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Commentary

How Support of Early Career Researchers Can Reset Science in the Post-COVID19 World

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The COVID19 crisis has magnified the issues plaguing academic science, but it has also provided the scientific establishment with an unprecedented opportunity to reset. Shoring up the foundation of academic science will require a concerted effort between funding agencies, universities, and the public to rethink how we support scientists, with a special emphasis on early career researchers.

The novel coronavirus, SARS-CoV-2, has placed science at the center of every conversation, amplifying the importance of scientific research to economic stability, healthcare infrastructure, and disaster preparedness. In academic science, recovery from the immediate COVID19 crisis will require departments, universities, private foundations, federal agencies, and the public to work together collaboratively and comprehensively. The goal of recovery should not be to return to "normal" but, rather, to reset. Here, we argue that recovery provides us with the opportunity to address three systemic issues that plague the conduct of research in the twenty-first century, with an emphasis on supporting early career researchers who are the most vulnerable. The strategies needed to ensure stability and success of early career scientists post-COVID19 can be adapted to chip away at the systemic issues affecting the scientific establishment.

Excess Does Not Equal Excellence

Science has changed immensely over the past 50 years. More has become better: more experiments per paper, more papers per year, more expectations and requirements for grants and tenure, more opinions from reviewers. The scientific community rewards quantity over quality. Most scientists can easily name a seminal paper; many were published long before the 2000s, and many had, at most, a handful of figures. Today, papers are often published with a plethora of supplemental figures that will largely go unread and underappreciated. The desire for "more" results in delays in publication, the awarding of grants, and career advancement for early career researchers; it also stymies creativity and encourages the proliferation of low-quality journals.

Diversification Leads to Discovery

This crisis is exacerbating the well-documented discrimination afflicting academic science (Monroe et al., 2008). Women, parents, and individuals who identify as racial or ethnic minorities leave science, technology, engineering, and math (STEM) fields as early career researchers at an excessively high rate in the best of times and will undoubtedly suffer more from the present lab closures. The responsibilities of family life disproportionately impact women. A parent who is trying to homeschool their children, manage household duties, and work will have left little time to further their own scientific agenda. Faculty with family responsibilities—women specifically—must be supported. The COVID19 crisis will only highlight the rampant diversity issues plaguing the scientific establishment, many of which begin with the loss of women and minorities during early career stages and may lead to further disenfranchisement of the disadvantaged (Malisch et al., 2020).

Rethink the Fundamentals of Funding

The current model of academic science is heavily reliant upon federal funding, even though agencies such as the National Institutes of Health (NIH) were not built to sustain such expectations. The federal government's funding capacity has significantly diminished as the cost of science has radically increased. The 2019 defense

budget was ~$685 billion while the 2019 NIH budget was $39 billion. The COVID19 crisis has clearly amplified that the greatest risk to American life is not war, but disease. Funding is needed at all levels; however, early career researchers should be particularly supported as the consistent trend of shifting funding away from younger researchers has no end in sight (Daniels, 2015).

Ensuring a Durable Future for Academic Science Post-COVID19

Recovery from the immediate COVID19 crisis necessitates a multi-pronged approach including fiscal and non-fiscal strategies to help graduate students, postdoctoral fellows, and early and later career faculty. This pandemic has particularly impacted senior postdoctoral fellows seeking academic faculty positions and early career faculty seeking to establish themselves as independent investigators. Special consideration for these early career researchers is key to overcoming the crisis and strengthening the foundations of academic science. Our action plan proposed below is not an exhaustive list of all possible recommendations for supporting scientists, nor is it inclusive of every academic scientist's specific circumstance. Not all of our suggestions are applicable at every university or institution, as each will have its own unique set of challenges. We acknowledge that monetary support will be limited due to the deteriorating economic situation and drastic loss of revenue from clinical operations for most medical campuses. While the immediate goal of the recommendations is to provide support for scientists from funding agencies, universities, departments, and the public following COVID19, this support also provides solutions to the three major challenges. Solutions to these systemic issues (i.e., Excess Does Not Equal Excellence, Diversification Leads to Discovery, or Funding Agencies) are interwoven across the structure of academic science, allowing us to comprehensively tackle these issues at all levels. Plans for recovery from the COVID19 pandemic must ensure as much continuity as possible in research while improving upon existing infrastructures in order to provide a more inclusive, cohesive, and efficient future for the next generation of independent scientists.

