

# **Evidence-Based Thoughts About Extramural Research: Money, People, and Science**

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Deputy Director for Extramural Research  
National Institutes of Health

Conference: Learn More About NIH  
Wednesday, June 13, 2018

Connelly Auditorium, Thomas Jefferson University,  
1001 Locust Street, Philadelphia, PA 19107

Disclosures: None



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# Opinion: Celebrating R and D expenditures badly misses the point

**Daniel Shapiro<sup>a,1</sup> and Kent Vrana<sup>b</sup>**

<sup>a</sup>Department of Humanities, Pennsylvania State College of Medicine, Hershey, PA 17033; and

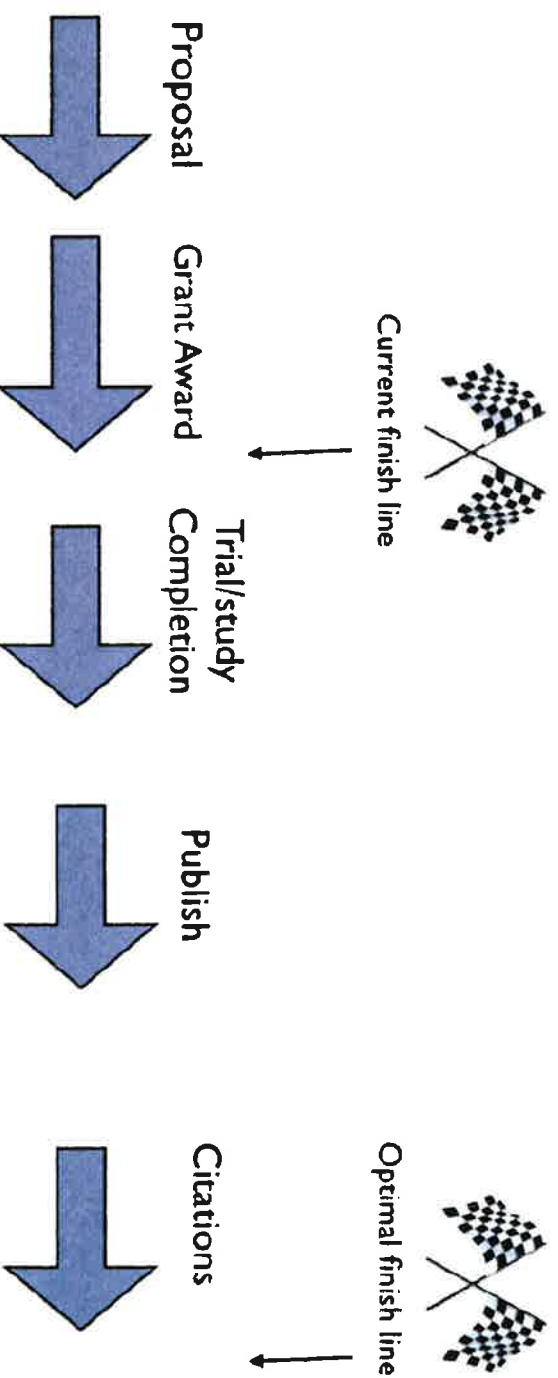
<sup>b</sup>Department of Pharmacology, Pennsylvania State College of Medicine, Hershey, PA 17033

akin to an airline proclaiming, “we use more gasoline than any other airline!” or “we spend more per year transporting our passengers!” Consider the appearance and potential con-



# So What Should Our Metrics Be?

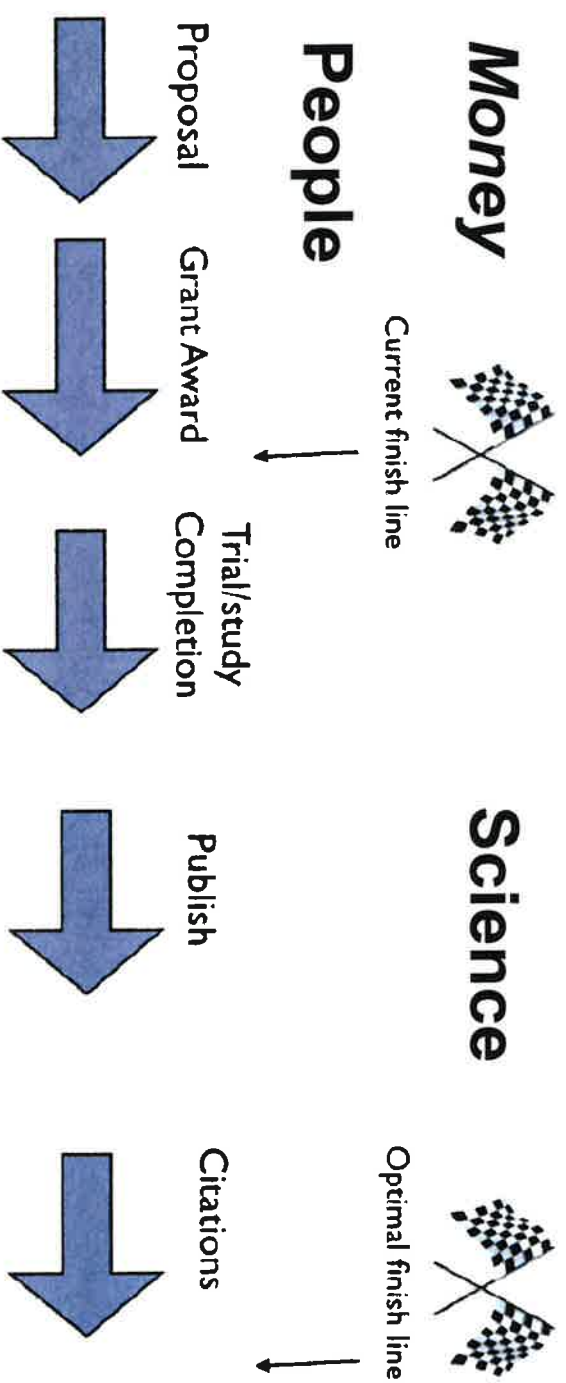
## A New Finish Line



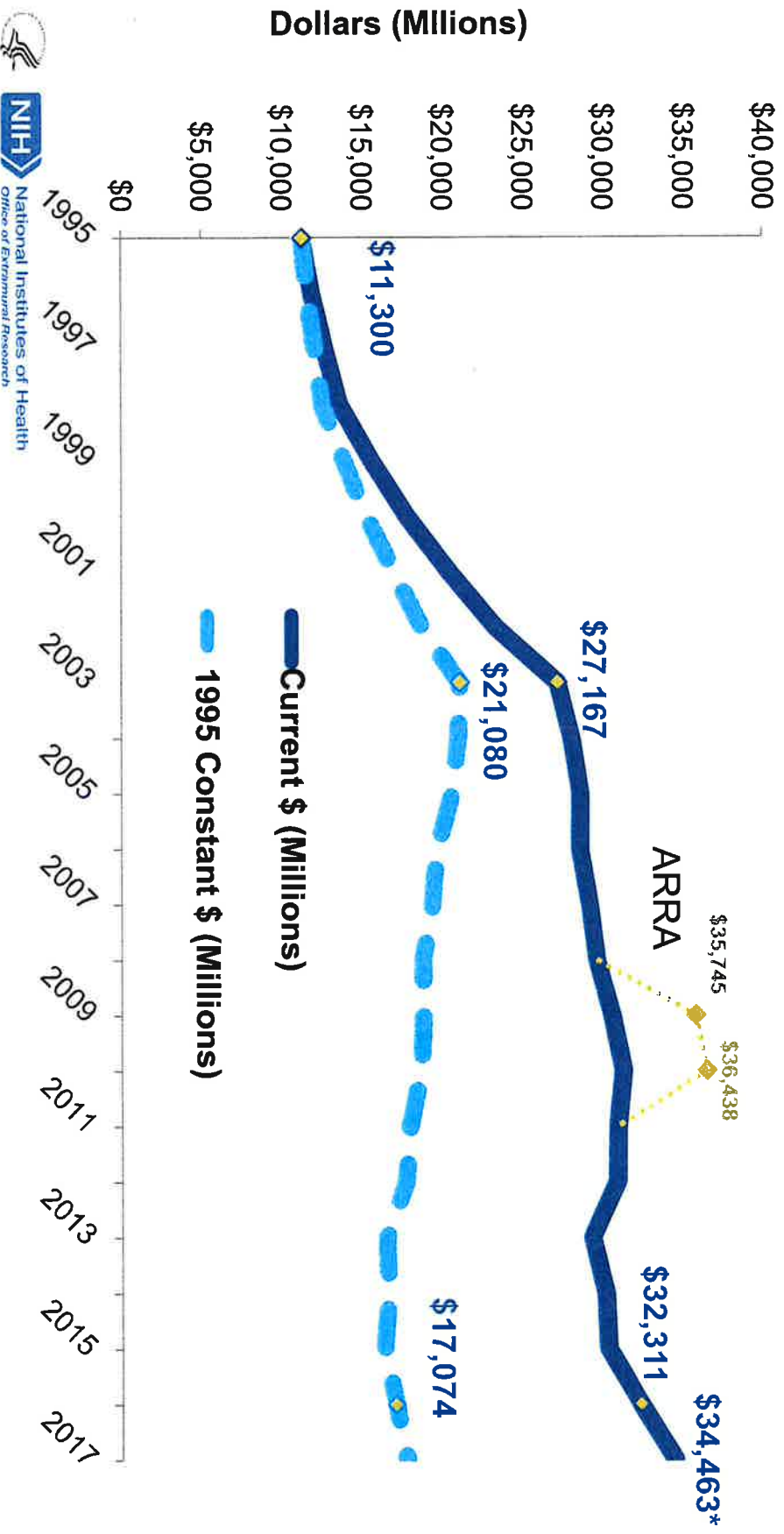
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Shapiro D, Vrana K. PNAS 2015;112:9496-7

