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Internal Grant Review to Increase Grant Funding for Junior Investigators

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Abstract

Decreasing biomedical research support over the past decade has driven many talented young scientists to seek careers outside academia. In 2011, the Department of Neurology at Johns Hopkins University School of Medicine developed an internal grant review program (IGRP) to systematically review career development awards (CDAs) and research grants (e.g., R01s) for junior investigators prior to NIH submission. With IGRP implementation, we observed significant increases in the number of CDAs and R-grants awarded to junior investigators. Thus, internal grant review is an effective means for supporting junior faculty and help them retain their research roles within academia.

Introduction

The National Institutes of Health (NIH) is the world's largest funding source for biomedical research. Between 2003 and 2015, however, NIH's ability to fund investigators has declined by 22%, as a combined result of budget cuts, sequestration, and unmatched inflationary losses.[1] The latest figures indicate a 19.9% success rate for all submitted NIH research grant applications and 25.9% for individual training grants (fiscal year 2016).[2] Compared with 2003, when the success rates for all submitted grant applications and individual training grants were 32% and 39%, respectively, this declining funding rate has made it increasingly difficult for both clinical and basic science investigators to launch academic research careers.

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Author Contributions

Conception, design, and implementation of the IGRP: HST, MBB, JBE, GKB, TEL, NJH, and CLM. Drafting and editing of the manuscript: HST, MBB, JBE, GKB, TEL, NJH, and CLM. Data acquisition and analysis: HST and CLM. Figures and tables: HST and CLM.

Conflicts of Interest

None to report.

Junior faculty are particularly vulnerable, and low success rates for grant funding are driving talented scientists to careers outside academia.[3] A recent *Chronicle* survey indicated that ~50% of the more than 11,000 university researchers had abandoned a central investigation in their lab, and 75% lost graduate students and research fellows due to cuts in funding. The long-term effects of fewer students and fellows entering into training will manifest as reductions in the next generation of biomedical scientists.[4] Moreover, the age of new investigators awarded their first R01-equivalent grant continues to rise, with 2016 estimates at 45 years-old for MD/PhDs and MDs, and 42 years-old for PhDs.[5] Without funding in the early years of their careers, young scientists are at risk of moving from the academic setting to careers outside of biomedical research, or out of science altogether.

To support junior investigators to obtain funding, the Department of Neurology at the Johns Hopkins University School of Medicine established an internal grant review program (IGRP) in 2011, led by a committee of experienced investigators and a research administrator. The reason for implementing this program at the time was based on a perception by Departmental leaders that grant funding for junior investigators had declined in recent years. One concern was that the applicants were not getting sufficient mentorship during the grant writing process, which negatively impacted their chances at funding success. To address this issue, the Chairman selected a committee to initiate the IGRP. Initially, this committee consisted of a senior member at the Vice Chair level, an Associate Professor, an Assistant Professor (all with track records of NIH funding), and an Administrative Assistant. Over time, the committee evolved to include the Vice Chair of Research for Neurology, another full Professor, two Associate Professors, one Assistant Professor, and one Program Administrator. Of these, two are part of the original committee formed in 2011. In addition, an Associate Professor from Physical Medicine and Rehabilitation (PM&R) joined the committee in 2016 in response to that department Chairperson's goal to improve funding and research support, guided by the years of experience of the IGRP.

Although many institutions utilize some form of an internal grant review, to our knowledge, there is no publication that describes the methodology and effectiveness of such programs. An internet search of internal grant review programs at other universities revealed some methodological commonalities: financial incentives for applicants and/or reviewers, structured timelines leading up to submission, non-anonymity of reviewers (i.e. mentor committees), and reviews available for non-NIH entities (e.g. foundation awards). For most programs, participation of applicants in the review process was voluntary. Guided by practices at other institutions, along with trial-and-error learning over many iterations, the Neurology IGRP at Johns Hopkins gradually developed a formal process of internal grant review whose methodology could be useful to other groups who may want to start up a similar program or modify an existing one.

