How Do We Measure the Value and Output of Research? Thoughts from NIH

Michael S Lauer, MD
Deputy Director for Extramural Research
National Institutes of Health

Meeting of the Federal Demonstration Partnership
Monday, January 9, 2017
Hyatt Regency Capitol Hill, Regency B Ballroom, 400 New Jersey Ave NW, Washington DC (12:15 PM)
Disclosures: None

Lots of Interest

100 Metrics to Assess and Communicate the Value of Biomedical Research

An Ideas Book

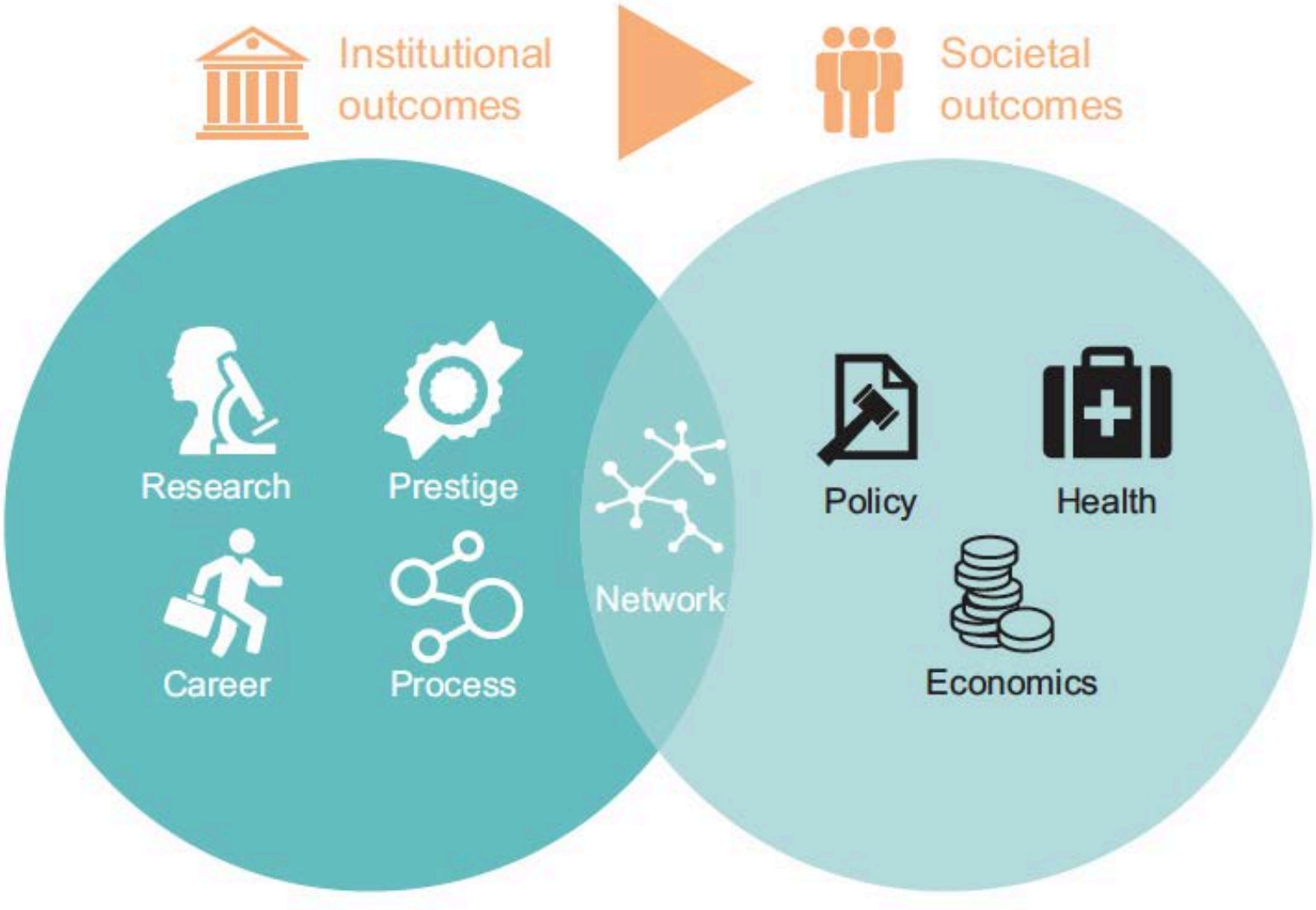
Susan Guthrie, Joachim Krapels, Catherine Lichten, Steven Wooding