## A New Finish Line

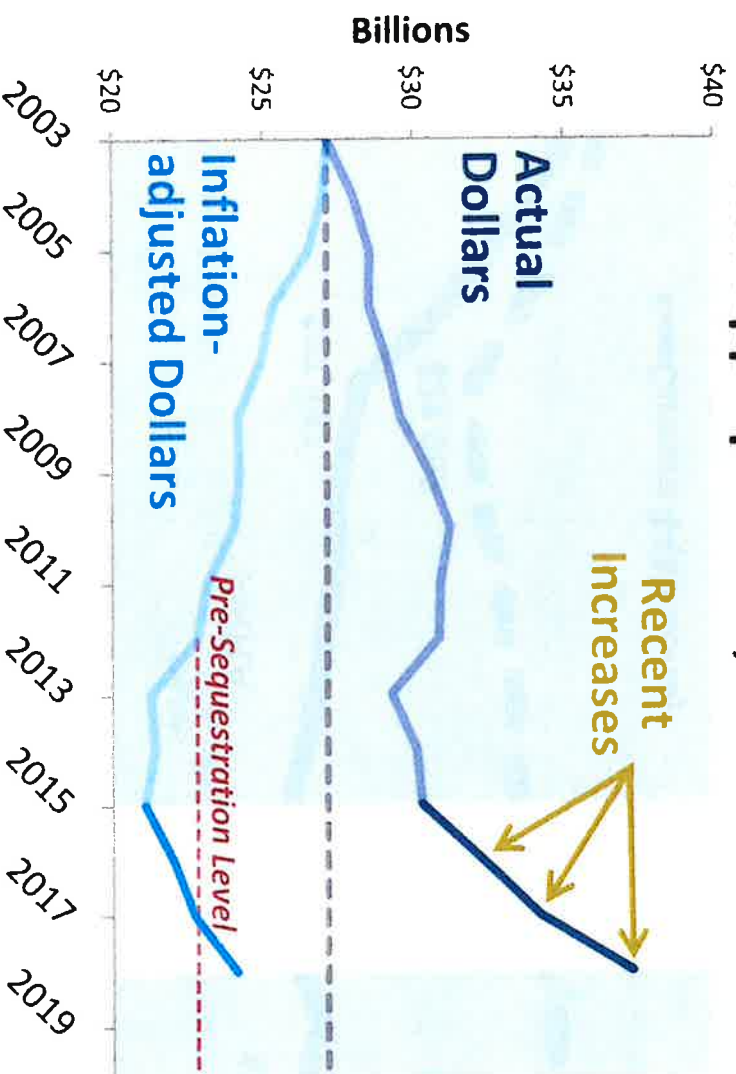


# NIH Budget Trends



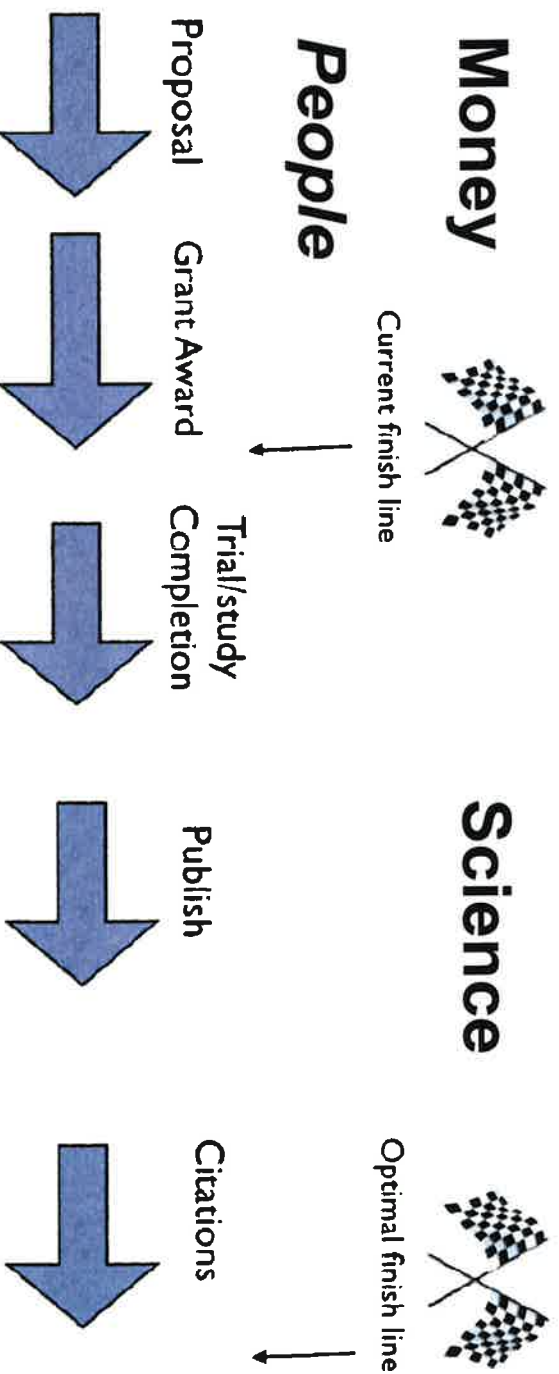
## Most Recent Trends

### NIH Appropriations, FY 2003-18





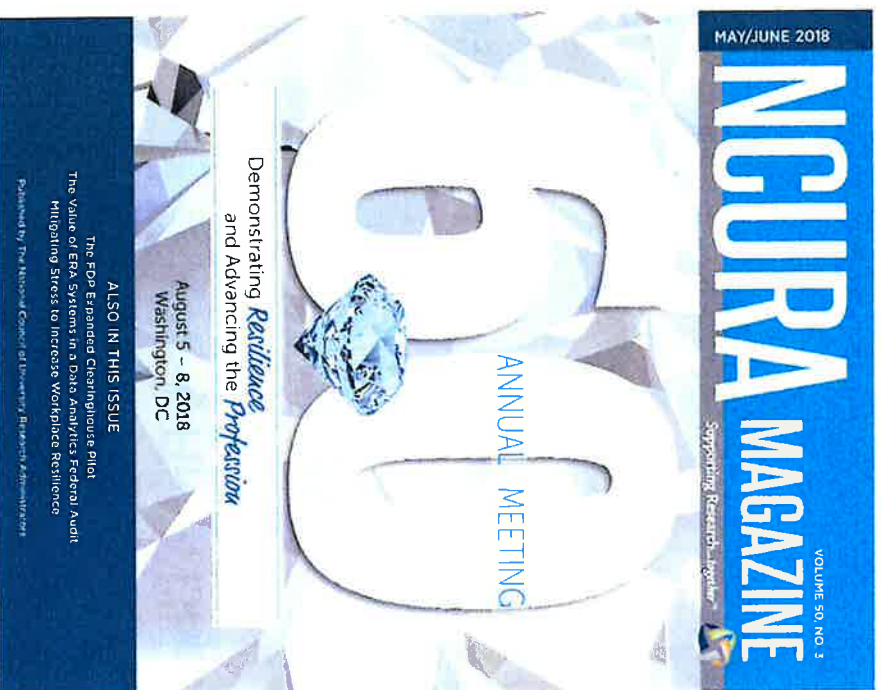
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# YOUNG, TALENTED AND FED-UP

BY KENDALL POWELL

**M**artin Tingley was coming undone. It was late autumn 2014, just over a year into his assistant professor job at Pennsylvania State University in State College, and he was on an eight-hour drive home after visiting his wife in Boston. He was stressed, exhausted and close to tears. As the traffic zipped past in the dark hours of the early morning, the headlights gave him the surreal feeling that he was inside a video game.

Usually, Tingley thought of himself as a “pretty stoic guy,” and on paper, his career was going well. He’d completed a master’s degree in statistics and a PhD in Earth science, both at Harvard University. With these, and four years of postdoctoral experience, he had landed a rare tenure-track faculty position. He thought he would soon be successfully combining statistics and climate science to produce the type of interdisciplinary research that funding agencies say they want.

In fact, scientific life was proving tough. He found himself working 60–80 hours per week doing teaching and research. His start-up funding had run out, he had yet to secure a major grant and, according to a practice com-

**Scientists starting labs say that they are under historically high pressure to publish, secure funding and earn permanent positions — leaving precious little time for actual research.**

an opportunity to direct their own creative.

Young scientists and senior scientists alike feel an acute pressure to publish and are weighed down by a growing bureaucratic burden, with little administrative support. They are largely judged on their record of publishing and of winning grants — but without clear targets, they find themselves endlessly churning out paper after paper. The crucial question is whether this is harming science and scientists. Bruce Alberts, a prominent biochemist at the University of California, San Francisco, and former president of the US National Academy of Sciences, says that it is. The current hyper-competitive atmosphere is stifling creativity and pushing scientists “to do mediocre science,” he says — work that is safe and uninteresting. “We’ve got to reward people who do something differently.”

Our informal survey suggests that the situation is already making research an unenviable career. Frankly, the job of being a principal investigator and running a lab just looks horrible,” wrote one neuroscientist from the United States. Tingley wouldn’t disagree.

## FUNDING FIGHT

Tingley has always had broad interests. At



**“The funding cycle is brutal.”**

MARTIN TINGLEY

Nature 2016;538:446-9



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## What They're Saying

### SUFFERING IN SCIENCE

We asked young scientists to tell us their concerns. This is what they said.

