career in biomedical research is appropriate: It may be technical (e.g., new techniques or technical methods, quantitative/computational approaches), operational (e.g., practices that promote rigorous and reproducible science, research safety, animal, or human welfare) or professional (e.g., management, leadership, communication, teamwork) in nature.

Appendix 3. Recommended instructions for letters of support

The purpose of this letter is to help the committee understand the applicant's strengths, weaknesses, and potential to pursue a productive career in biomedical science. Do so by addressing the following questions:

1. Identify the 2-4 most important characteristics of this applicant that will contribute to this applicant becoming a successful scientist and explain why. Give supporting examples. (400 words)

    - Identify 2-4 areas for growth that the applicant should address to improve their prospects of becoming a productive biomedical scientist. Explain how the proposed fellowship helps address these needs. Any area of growth necessary for them to advance their career in biomedical research is appropriate: It may be technical (e.g., new techniques or technical methods, quantitative/computational approaches), operational (e.g., practices that promote rigorous and reproducible science, research safety, animal, or human welfare) or professional (e.g., management, leadership, communication, teamwork) in nature. (400 words)

2. What scientific and intellectual contributions has the applicant made during their training/research experience with you? (250 words)

3. Give an overall assessment of the applicant's readiness for this fellowship taking into account their background, potential, current skills (or abilities), and career goals. (400 words)

Appendix 4. Current instructions for the Fellowship Supplemental Form for the 424 grant application (condensed for clarity)

Link to full set here.

Applicant's Background and Goals for Fellowship (6 pages, ~ 4800 words)

A. Doctoral Dissertation and Research Experience

- Briefly summarize your past research experience, results, and conclusions, and describe how that experience relates to the proposed fellowship. In some cases, a proposed fellowship may build directly on previous research experiences, results, and conclusions. In other situations, past research experiences may lead a candidate to apply for a fellowship in a new or different area of research. Do not list academic courses in this section.
- Applicants with no research experience: Describe any other scientific experiences.
- Advanced graduate students (i.e., those who have or will have completed their comprehensive examinations by the time of award): Include a narrative of your planned doctoral dissertation (may be preliminary).
- Postdoctoral fellowship applicants: Specify which areas of your proposed research were part of your predoctoral thesis or dissertation and which, if any, were part of a previous postdoctoral project.

B. Training Goals and Objectives

- Describe your overall training goals for the duration of the fellowship and how the proposed fellowship will enable the attainment of these goals.
- Identify the skills, theories, conceptual approaches, etc., to be learned or enhanced during the award, including, as applicable, expertise in rigorous research design, experimental methods, quantitative approaches, and data analysis and interpretation, as applicable.
- Discuss how the proposed research will facilitate your transition to the next career stage.

C. Activities Planned Under this Award

- The activities planned under this award should be individually tailored and well-integrated with your research project.
- Describe, by year, the activities (research, coursework, professional development, clinical activities, etc.) you will be involved in during the proposed award. Estimate the percentage of time to be devoted to each activity. The percentage should total 100 for each year.
- Describe the research skills and techniques that you intend to learn during the award period.
- Provide a timeline detailing the proposed research training, professional development, and clinical activities for the duration of the fellowship award. Detailed timelines of research activities involving animals, human subjects, or clinical trials are requested in other sections of the fellowship application and should not be included here. The timeline you provide here should be distinct from the Study Timeline in the PHS Human Subjects and Clinical Trials Information form.

Appendix 5. Sample of current NRSA review criteria (from F31 parent announcement). (PA-21-049)

Fellowship Applicant

- Are the candidate's academic record and research experience of high quality?
- Does the candidate have the potential to develop into an independent and productive researcher?
- Does the candidate demonstrate commitment to a research career in the future? Does the research project reflect a significant contribution of the candidate to the originality of the project idea, approach and/or hypotheses?

Sponsors, Collaborators, and Consultants

- Are the sponsor(s') research qualifications (including recent publications) and track record of mentoring individuals at a similar stage appropriate for the needs of the candidate?
- Is there evidence of a match between the research and clinical interests (if applicable) of the candidate and the sponsor(s)?
- Do(es) the sponsor(s) demonstrate an understanding of the candidate's training needs as well as the ability and commitment to assist in meeting these needs?
- Is there evidence of adequate research funds to support the candidate's proposed research project and training for the duration of the research component of the fellowship?
- If a team of sponsors is proposed, is the team structure well justified for the mentored training plan, and are the roles of the individual members appropriate and clearly defined?
- Are the qualifications of any collaborator(s) and/or consultant(s), including their complementary expertise and previous experience in fostering the training of fellows, appropriate for the proposed project?
- If the candidate is proposing to gain experience in a clinical trial as part of his or her research training, is there evidence of the appropriate expertise, experience, resources, and ability on the part of the sponsor(s) to guide the candidate during the clinical trial research experience?
- Does the sponsor's research and training record, as well as mentoring statement, indicate that the candidate will receive outstanding training in the proposed research area and have the opportunity to publish high quality papers and present research data at national meetings as the project progresses?

Research Training Plan

- Is the proposed research project of high scientific quality, and is it well integrated with the proposed research training plan?
- Based on the sponsor's description of his/her active research program, is the candidate's proposed research project sufficiently distinct from the sponsor's funded research for the candidate's career stage?
- Is the research project consistent with the candidate's stage of research development?
- Is the proposed time frame feasible to accomplish the proposed training?
- If proposed, will the clinical trial experience contribute to the proposed project and/or the candidate's research training?

- Does the training plan provide adequate opportunities to present and publish research findings and meet with scientists in the community at national meetings as the work progresses?
- Will the training plan provide the professional skills needed for the candidate to transition to the next stage of his/her research career?