RAND EUROPE

AAMC

NIH National Institutes of Health
Office of Extramural Research

High-Level Categories



Bonham A and Alberti PA (AAMC, RAND)

VIEWPOINT

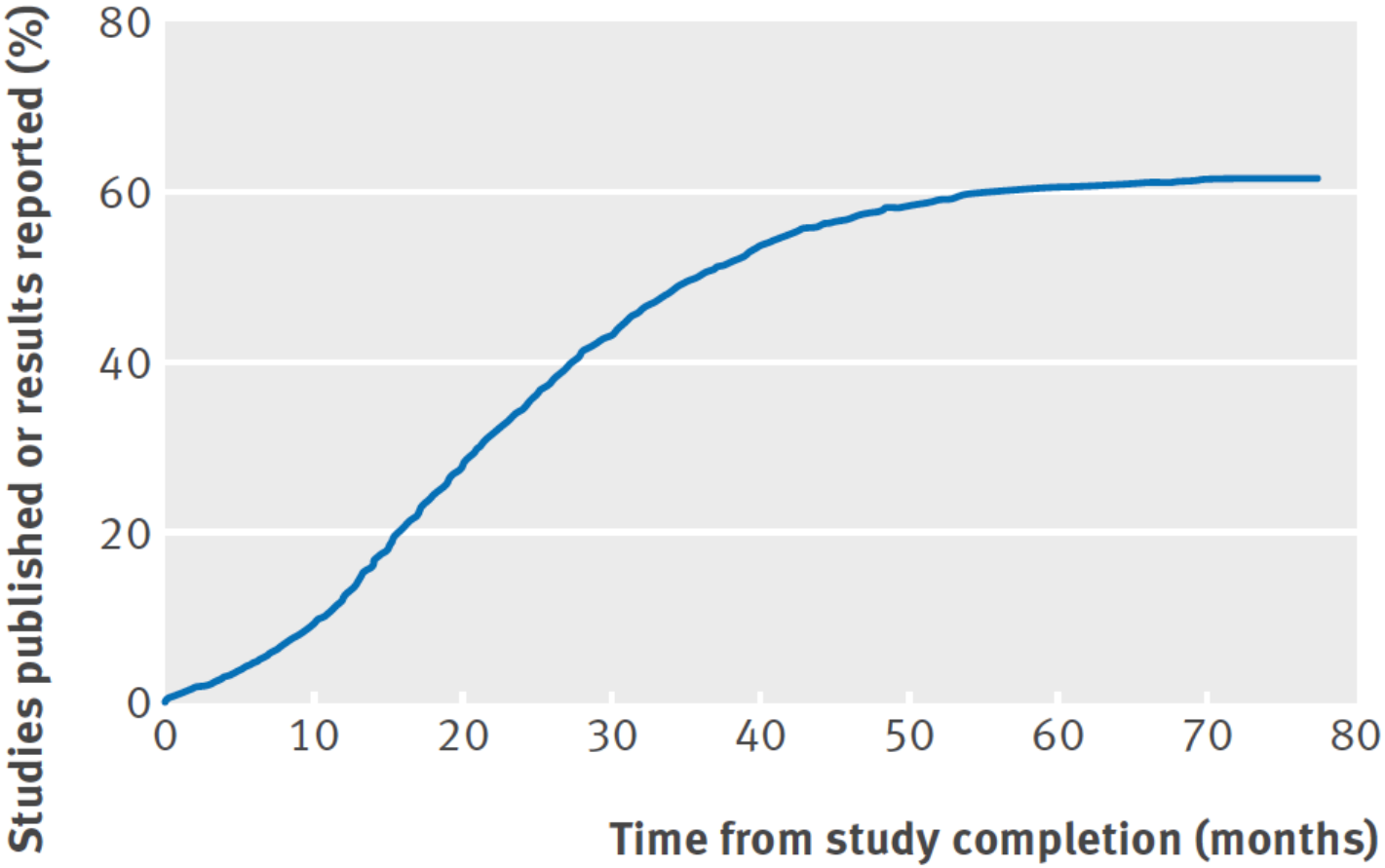
Assessing Value in Biomedical Research
The PQRST of Appraisal and Reward