- Desperate pursuit of grants
- Long hours, but no time for science
- Extreme competition ... to cut corners
- Dependence on senior scientists
- Administrative overload ... No help



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Nature 2016;538:446-9

## What's Behind All This?



POINT OF VIEW

### **Strategies from UW-Madison for rescuing biomedical research in the US**

**Abstract** A cross-campus, cross-career stage and cross-disciplinary series of discussions at a large public university has produced a series of recommendations for addressing the problems confronting the biomedical research community in the US.  
DOI: 10.7554/eLife.09305.001

**“We identified two *core problems*:**

- Too many researchers vying for too few dollars.
- Too many postdocs competing for too few positions.

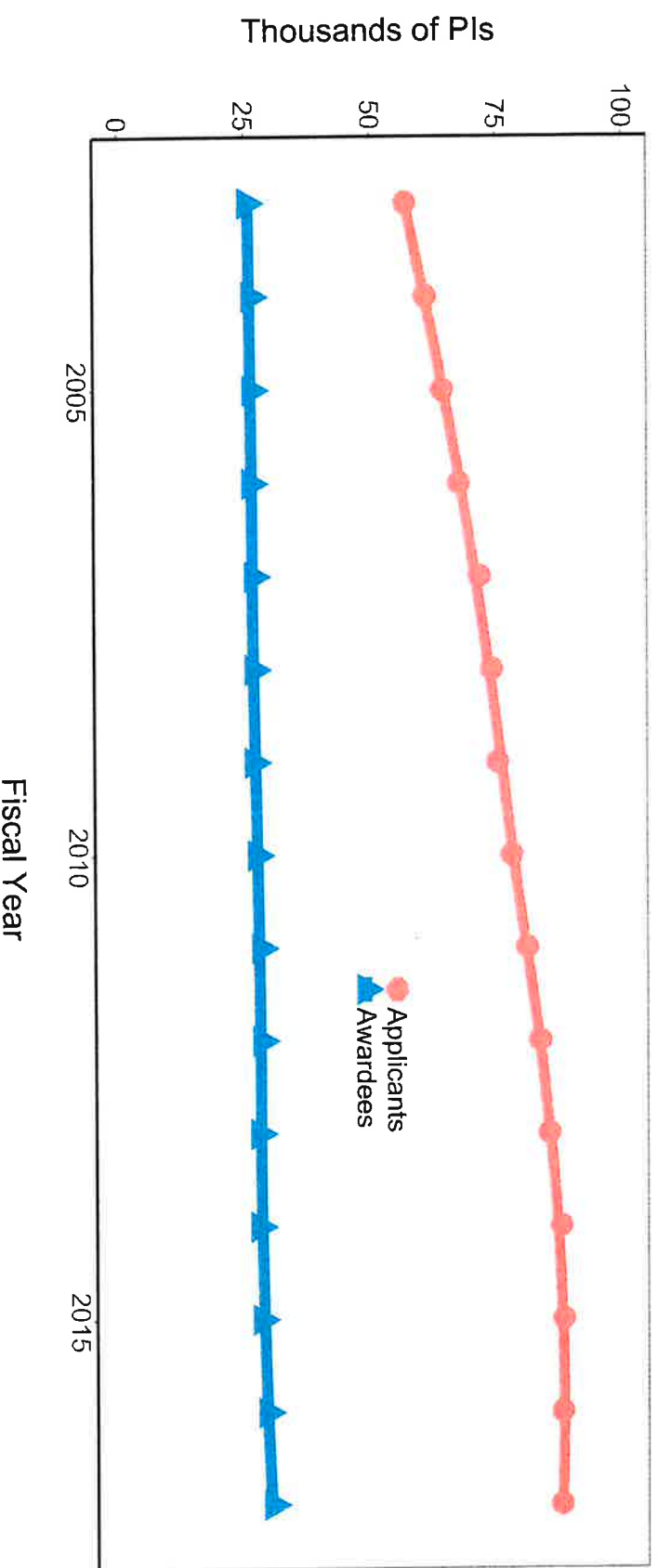
**Most other issues can be viewed as symptoms.”**



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## Too Many Researchers?

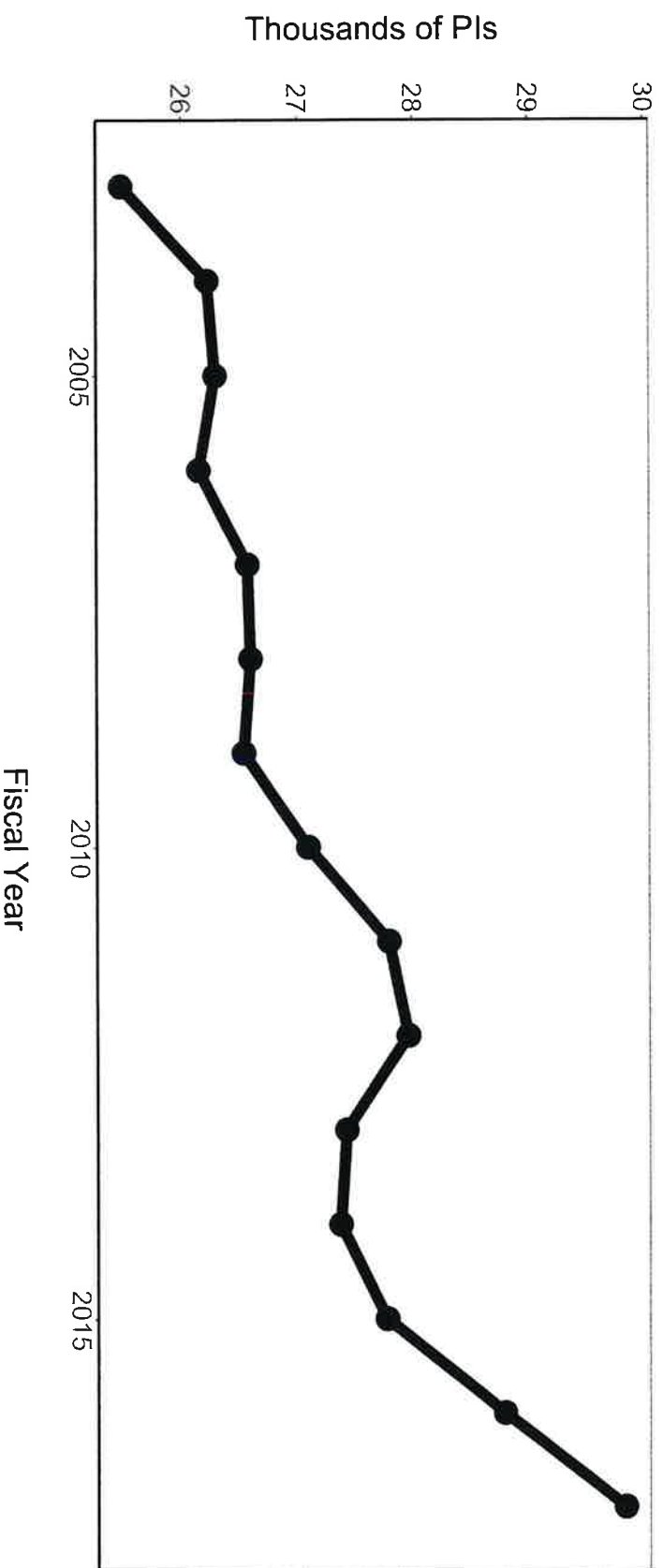
Awardees and Applicants for all RPGs over Time



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## Some Good News: Unique Awardees Over Time

Awardees for all RPGs over Time



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## Who is Most Affected by Hypercompetition?



**“In the United States, for example, funding success rates for all age brackets are less than half what they were in 1980, so researchers have to spend more time seeking funds. That burden falls most heavily on new faculty members ... makes them conservative rather than ambitious.”**

Nature 2016;538:427



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Legislation

### H.R.34 - 21st Century Cures Act

114th Congress (2015-2016) | [Get alerts](#)

#### Subtitle C—Supporting Young Emerging Scientists

SEC. 2021. INVESTING IN THE NEXT GENERATION OF RESEARCHERS.

(a) IN GENERAL. —Part A of title IV of the Public Health Service Act ([42 U.S.C. 281 et seq.](#)) is amended by adding at the end the following:

“SEC. 404M. NEXT GENERATION OF RESEARCHERS.

## OPINION

### The Next Generation Researchers Initiative at NIH

Michael Lauer<sup>1</sup>, Lawrence Tabak<sup>2</sup>, and Francis Collins<sup>3</sup>

Growing concerns about the wellbeing and stability of the biomedical research workforce are well documented. Over the last 15 years (since the end of the doubling of the NIH budget), we have observed worsening "hypercompetition" as more scientists vie for fewer available dollars (1, 2). Within this hypercompetitive environment, the research workforce is growing older at a rate that is disproportionate to the general American labor force (3). Late-career investigators have been awarded a greater proportion of available research funding, raising concerns that early-career investigators risk being crowded out of the workforce before they have a chance to launch independent scientific careers (3). Other analysts have suggested that adverse effects are also being felt by midcareer investigators (4); large numbers of mentorless investigators may achieve research independence only to lose it because they are unable to renew their one grant or obtain a second new grant.