Funding Agencies

Grantsmanship

The resiliency of research is dependent upon the support of funding agencies. Like the broader scientific community, funding agencies will need to adapt their strategies and structure to fit the changing times. Simplification of grant application processes, including fewer supplemental documentations and more implementation of letter-of-intent formats prior to full proposals, could increase efficiency for both the funding agency and researcher. Lab closures will undoubtedly create a void in the preliminary data that are necessary to obtain most awards. Early career researchers who had less time to acquire these data prior to lab shutdowns will be the most affected. Funding agencies could introduce policies and programs targeted at early investigators that require fewer preliminary data (similar to the National Institute of Mental Health [NIMH] Brain Research through Advancing Innovative Neurotechnologies [BRAIN] Initiative R01 or the DP2), reducing the excess in data required for most grants. Grants submitted by graduate students, postdoctoral fellows, and early career faculty who do not have sufficient preliminary data per current standards should be given special consideration. Currently, many of the new funding opportunities by funding agencies, such as the NIH, are geared toward supplements to existing grants or COVID-related research. As there will likely be restrictions or reductions to new funding opportunities in the coming years due to fiscal shortages, faculty with existing grants might help early career faculty by including them in their supplemental applications. Including early career faculty will also foster collaboration and resource sharing, both of which will be vital during this time (Excess Does Not Equal Excellence and Rethink the Fundamentals of Funding).

Extension of Deadlines, Timelines, and Funding

Numerous funding agencies have already implemented deadline extensions, but deadlines must be further extended for the duration of lab disruptions. It is also imperative that funding agencies extend early investigator status for grant applications and implement no-cost extensions for currently held grants. Additional bridge funding programs may be especially important for faculty who are between projects or aiming to switch areas of study following the COVID19 crisis.

Universities

Extensions for Tenure: Faculty

Most universities have added one-year extensions to the tenure tracks of early career researchers, but sliding extensions may better support the success of vulnerable academics. Many early career investigators may request extensions during lab closures, but they should also have the ability to go up for tenure early if the opportunity arises. Ensuring the promotion and advancement of marginalized groups such as women, who make up < 30% of STEM faculty, is even more imperative post-COVID19. COVID19-initiated resetting of expectations for the publishing, teaching, mentorship, and service requirements for tenure may not only help minimize the excesses innate to the current tenure structure, but also may help foster environments that can acknowledge implicit biases and keep marginalized groups from disproportionately leaving STEM fields. Tenure expectations for the next generation of early career researchers may need to account for increased variability between faculty that is exacerbated by the COVID19 crisis and allow for more flexibility in the process. This crisis has amplified how the antiquated one-size-fits-all guidelines only encourage the disenfranchisement of women and racial or ethnic minorities (Diversification Leads to Discovery and Excess Does Not Equal Excellence).

Trainees

The current crisis will have a dramatic trickle-down effect, and numerous hiring freezes are already in place. Mechanisms to allow postdoctoral fellows or graduate students in their final year to continue in their current positions should be enacted, if necessary, and if labs or universities are able to provide fiscal support. Current closures are also disrupting the ability of many graduate students to complete their rotations. Universities could extend the timeline for rotations and potentially cover graduate students' stipends. Trainees, particularly postdoctoral fellows, may

have limited ability to extend their period of training due to visa restrictions. Universities should coordinate with federal agencies to pursue strategies aimed at extending visa expiration timelines, allowing trainees to complete work that was delayed due to the COVID19 crisis. These mechanisms are needed to assure that we do not lose an entire generation of scientists following the coronavirus crisis.