Since IGRP's inception, the Chairman required departmental junior applicants to undergo internal review for NIH Mentored Career Development Awards (CDAs) (i.e., K01, K08, K23). First-time R01 applicants (i.e., "New Investigators") were strongly encouraged, but not required, to complete internal grant review. CDAs offer primary support for postdoctoral fellows and junior faculty by providing an essential foundation in biomedical research

through didactic learning and mentorship as they develop the necessary skills for careers as independent investigators. CDAs require that mentorship and career development plans are built into the application to ensure a solid infrastructure supports the mentee through their early career training. Moreover, funding rates for CDAs are higher than for R-grants.[2] The primary goal of the current analysis was to assess the impact of our IGRP on grant award funding success.

Methods

The IGRP committee reviews applications in three cycles annually, preceding each of the NIH cycle due dates in February, June, and October (Fig 1). The internal review protocol consists of two main steps. The first step, "Aims Presentation," consists of an open conference in which the applicant is required to give a 10-minute oral presentation of the application that addresses the specific aims, hypotheses, study background, preliminary data, training plan (for CDA applicants), and in the case of resubmissions, responses to major criticisms. A 10-minute question and answer session follows each presentation. The entire session is held during normal business hours and usually lasts 2-3 hours, depending upon the number of applicants. Presentation schedules are announced to the department ahead of time so that people can choose to attend specific presentations. CDA mentors are required to attend the conference during their mentee's presentation to ensure applicant and mentor agreement on critical aspects of the proposal. This open forum helps to identify pitfalls in the research, improve scientific inquiry, and refine specific aims and hypotheses early in the grant writing process – a full 10 weeks prior to NIH submission.

The applicant must also provide a written draft of the Specific Aims before the oral presentation. Within seven days after the oral presentations, the committee provides written feedback to the applicant (and mentor) on the Aims as written and as presented orally, including (but not limited to) a summary of the feedback discussion at the oral presentation. Feedback often includes suggestions to revise or reconfigure (e.g., if aims are interdependent, feasibility is weak, project is too ambitious, or there is a fatal flaw in the logic of the design). At this stage, an applicant may decide to delay submission based on the feedback. For applicants who decide to continue with submission, the committee identifies at least two potential reviewers based on their area of expertise, which may be related to disease area or methodology. For example, if the application focuses on movement disorders, qualified specialists in Neurology or another department within the School of Medicine are invited to review. Reviewers are provided with the applicant's specific aims with the invitation so they can decide whether to agree to review. In some cases, external reviewers are invited if the expertise is not available within Hopkins.

The second step of the IGRP involves independent peer review of the grant application. Five weeks prior to the NIH due date, application materials are submitted via a web portal that was developed for the IGRP to facilitate review.[6] Before the web portal, review was solely facilitated through email, which was also effective. Applicants submit the following grant sections for review:

Mentored Career Development Awards (K01, K08, K23) and Career Transition Awards (K99/R00)

1. Specific Aims
2. Research Strategy
3. Training in the Responsible Conduct of Research
4. Candidate Information and Goals for Career Development
5. Plans and Statements of Mentor and Co-mentor(s)
6. Biographical Sketch
7. Response to Reviewer Comments (Resubmissions)

Research Grants (R01, R03, R21)

1. Specific Aims
2. Research Strategy
3. Biographical Sketch
4. Response to Reviewer Comments (Resubmissions)

Once all required materials are uploaded into the web portal, two reviewers are selected and granted access to the applicant's materials via email notification. Reviewers have seven days to complete the review, using a NIH-style evaluation form, providing an overall impact score 1-9, and strengths and weaknesses of individual categories.[7] Additionally, reviewers make a recommendation to: 1) submit with revisions, 2) delay submission (major revisions or more pilot data are needed), or 3) too rough to edit (delay). Reviewers submit the completed evaluation into the web portal, maintaining anonymity. However, reviewers have the option of breaking anonymity to directly address comments with the applicant. The applicant is notified via email when the review is complete, and then given access to the evaluation. Based on the reviews, an overall recommendation from the IGRP is given to the applicant. The committee does not permit or prevent the applicant from submitting; that decision is left to the applicant and mentor.