In our latest effort to tackle this problem, the NIH is launching the "Next Generation Researchers Initiative,"

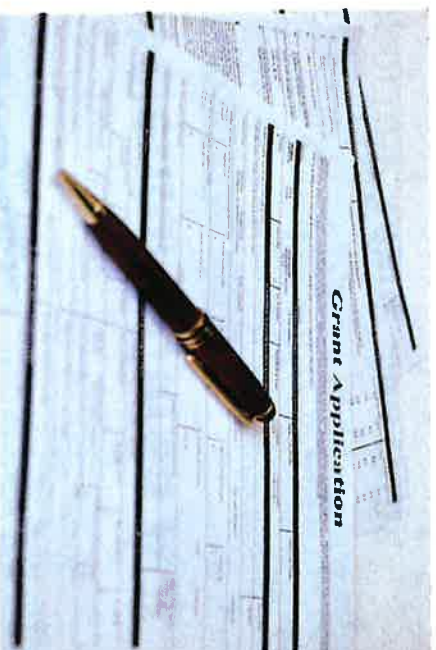


Fig. 1. The NIH hopes its latest initiative will improve the grant-funding prospects for early- and midcareer investigators. Image courtesy of Shutterstock/Stephen\_Payne.

## OPINION



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## Hot Off the Press: NAS Report

# THE NEXT GENERATION OF BIOMEDICAL AND BEHAVIORAL SCIENCES RESEARCHERS: BREAKING THROUGH

Committee on the Next Generation Initiative  
Board on Higher Education and Workforce  
Policy and Global Affairs

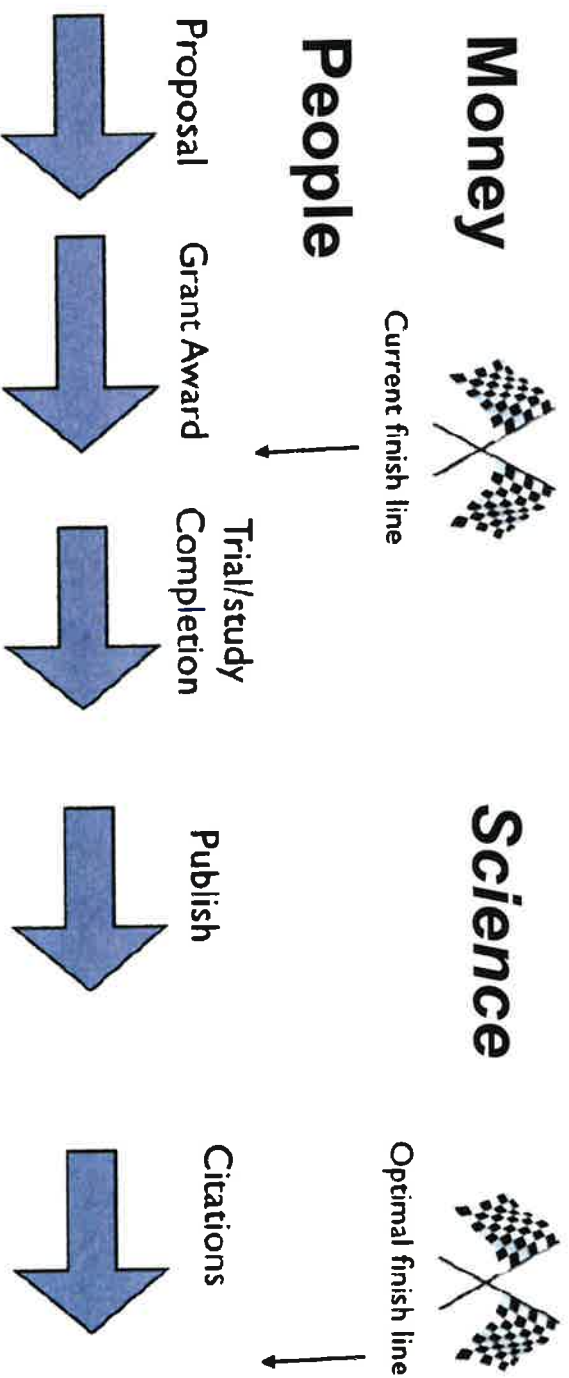
A Consensus Study Report of  
*The National Academies of*  
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<http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=25008>

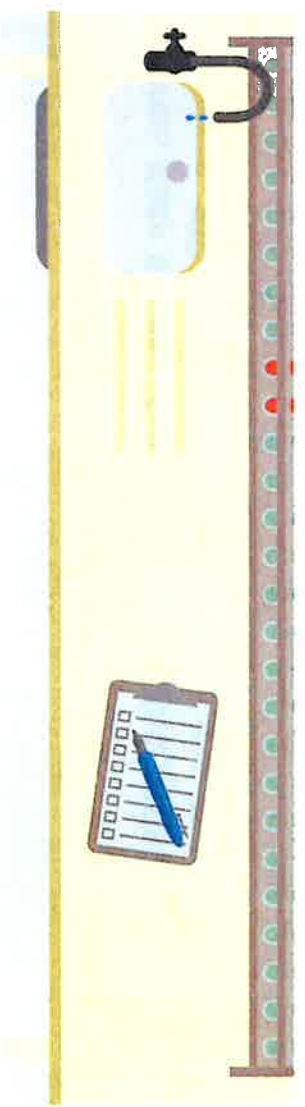
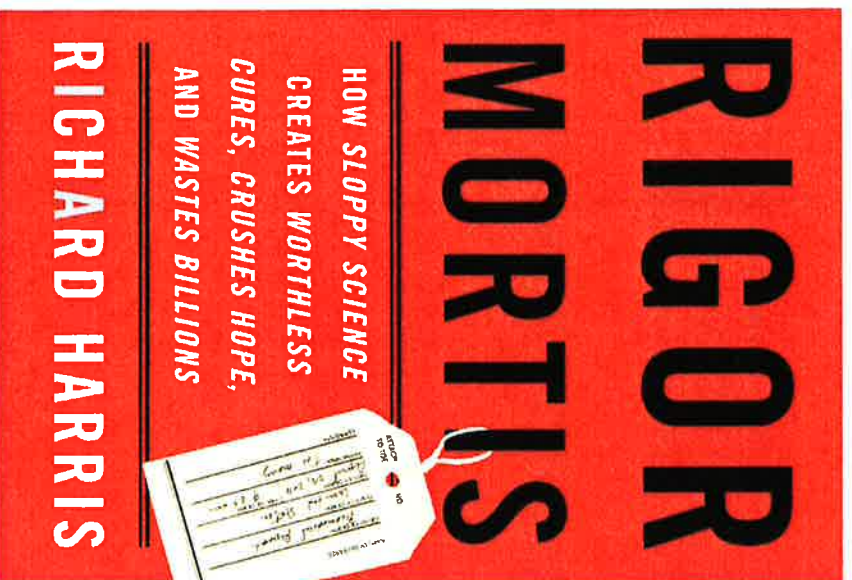
## A New Finish Line



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Shapiro D, Vrana K. PNAS 2015;112:9496-7

## Poor Quality Science?



## NIH plans to enhance reproducibility

**Francis S. Collins** and **Lawrence A. Tabak** discuss initiatives that the US National Institutes of Health is exploring to restore the self-correcting nature of preclinical research.

Nature 2014;505:612-13



**RESEARCH**

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**REVIEW SUMMARY**

**SCIENCE COMMUNITY**

# Science of science

Santo Fortunato, \* Carl T. Bergstrom, Katy Börner, James A. Evans, Dirk Helbing,  
Staša Milojević, Alexander M. Petersen, Filippo Radicchi, Roberta Sinatra, Brian Uzzi,  
Alessandro Vespignani, Ludo Waltman, Dashun Wang, Albert-László Barabási\*