Curtailment of Applicable Hiring Freezes

Many universities have implemented hiring freezes for faculty and staff for the remainder of the year or beyond. Universities should not limit the ability of early career faculty to hire postdoctoral fellows and staff, however. Restricting early career faculty from hiring technical assistance and lab managers will stymie their ability to generate preliminary data, which will consequently limit grant and paper submissions and delay career advancement. Even a short hiring freeze could have devastating effects on the ability of early career faculty labs to succeed. Allowing early career faculty to continue hiring will also help to ease the bottleneck of graduate students looking for postdoctoral or research scientist positions within the next few years. Hiring freezes at any level will disproportionately affect early career individuals and oversaturate the market with qualified candidates. Permitting ongoing interviews for faculty positions, even if the official hire date is postponed, could alleviate stress on the postdoc population and expedite the hiring process when hiring freezes are lifted. The faculty search process serves as a valuable feedback mechanism for postdoctoral fellows that sometimes has an impact on career path. Halting all hiring and all faculty searches may drive talented postdocs, especially women and members of ethnic or racial minorities, out of academia (Diversification Leads to Discovery).

Institutional Funds and Startup Packages

Although universities may curtail spending from institutional funds, special consideration should be given to new and early career faculty. Early career faculty must retain access to their startup packages during this time. Institutional funds should be released for salary support for early career faculty and for all staff, students, and trainees in their labs. If startup funds are set to expire, the expiration date should be extended. New faculty should be given the funds needed to establish their labs once research activities resume (Rethink the Fundamentals of Funding).

Supplementation

The economic toll caused by shelter-in-place will undoubtedly be significant, including the reduction in funding through endowments and charitable giving. We fully acknowledge that monetary supplementation may be difficult for universities following the COVID19 crisis. Any combination of fiscal supplementation with other mechanisms of non-fiscal support should be considered. Universities might implement new or expanded fellowships for postdocs and graduate students, add to existing startup packages for faculty, assist with the purchasing of equipment or expand shared equipment funding, or create subsidies or joint ventures with federal programs similar to unemployment or re-deployment programs. Universities might supplement pay or provide reimbursement for staff, postdoc, and graduate student salaries during the duration of academic closures.

Supplementation: Per Diem Costs

Many universities have per diem policies that differ based on funding source, with reduced per diem costs associated with federal grants. Early career faculty without federal funding have per diem costs double that of other labs. Universities could implement mechanisms to reduce or supplement animal costs that will be accrued during lab closures and when labs reopen and expand their animal colonies (Rethink the Fundamentals of Funding).

Supplementation: Childcare Initiatives

Onsite daycare facilities support postdoctoral fellows and faculty with young children. These family care centers are critical to narrowing the gap and slow the attrition of women and parents in science. Universities could work with early childhood education programs to establish or expand daycare and preschool programs, providing free or subsidized childcare for faculty and teaching opportunities for early education majors. Universities might also reach out to current or retired teachers seeking supplemental income (Diversification Leads to Discovery).

Supplementation: Access to Technology

Universities should encourage and enable graduate students and postdocs to use this time to learn new computational skills in anticipation of reductions in ability to do work at the bench. Many university-offered computational courses were over-committed during lab closures due to a significant increase in enrollment requests. Universities should make a concerted effort to increase bandwidth and capacity for computational courses. Many free online resources are also available to supplement the acquisition of coding skills.

Departments: Administrative and Teaching Load

Administrative and teaching expectations should be reevaluated during university closures. Departments should reassess administrative and teaching loads, especially for early career faculty whose promotions are contingent upon teaching requirements. This is especially important, since female scientists generally have increased teaching loads and more advisory expectations than male scientists (Gibney, 2017), which could disproportionately delay scientific recovery of female scientists from COVID19 closures (Diversification Leads to Discovery).