Results

From 2011-2016[1], IGRP reviewed 79 applications. In our analyses, we excluded first submissions that were later reviewed again as re-submissions (n=16), applicants outside of our department (n=3), applicants who left the university and were, therefore, unable to re-submit (n=3), submissions to grant mechanisms not included in this report (n=2), and incomplete review (n=17). An application was considered to "complete the review process" if: 1) funded on first submission, 2) resubmitted regardless of outcome, or 3) not resubmitted within the NIH's 37-month resubmission rule.[8] Due to eligibility requirements, K99 applicants that did not resubmit by the end of their 4th year of fellowship were also

[1]Data available for NIH cycles I and II only in 2016.

considered completed. Thus, 38 applications completed grant review within this time period. Of these, 22 (58%) were funded (Table 1).

To determine the impact of IGRP on funding success, we examined funding for CDAs submitted before (2000-2011) vs. after (2011-2016) IGRP implementation. R-grants were not included in this analysis because internal review of R-grants has been optional, and will be discussed separately. Using NIH's Research Portfolio Online Reporting Expenditures and Results tool (RePORTER) for fiscal years 2000-2017, we identified the total number of the Department of Neurology's funded CDAs. Fiscal year 2011 (IGRP's first year of review) was split: we credited CDAs funded in the first two cycles of 2011 to pre-program because they were submitted in 2010, and those funded in the third 2011 cycle to the IGRP. Funding data were available through the first two submission cycles of 2016, translating to funding in fiscal year 2017. The mean number of departmental CDAs obtained pre-program (2000-2011, n=17) was 1.46 per year. The mean number of CDAs obtained since IGRP (2011-2016, n=15) was 2.37 per year, representing a 62% increase. An independent-samples t-test indicated a significant increase in the *number* of funded grants since the IGRP began, $t(17) = 2.627$ $p < .05$.

Our department records for the total number of K-applications allowed us to track only as far back as 2009, which prevented us from computing a success *rate* of CDA funding before IGRP implementation for comparison. For R-grants, however, we could compare success rates influenced by the IGRP because internal review was optional for New Investigators. Thus, we could compare success rates for R-applicants reviewed by the IGRP versus those that were not over the identical time period.

From 2011 to 2016[2], there were 39 total R-applications submitted by New Investigators within our department, adhering to the inclusion criteria described above. Of these 39 applications, 12 went through internal review. Seven of these 12 applications were funded (58%). By contrast, 27 applications were submitted without receiving internal review, and six of those were funded (22%). Thus, the likelihood of success for R-type awards was more than 2.5× higher when an application was reviewed internally prior to NIH submission.

To explore the hypothesis that differences in recent funding successes were due to applicants waiting until they were more senior before submitting grant applications (rather than an effect of the IGRP), we compiled information on the rank of the investigator (e.g., Postdoctoral Fellow, Assistant Professor, etc.) and years at rank at the time of grant submission. These data are summarized in Table 2. We compared years at rank at time of submission for successful R-award applicants at the Assistant Professor level (the only group that could be reasonably compared given the low Ns for each sub-group) based on whether they participated in IGRP or not. A Mann-Whitney test indicated no difference in distribution of years at rank between these groups (median = 5 years for IGRP participants and 2 years for non-IGRP participants, $U = 9.00$, $p = .412$). Similarly, we compared years at rank for unsuccessful R-award applicants at the Assistant Professor level. A Mann-Whitney test indicated no difference in distribution of years at rank between these groups either

[2]Data available for NIH cycles I and II only in 2016.

(median = 3 years for IGRP participants and 2 years for non-IGRP participants, U = 21.50, p = .335). For CDA applicants, comparisons were again made for successful applicants, comparing years at rank for those who submitted via IGRP versus those who submitted prior to IGRP, at the Assistant Professor and Fellow levels (combined). A Mann-Whitney test indicated no difference in distribution of years at rank between these two groups (median = 1 year for IGRP participants and 3 years for pre-IGRP participants, U = 44.00, p = .119).

Discussion

Our data indicate that use of the IGRP increased funding for junior investigators. This was the case for both K- and R-awards, which enabled research to continue at a particularly vulnerable stage in the academic research career pathway. Although improvement in funding success may be due to applicants benefiting from reviewer feedback, benefit may also be drawn from imposing early deadlines, resulting in more time to develop a mature grant for submission. The IGRP has strengthened mentorship by imposing mentor-applicant interactions early in the grant writing stages. Involvement of department faculty in grant reviews also has resulted in a broader base of mentorship to serve junior investigators that extends beyond the direct mentor-mentee relationship.