S. Fortunato et al., Science 359, eaa00185  
(2018). DOI: 10.1126/science.aa00185



## How Do We Convey ... What's the Value of Research?

### **100 Metrics to Assess and Communicate the Value of Biomedical Research** An Ideas Book



Susan Guthrie, Joachim Krapels,  
Catherine Lichten, Steven Wooding

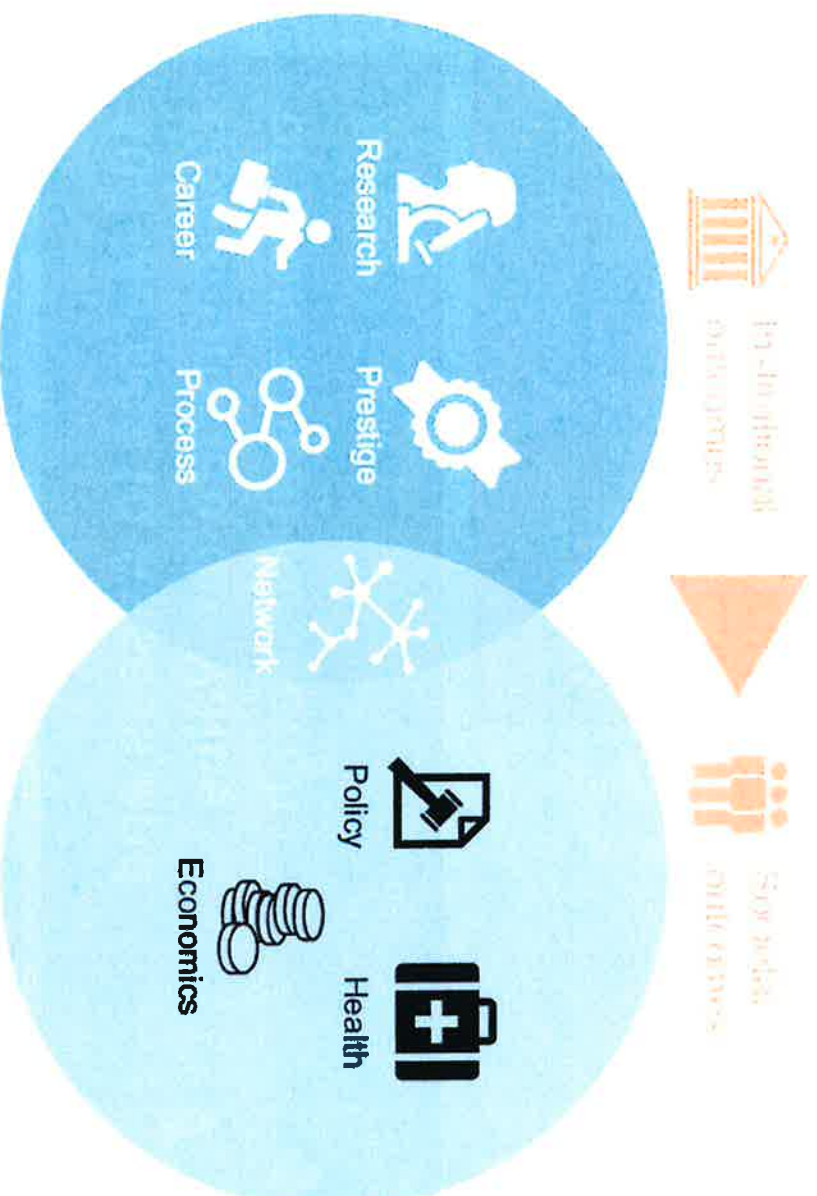


EUROPE



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# High-Level Categories



## Assessing Value in Biomedical Research The PQRST of Appraisal and Reward

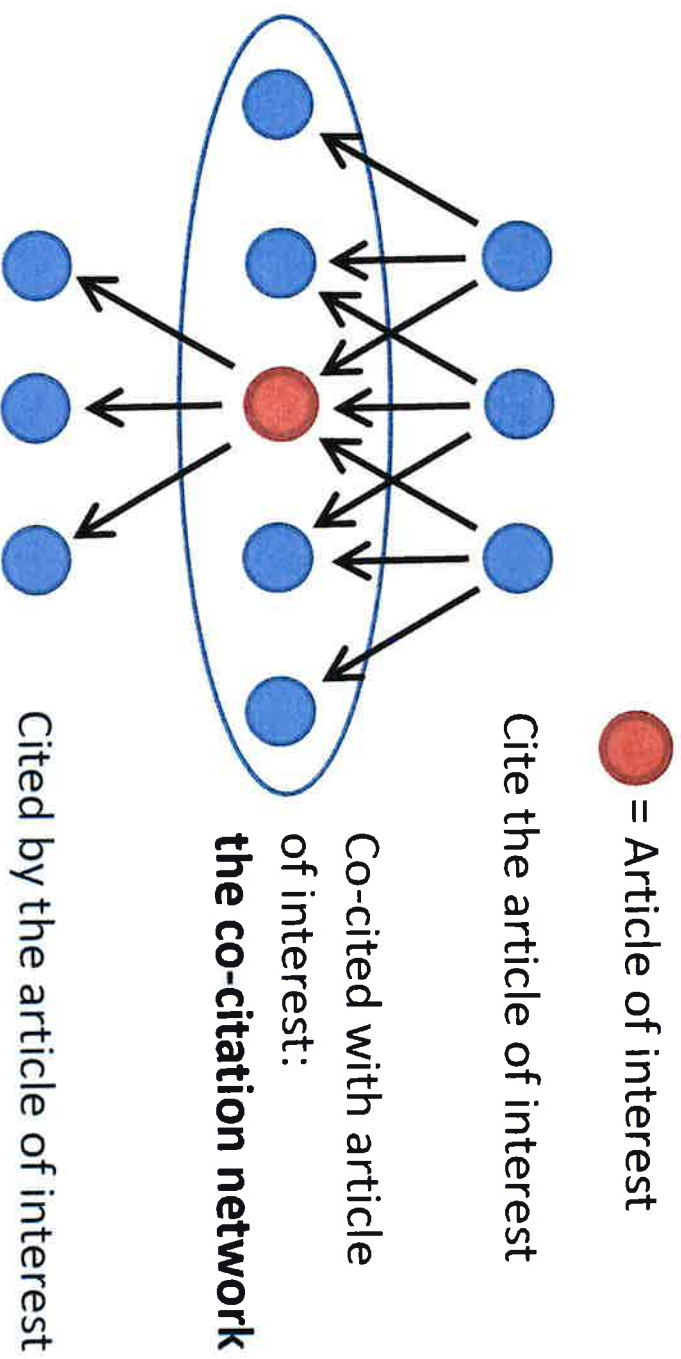
### Framework: PQRST

- **P = productivity**
  - Highly-cited papers
  - Patents
- **Q = quality**
- **R = replication**
- **S = sharing**
- **T = translation**

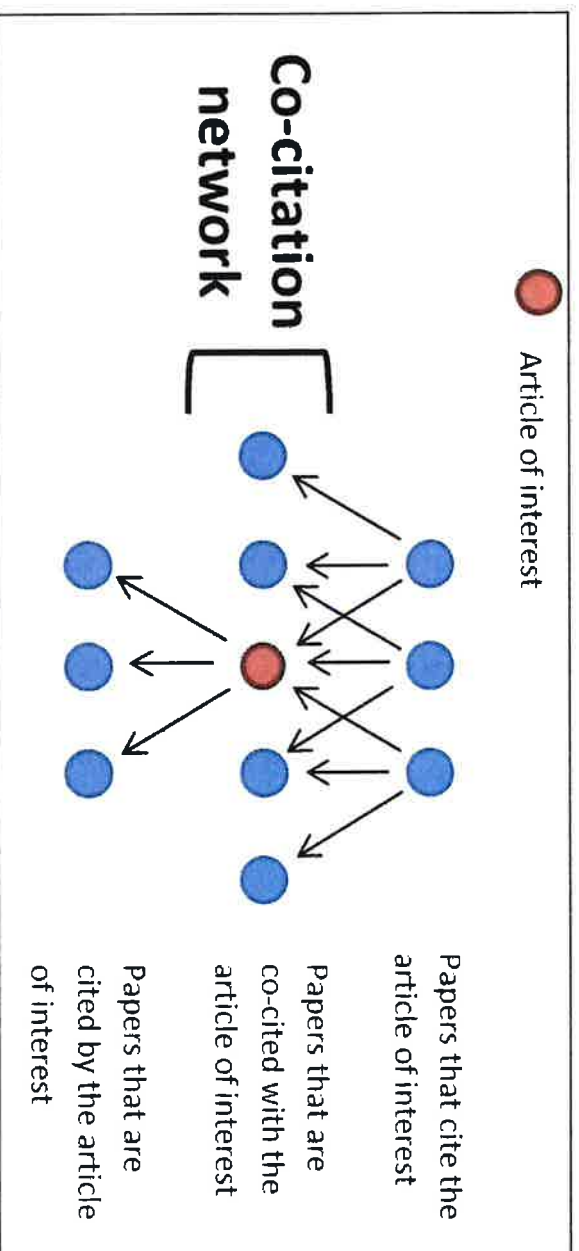


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## P: Relative Citation Ratio

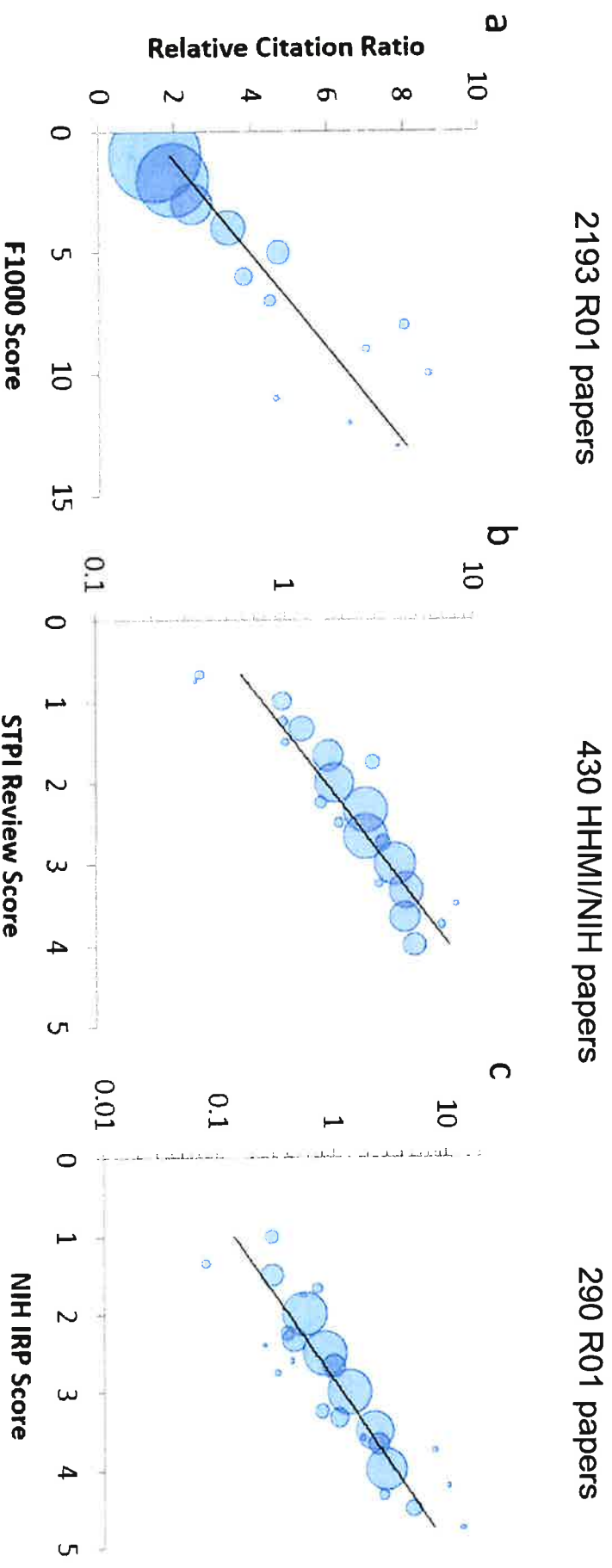


# What It Means



0 = never cited  
1 = average  
2 = twice the average  
>20 = exceptionally highly cited