Mentorship

Mental Health

The COVID19 crisis and subsequent lab closures will take an incredible toll on mental health. Early career faculty who have yet to establish themselves or their research independently and postdocs whose future job prospects are now significantly limited will be especially impacted by prolonged lab shutdowns. Department chairs, division leaders, and mentors should do their best to check in with early career faculty and postdocs during this time. Mentoring will be key both during and after this crisis. Establishing scheduled virtual meetings during social distancing and in-person meetings after labs are reopened could help alleviate some mental stress. University mental health resources are also available for anyone who needs support. As students generally contact female faculty about mental health issues more frequently than male

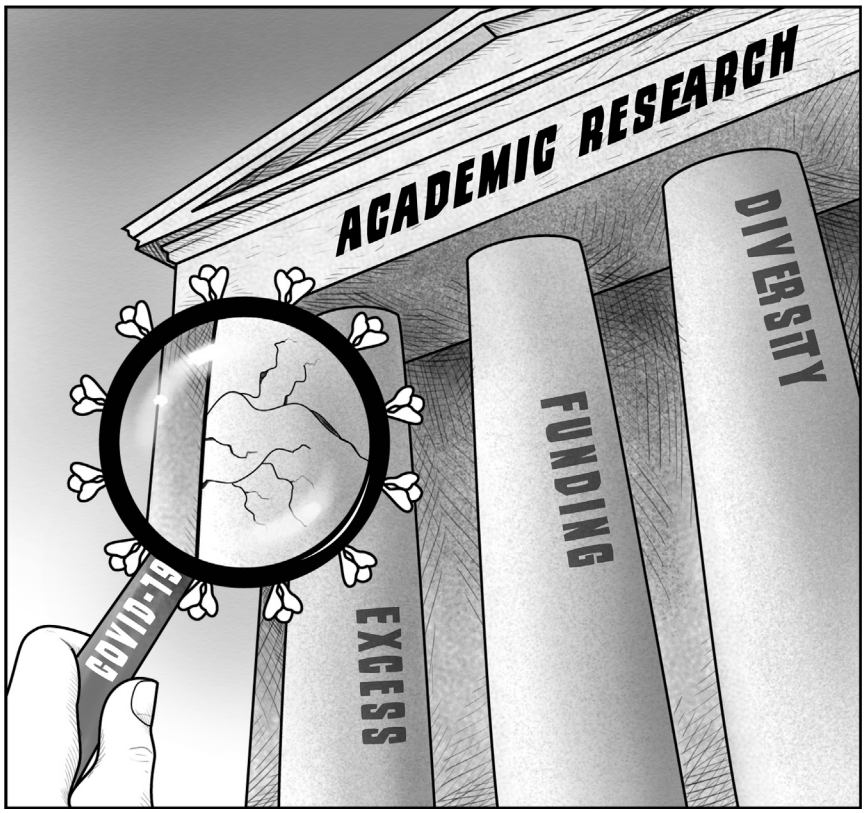

Figure 1. The COVID19 crisis has magnified the systemic issues plaguing academic research. These include the often stifling excess requirements in publication, tenure, and grant processes; the reliance on funding from national agencies that is catered towards senior level researchers; and the lack of diversity in academic research due to the attrition of women and racial or ethnic minorities during early career stages.

faculty (Bennett, 1982), equal encouragement of mentorship from all faculty is essential to not overburdening women faculty during this time (Diversification Leads to Discovery).

Graduate Student Programs

Mentoring graduate students throughout lab closures and after reopening should be strongly encouraged. Those conducting experiments will be most affected by lab closures, and this should be explicitly acknowledged by faculty and mentors. Universities must assure graduate students that graduate programs will be stabilized and that admittance will not be decreased. For many faculty, graduate students are the major workforce of the lab. To ensure that faculty can successfully build and sustain a lab, continued ability to attract graduate students is necessary. This is especially important for new investigators, as getting postdoctoral fellows can be more challenging for newer faculty.