Our process has evolved during the last 7 years. We encountered pitfalls that called for changes to the process. For example, we initially reviewed applications three weeks before the NIH deadline, but this did not allow applicants enough time to make all necessary revisions, and many reviewers felt they could not recommend major changes so close to the deadline. Once we extended the timeline to five weeks before the NIH deadline, reviewers provided more extensive comments and applicants had more time to incorporate revisions.

We deliberately chose to limit IGRP reviews to NIH mechanisms (CDAs and R-awards) because these are the most commonly sought after federal grant opportunities within our department and, therefore, are the most familiar to our faculty. Also, the established NIH tri-annual deadlines allow procedural consistency across IGRP review cycles. In terms of increasing the quality of the scientific review, we found that presenting the specific aims as an oral presentation to an open audience provided opportunities for the applicant to defend his/her ideas, for future applicants to view the process, and for a multidisciplinary perspective of the preliminary data and overall understanding. Alternatives to this format include aims presentation to a smaller audience (select committee), or reviewing written aims via email.

A limitation of our analyses is that we could compute only an indirect measure of success with pre-reviewed CDA applications, rather than a direct success rate. This is because we did not have records of the number of submissions prior to implementation of the IGRP. Thus, while the total number of funded CDAs rose significantly with the implementation of the IGRP, it is possible that the total number of CDA applications also rose during this same time frame. If so, the rise in funded CDAs could simply reflect a similar rise in total submissions. However, this explanation for the increase seems unlikely because the total number of CDA applications submitted to the NIH remained relatively stable over this time period.[9] In addition, we saw a concomitant increase in success rates for R-grants with the

IGRP, suggesting that the rise in the number of CDAs funded was likely due to the IGRP as well.

It is possible that the high success rates of first time R-award applicants who participated in the IGRP were influenced by a self-selection of highly motivated individuals who could arrange their submission timeline to meet the requirements of internal review. People who are naturally well organized, highly motivated, and open to exposing themselves to constructive feedback would lead such people to write better grants even if the review process added little. Similarly, successful applicants may be those with more grant writing experience, even if previously unfunded, which would point to the more senior and/or motivated applicants. However, a comparison of those who utilized the IGRP did not differ according to years at rank, regardless of funding status, which dispels the notion that more senior applicants took advantage of the IGRP process. There is no way to do a valid control within the context of this retrospective review. Nevertheless, those who completed the internal review had a 2.5× greater chance of successfully obtaining an R-award compared to those who did not, which should encourage those not naturally inclined to seek help with grant writing to strongly consider doing so.

Our biggest obstacle to date has been achieving 100% timely return of reviews (within 7 days). We rely on the dedication of our senior faculty and their commitment to the teaching mission of our institution to get the reviews done. Heavy clinical, research, and teaching loads can interfere with timely returns. However, the overall willingness of our reviewers to participate in the IGRP has not been an issue. The culture in our department has been very supportive of mentoring junior investigators. Moreover, the IGRP's experience has not been limited to a small group of committed reviewers. Instead, our reviewer pool represents researchers from all divisions within the department, as well as from other departments. However, incentivizing participation through monetary or other rewards would be a reasonable approach if resources are available.

In summary, the IGRP requires a cadre of committee leadership, low overhead, and investment by senior faculty in the peer review process. It can be generalized to any academic department, regardless of grant mechanism or funding agency. Importantly, these steps help support junior faculty to achieve early grant writing success that is critical for their academic research careers.