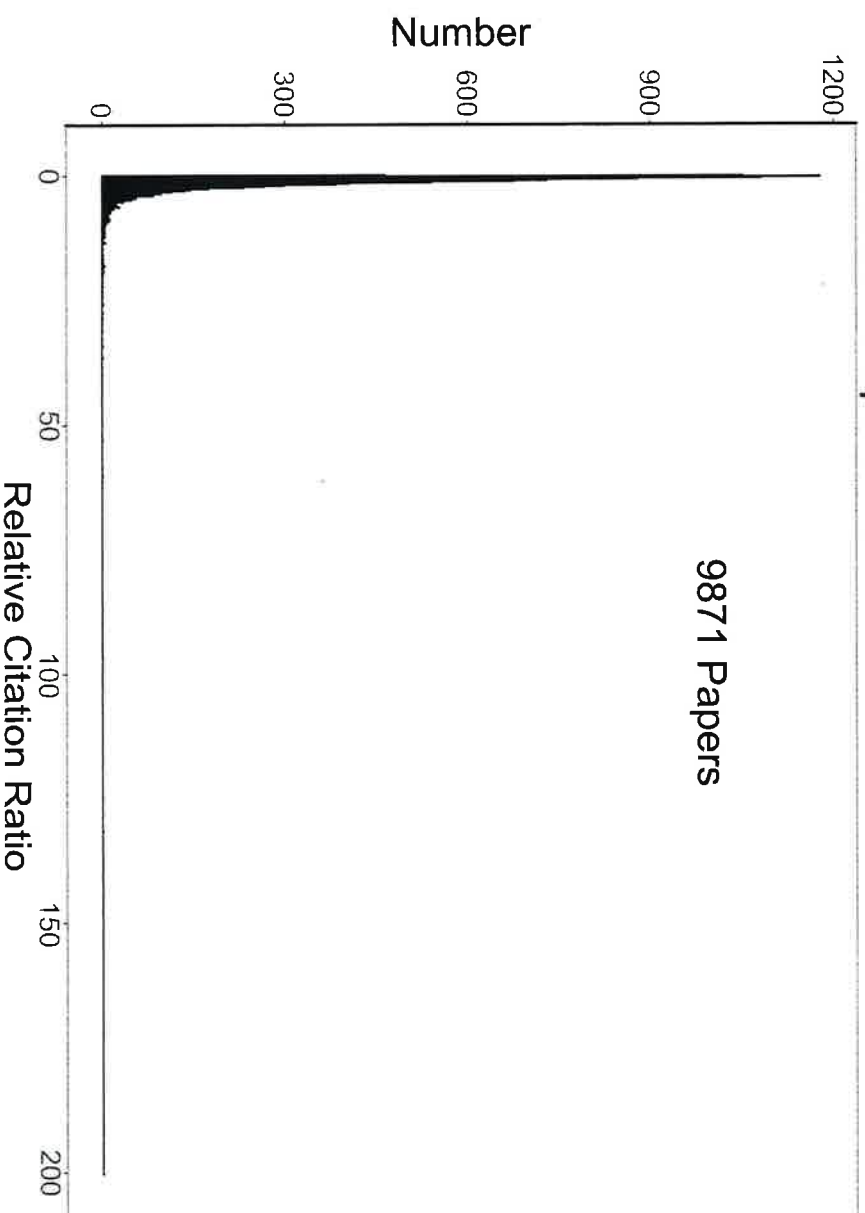
# How Do We Know Whether It Means Anything?





## Citation Metrics (Really Most) Follow Skewed Distribution

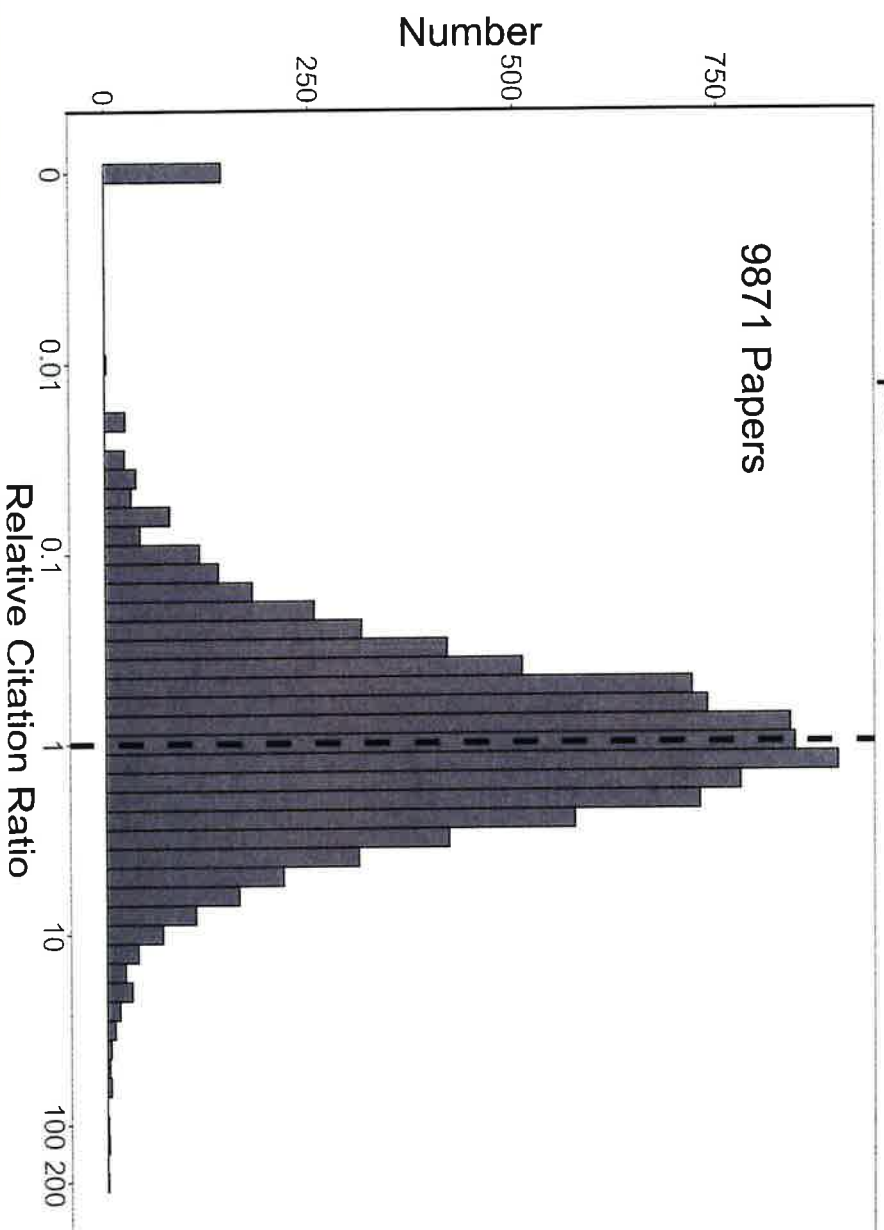
Jefferson Papers Published 1995 to 2014



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## Logarithmic Transformation Yields ...