Training Potential

- Are the proposed research project and training plan likely to provide the candidate with the requisite individualized and mentored experiences in order to obtain appropriate skills for a research career?
- Does the training plan take advantage of the candidate's strengths and address gaps in needed skills? Does the training plan document a clear need for, and value of, the proposed training?
- Does the proposed training have the potential to serve as a sound foundation that will clearly enhance the candidate's ability to develop into a productive researcher?

Institutional Environment & Commitment to Training

- Are the research facilities, resources (e.g., equipment, laboratory space, computer time, subject populations, clinical training settings) and training opportunities (e.g. seminars, workshops, professional development opportunities) adequate and appropriate?
- Is the institutional environment for the candidate's scientific development of high quality?
- Is there appropriate institutional commitment to fostering the candidate's mentored training?

Appendix 6. Roster of the CSR Advisor Council Working Group on Fellowship Review

MEETING ROSTER

CENTER FOR SCIENTIFIC REVIEW
CSR Advisory Council Work Group on Fellowship Review

CO-CHAIR

VILLA, ELIZABETH, PHD
ASSOCIATE PROFESSOR
SECTION OF MOLECULAR BIOLOGY
DIVISION OF BIOLOGICAL SCIENCES
UNIVERSITY OF CALIFORNIA, SAN DIEGO
LA JOLLA, CA 920930
EVILLA@UCSD.EDU

CO-CHAIR

REED, BRUCE, PHD
DEPUTY DIRECTOR
CENTER FOR SCIENTIFIC REVIEW NATIONAL
INSTITUTES OF HEALTHBETHESDA, MD 20892
BRUCE.REED@NIH.GOV

MEMBERS

MILLER, SCOTT J, PHD
IRENEE DUPONT PROFESSOR OF CHEMISTRY
DEPARTMENT OF CHEMISTRY
YALE UNIVERSITY
NEW HAVEN, CT 06520-8107
SCOTT.MILLER@YALE.EDU

RAJARAM, NARASIMHAN, PHD
ASSOCIATE PROFESSOR
DEPARTMENT OF BIOMEDICAL ENGINEERING
UNIVERSITY OF ARKANSAS AT FAYETTEVILLE
FAYETTEVILLE, AR 72701
NRAJARAM@UARK.EDU

AD HOC

BOONE, ERICKA, PHD
DIRECTOR, DIVISION OF BIOMEDICAL RESEARCH
WORKFORCE
DIRECTOR, DIVISION OF LOAN REPAYMENT
OFFICE OF THE DIRECTOR
NATIONAL INSTITUTES OF HEALTH
BETHESDA, MD 20892
ERICKA.BOONE@NIH.GOV

BURTON, MICHAEL D JR, PHD
ASSISTANT PROFESSOR
DEPARTMENT OF BEHAVIORAL
AND BRAIN SCIENCES
UNIVERSITY OF TEXAS, DALLAS
DALLAS, TX 75080
MICHAEL.BURTON@UTDALLAS.EDU

FRIEDMAN, KATHERINE, PHD
ASSOCIATE PROFESSOR
DEPARTMENT OF BIOLOGICAL
SCIENCES
VANDERBILT UNIVERSITY
NASHVILLE, TN 37235
KATHERINE.FRIEDMAN@VANDERBILT.EDU

GAMMIE, ALISON, PHD
DIRECTOR
DIVISION OF TRAINING, WORKFORCE DEVELOPMENT,
AND DIVERSITY
NATIONAL INSTITUTE OF GENERAL MEDICAL SCIENCES
NATIONAL INSTITUTES OF HEALTH
BETHESDA, MD 20892
ALISON.GAMMIE@NIH.GOV

KAZMIERCZAK, BARBARA I, MS, BA, MD, PHD
PROFESSOR
DEPARTMENTS OF INTERNAL MEDICINE AND
MICROBIAL PATHOGENESIS
YALE UNIVERSITY SCHOOL OF
MEDICINENEW HAVEN, CT 06520
BARBARA.KAZMIERCZAK@YALE.EDU

MAYNARD SMITH, LYSTRANNE ALYSIA, PHD
SCIENTIFIC REVIEW OFFICER
CENTER FOR SCIENTIFIC REVIEW
NATIONAL INSTITUTES OF HEALTH
BETHESDA, MD 20892
LYSTRANNE.MAYNARD-SMITH@NIH.GOV

QUEEN, ROBIN M, BS, MS, PHD
PROFESSOR
DEPARTMENT OF BIOMEDICAL ENGINEERING AND
MECHANICS
VIRGINIA TECH
BLACKSBURG, VA 24061
RMQUEEN@VT.EDU

THOMAS, CIBU PAUL, PHD
SCIENTIFIC REVIEW OFFICER
CENTER FOR SCIENTIFIC REVIEW
NATIONAL INSTITUTES OF HEALTH
BETHESDA, MD 20894
CIBU.THOMAS@NIH.GOV

VANDERFORD, NATHAN LANE, PHD, MBA
DIRECTOR
DEPARTMENT OF TOXICOLOGY
AND CANCER BIOLOGY
COLLEGE OF MEDICINE
UNIVERSITY OF KENTUCKY
LEXINGTON, KY 40536
NATHAN.VANDERFORD@UKY.EDU

YANOWITZ, JUDITH L, PHD
ASSOCIATE PROFESSOR
DEPARTMENT OF OBSTETRICS,
GYNECOLOGY & REPRODUCTIVE SCIENCES
UNIVERSITY OF PITTSBURG
MAGEE-WOMENS RESEARCH INSTITUTE
PITTSBURG, PA 15213
YANOWITZJL@MWRI.MAGEE.EDU