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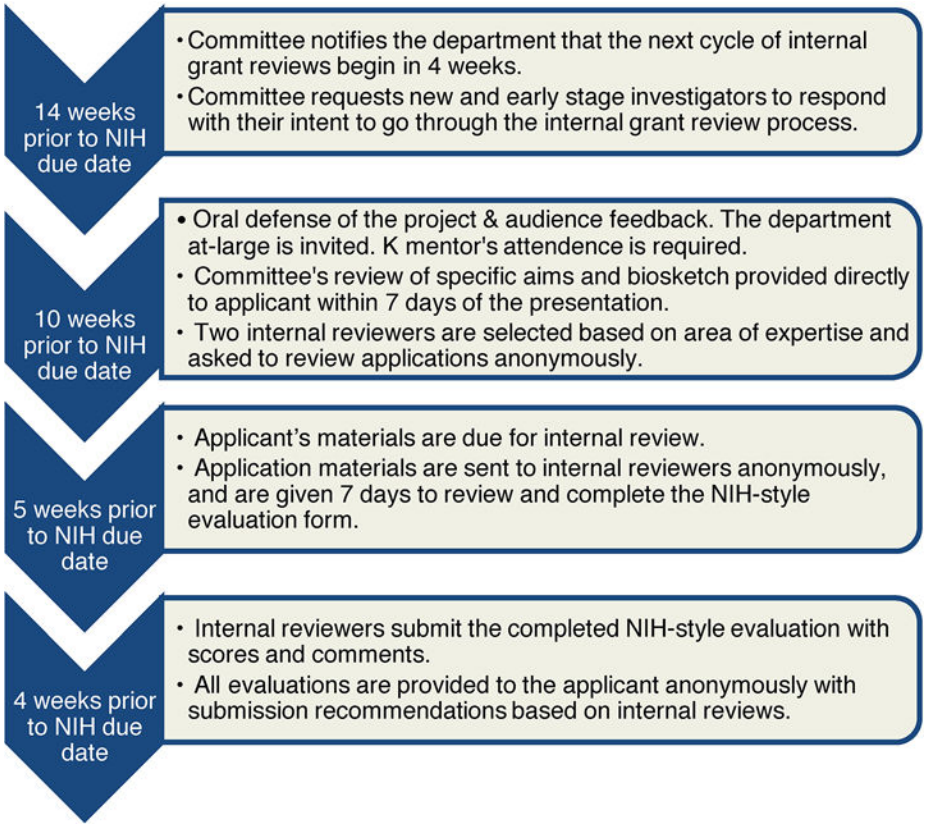

Figure 1.
Timeline of the Internal Grant Review Process

Table 1

Success Rates by Grant Type

Grant Type	JHU IGRP Success Rate[a] n (%)	NINDS[b]
CDA: K01, K08, K23	11 of 18 (61%)	19%
K99	4 of 8 (50%)	9%
R01, R03, R21	7 of 12 (58%)	19%
Average (combined)	22 of 38 (58%)	19%

[a] HU IGRP success rate was determined by dividing the number of awarded applications by the total number of applications that completed the IGRP process, across fiscal years. NIH success rates were determined by dividing the number of competing applications awarded by the total number of competing applications reviewed within a fiscal year.[1]

[b] NINDS = National Institute of Neurological Disorders and Stroke, fiscal year 2016. Rates for NINDS are shown for comparison because most of our department's applications are funded by NINDS.

Table 2

Profiles of CDA and R-Grant Applicants in Terms of Rank and Years at Rank at Time of Grant Submission

CDA's	Pre-IGRP		Post-IGRP	
	Funded		Funded	
Rank	**Mean Years at Rank**	**Number of Applicants**	**Mean Years at Rank**	**Number of Applicants**
Resident	3	1	N/A	0
Postdoctoral Fellow	3	3	4	3
Research Associate	4	1	1	4
Instructor	2	2	N/A	0
Assistant Professor	1	10	2	8
Total		**17**		**15**

R-Grants	Not Reviewed by IGRP				Reviewed by IGRP			
	Funded		Not Funded		Funded		Not Funded	
Rank	**Mean Years at Rank**	**Number of Applicants**	**Mean Years at Rank**	**Number of Applicants**	**Mean Years at Rank**	**Number of Applicants**	**Mean Years at Rank**	**Number of Applicants**
Postdoctoral Fellow	N/A	0	N/A	0	N/A	0	1	1
Research Associate	N/A	0	2	2	N/A	0	N/A	0
Instructor	3	1	1	1	N/A	0	N/A	0
Assistant Professor	3	4	2	16	4	7	3	4
Associate Professor	2	1	7	2	N/A	0	N/A	0
Total		**6**		**21**		**7**		**5**

CDAs: Post-IGRP vs. Pre-IGRP; All Funded

R-Grants: Not Reviewed vs. Reviewed by IGRP; Funded vs. Not Funded