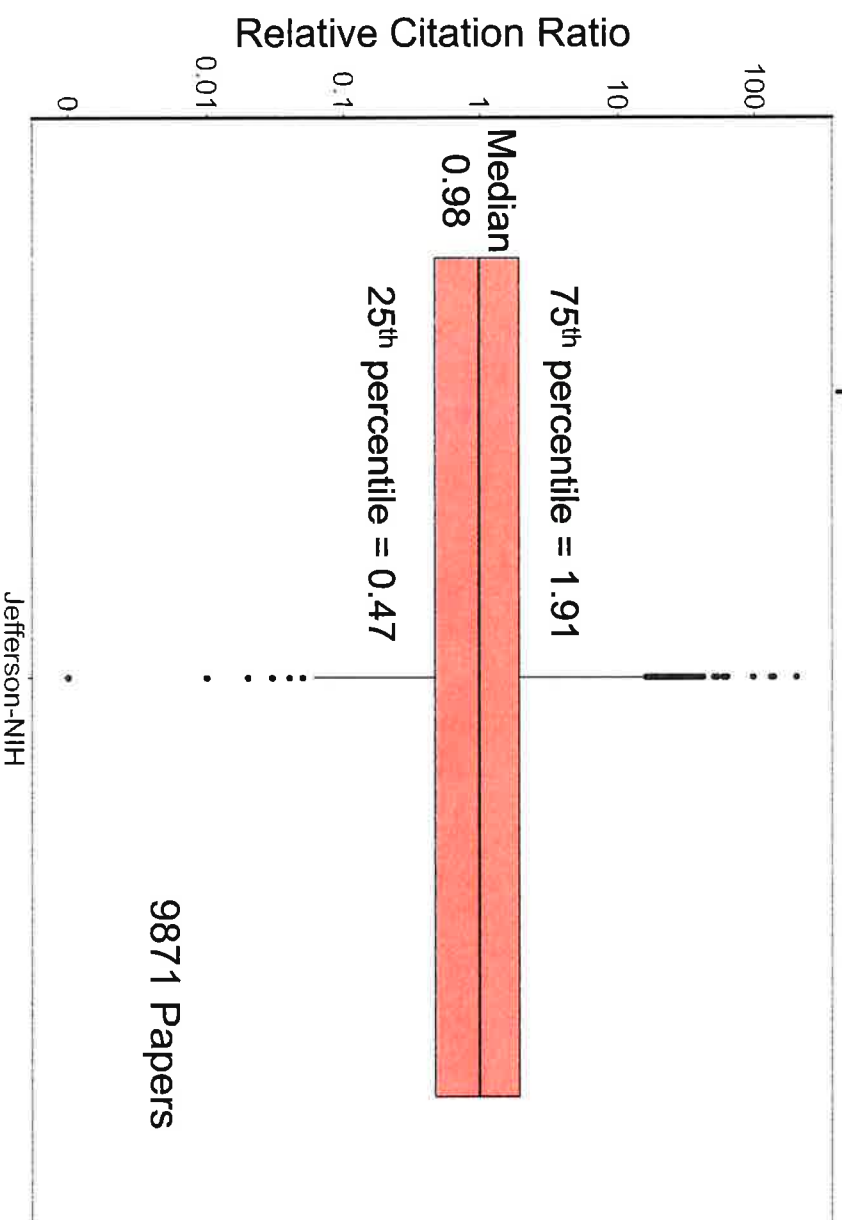
Jefferson Papers Published 1995 to 2014



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## Same Data by Box Plot

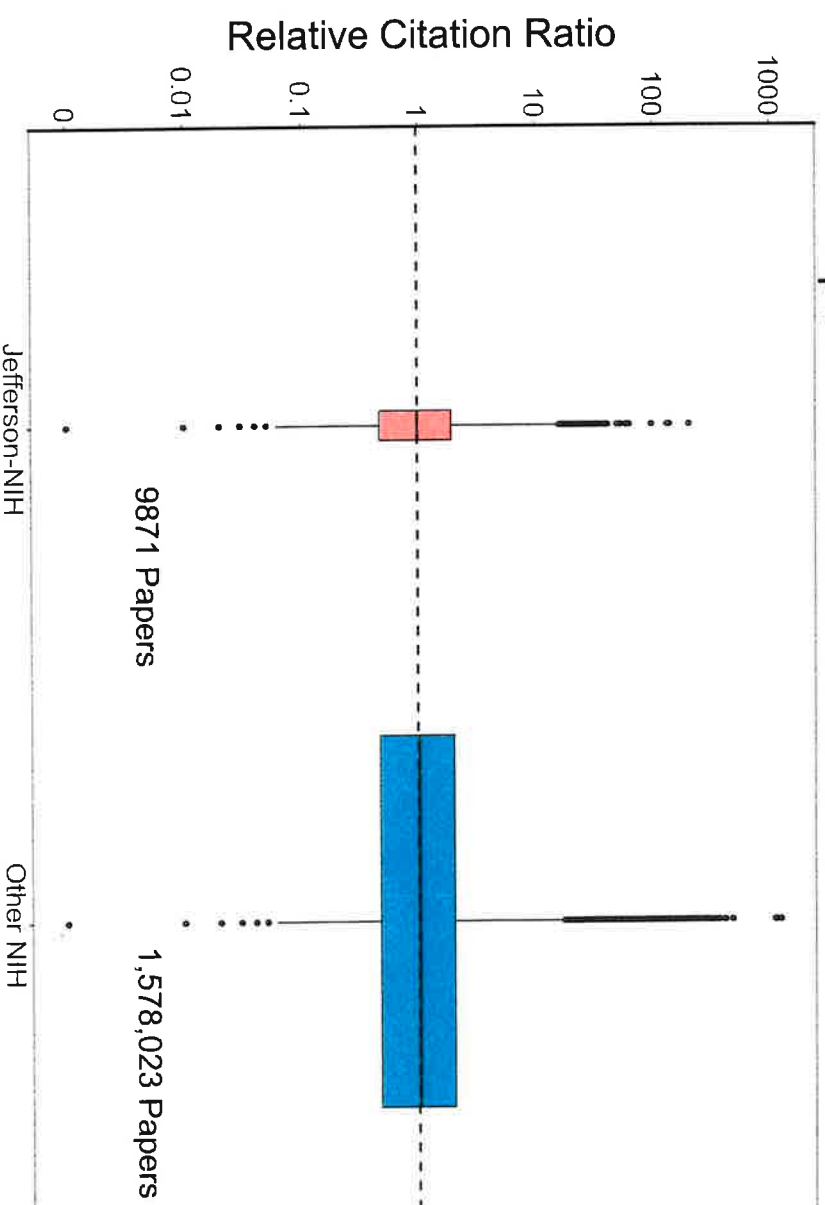
Jefferson Papers Published 1995 to 2014



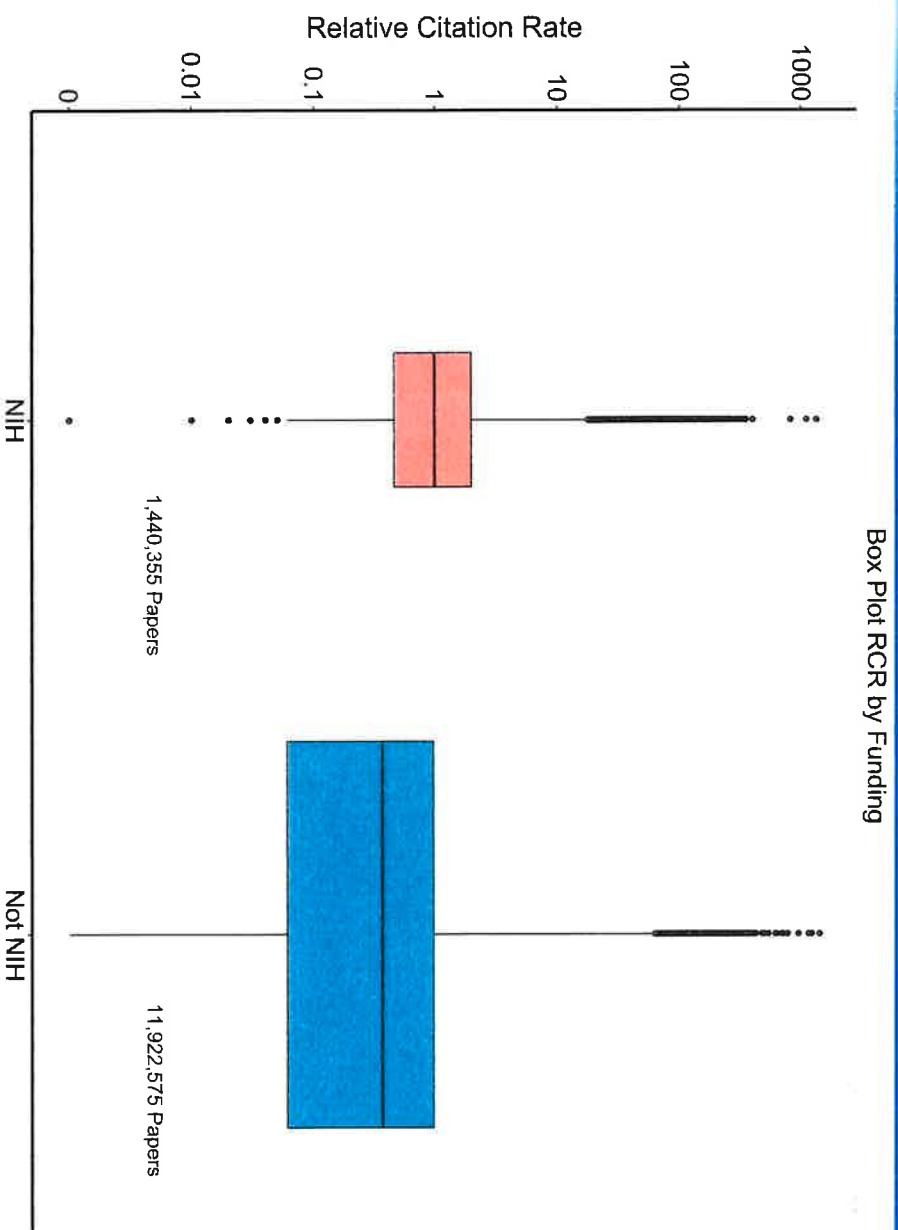
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## Compared to Other NIH

NIH Papers Published 1995 to 2014



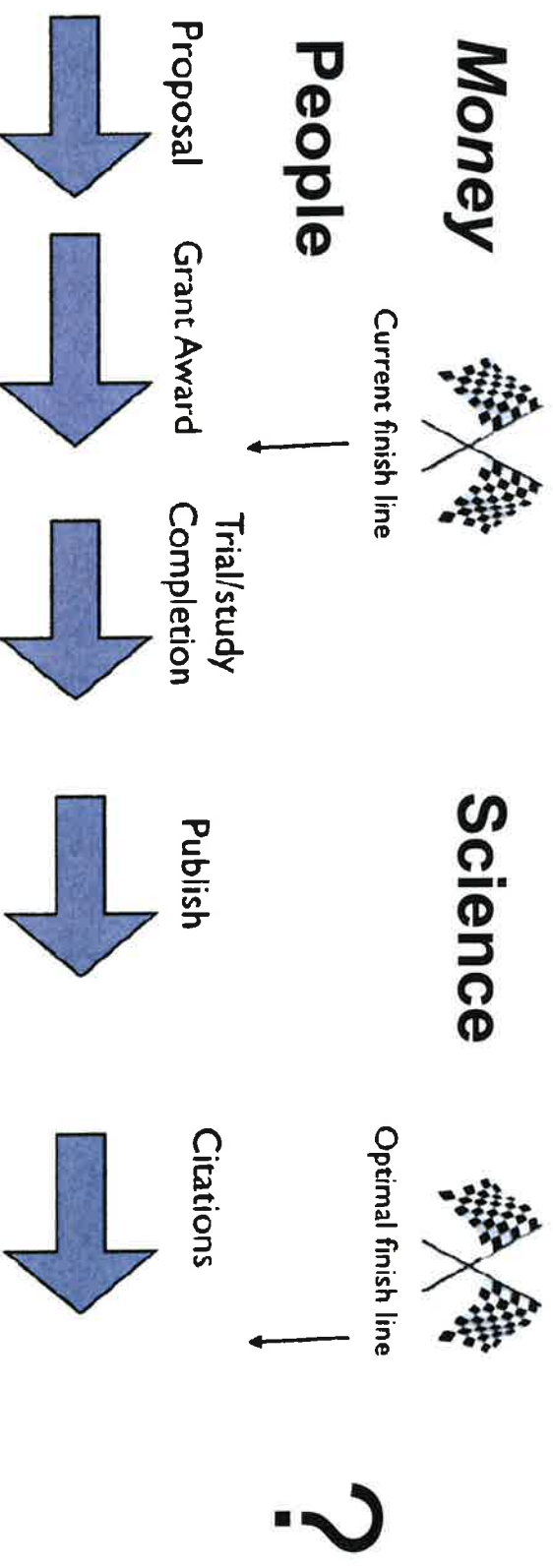
# NIH And Others...