Faculty Mentorship Programs

Once labs are reopened, pairing early career faculty with a later career faculty mentor of an established lab could facilitate more effective research programs and allow for resource sharing. Later career faculty could be incentivized to help early career researchers through reductions in teaching or administrative loads, supplementations to animal care costs, core facility usages, or other means of reimbursement and/or subsidizations. Investment of later career faculty in the success of early career faculty will help to ensure stability and success in the younger generation of independent researchers.

Clinician-Scientists

Faculty who have clinical responsibilities also necessitate special consideration during this time, especially if they are on the front lines. These individuals will not only lose productivity due to lab closures and curtailment of patient enrollment in clinical trials, they will also have the extra physical and mental stressors of working in the hospital during a crisis. Establishment of protocols to aid clinician-scientists is imperative to ensuring their important contributions to science. Just as senior faculty mentoring will be critical for junior faculty and graduating postdocs to successfully transition to a post-COVID era in the basic sciences, this type of mentorship protocol may be even more critical for clinician-scientists, many of whom do not have doctorates beyond the medical degree.

Public Initiatives

Make Science a National Priority

The current crisis has brought the importance of science and research to the forefront of public life. Not only is science critical for public health decision-making, but a sustained investment in research better positions political leaders to efficiently deploy testing and therapeutic solutions. Capitalizing this momentum is crucial to engaging the public in science and science funding. Providing additional funding sources focused on conveying science to the greater public and stimulating interest in science through educational outreach is critical. Exploiting technology and social media to bring science and research directly to the public will be vital in the post-COVID19 world. Such technology might include mechanisms to allow private citizens to directly invest in science and scientists (Else, 2019; Miller, 2019), including simplified website-based donation platforms or inclusion on election ballots. This is necessary for establishing new funding sources for scientists, potentially supplementing the dearth of funding for early career researchers at federal funding agencies (Rethink the Fundamentals of Funding).

Enhanced Scientific Transparency

The COVID19 crisis has revealed a lack of public understanding about how science is funded, conducted, and reported. The current administration's belief that the NIH is "giving away $32 billion a year" should be cause for concern (DeYoung et al., 2020). Much of the mistrust evident between the scientific establishment and the general population is rooted in lack of transparency and community

involvement in science. Taking scientists out of the "ivory tower" and increasing accessibility through technology may help to assuage the mistrust that hinders our preparedness in times of crisis. People cannot support what they do not understand. Removing excess requirements in publishing, grantsmanship, and tenure expectations could have the added benefit of creating more time for scientists to interact in the public domain. Scientists must work on building the trust that is imperative to success as a community, and early career scientists are primed to help pave this new future (Excess Does Not Equal Excellence).

Conclusions

Beyond the immediate challenges of returning to laboratories and research careers, the COVID19 crisis has exposed some of the underlying weaknesses and problems that permeate the current scientific enterprise (Figure 1). For example, editors are asking reviewers to not request more experiments unless absolutely necessary to validate the core claims of a manuscript during the review process. Most are applauding this effort to minimize excess and calling for its continued implementation even after scientists are able to get back to the bench. All institutions, funding agencies, departments, and members of the scientific community should speak openly and honestly about the difficulties faced during the current situation. Early career researchers should be involved in the decision-making processes, as they represent the future of science and academic leadership. The COVID19 crisis has provided us with the unique opportunity to reflect upon the present norms and enact change through fiscal and non-fiscal strategies. Our hope is that this pandemic will allow us to chart a new course for science, both academically and socially, and to begin to address the core challenges of research, with a special focus on supporting the next generation of independent scientists.

DECLARATION OF INTERESTS

Dr. Roberts serves as Editor-in-Chief of books for the American Psychiatric Association Publishing Division and as Editor-in-Chief of the journal *Academic Medicine*. Unrelated to this publication, Dr. Roberts serves as an advisor for the Bucksbaum Institute of the University of Chicago Pritzker School of Medicine and owns the small business Terra Nova Learning Systems.

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