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# What's the Real Finish Line?

## A New Finish Line





# From Scientific Discovery to Cures: Bright Stars within a Galaxy

## T: A Scientific Journey With Big Data

R. Sanders Williams,<sup>1,2,\*</sup> Samad Lotia,<sup>1</sup> Alisha K. Holloway,<sup>1,2</sup> and Alexander R. Pico<sup>1,2</sup>

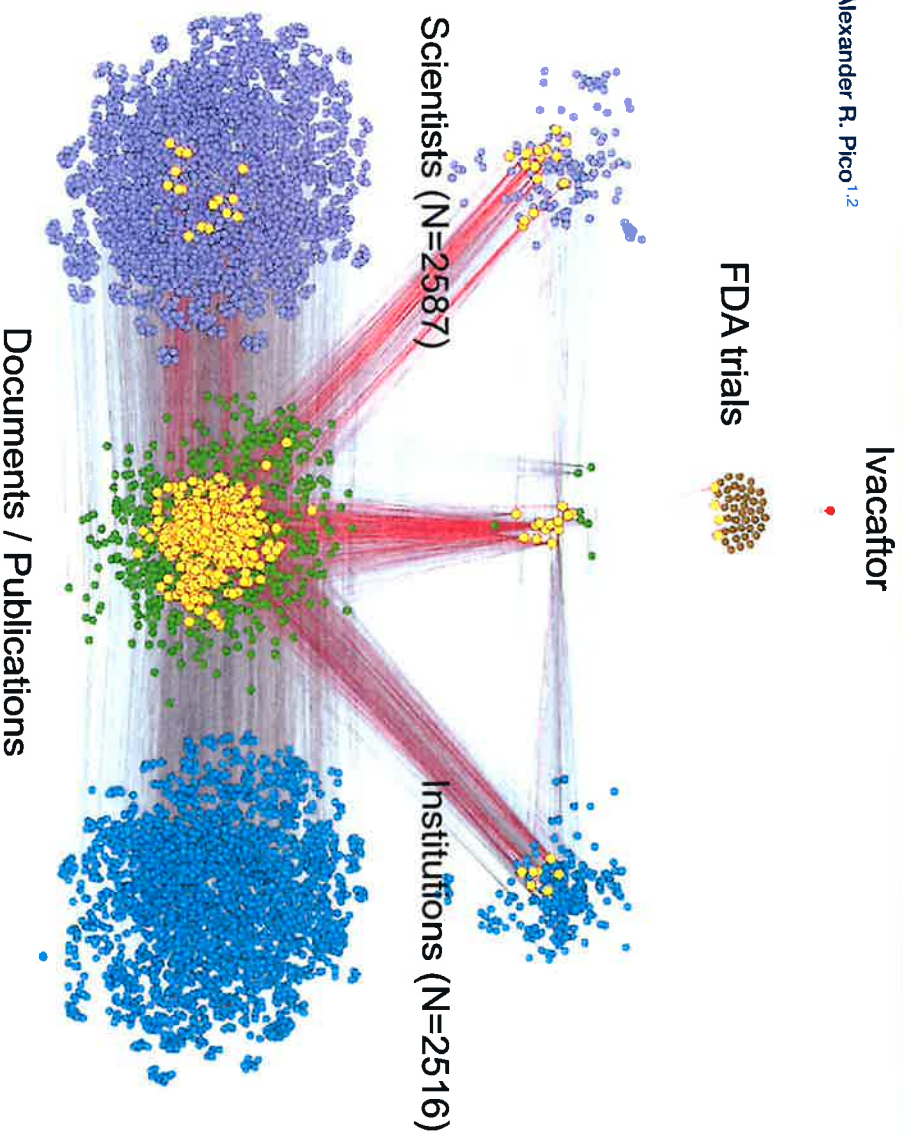
<sup>1</sup>Gladstone Institutes, San Francisco, CA 94158, USA

<sup>2</sup>University of California, San Francisco, San Francisco, CA 94143, USA

\*Correspondence: rs.williams@gladstone.ucsf.edu

<http://dx.doi.org/10.1016/j.cell.2015.09.007>

**“We propose that data mining and network analysis utilizing public databases can identify and quantify relationships between scientific discoveries and major advances in medicine (cures). Such approaches could enhance decision making...”**

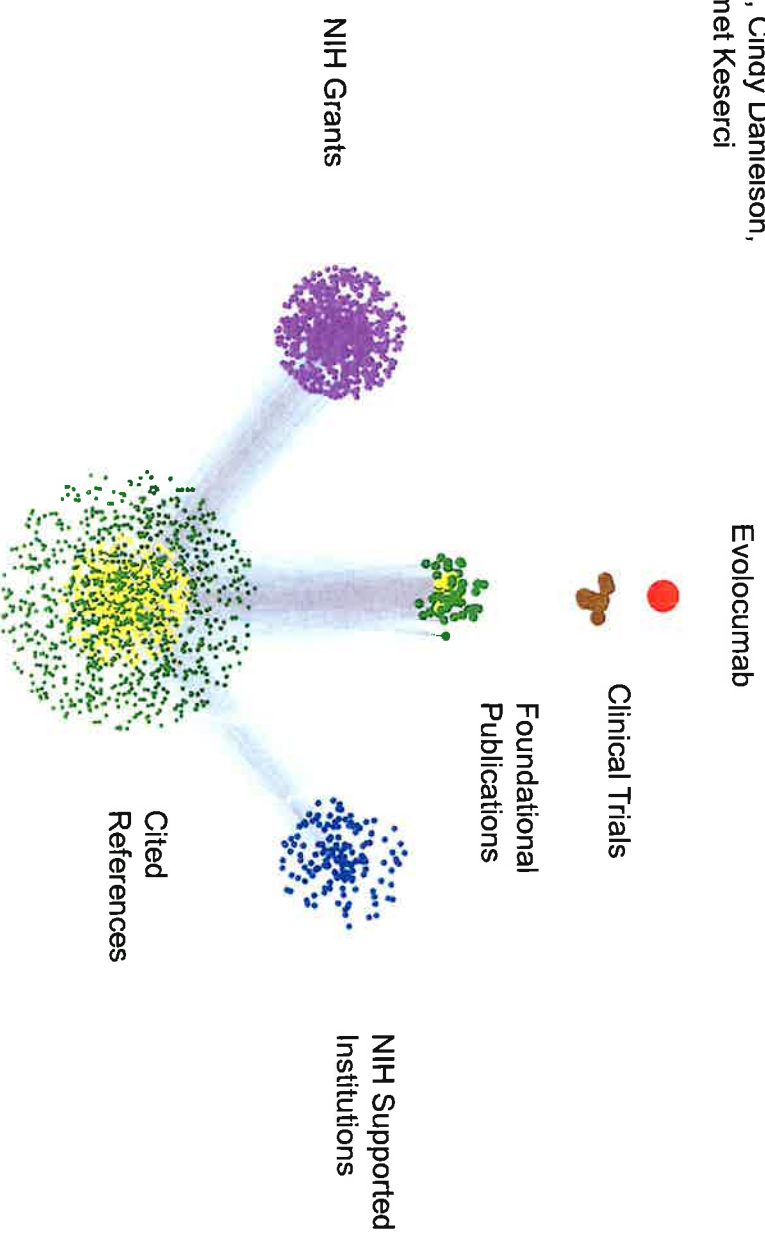


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Cell 2015;163:21-23

# An Ongoing Big Data Translation Exploration

Thanks to Brian Haugen, Cindy Danielson,  
George Chacko and Samet Keserci



## New Scientific Urgencies ... People, Money, Science

*THE NEW ENGLAND JOURNAL of MEDICINE*

### SPECIAL REPORT

## The Role of Science in Addressing the Opioid Crisis

Nora D. Volkow, M.D., and Francis S. Collins, M.D., Ph.D.

- Overdose prevention and reversal
- Treatment of opioid use disorders
- Treatment of chronic pain

<http://www.nejm.org/doi/pdf/10.1056/NEJMs1706626>

Looking Forward to Open Dialogue ...

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## Open Mike

*Helping connect you with the NIH perspective, and helping connect us with yours*

Posted on **June 16, 2017** by **Mike Lauer**

### NIH's Next Generation Researchers Initiative



<https://nexus.od.nih.gov/all/2017/06/16/nih-next-generation-researchers-initiative/>



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