PQRST

- P = productivity
  - Publish trial results
  - Highly-cited papers: **field-normalized**
- Q = quality
- R = replication
- S = sharing
- T = translation

Ioannidis JP, Khoury MJ. JAMA 2014 (June 9)

P: Publish Trial Results (!?)



"Only 29% of completed clinical trials conducted by the faculty at major academic institutions were published within two years…"

Chen R et al BMJ 2016;352:i637

Administrative Task?

POLICY-ISH

Academic Medical Centers Get An F In Sharing Research Results

February 23, 2016 · 1:59 PM ET
Commentary

HARLAN KRUMHOLZ

VIEWPOINT

Toward a New Era of Trust and Transparency in Clinical Trials

Who will check the study results if they aren't made public?
Simone Golob/Corbis

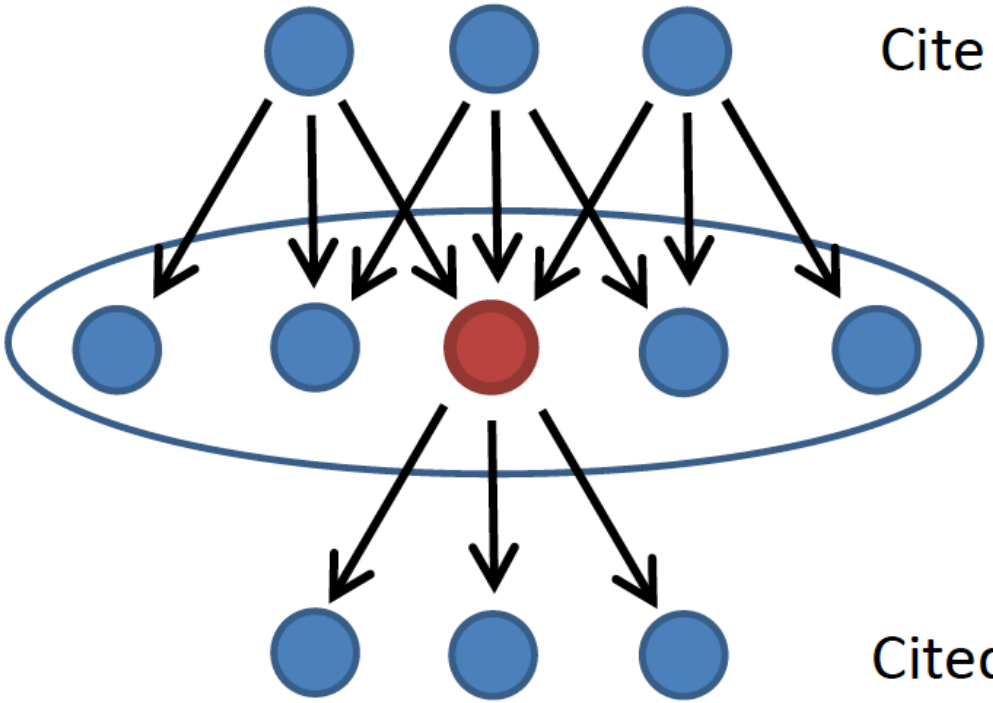
Kathy L. Hudson, PhD
National Institutes of Health, Bethesda, Maryland.

Michael S. Lauer, MD
National Institutes of Health, Bethesda, Maryland.

Francis S. Collins, MD, PhD
National Institutes of Health, Bethesda, Maryland.

Krumholz H. www.npr.org (Feb 23, 2016)
JAMA (on-line Sept 16, 2016)

P: Relative Citation Ratio



= Article of interest

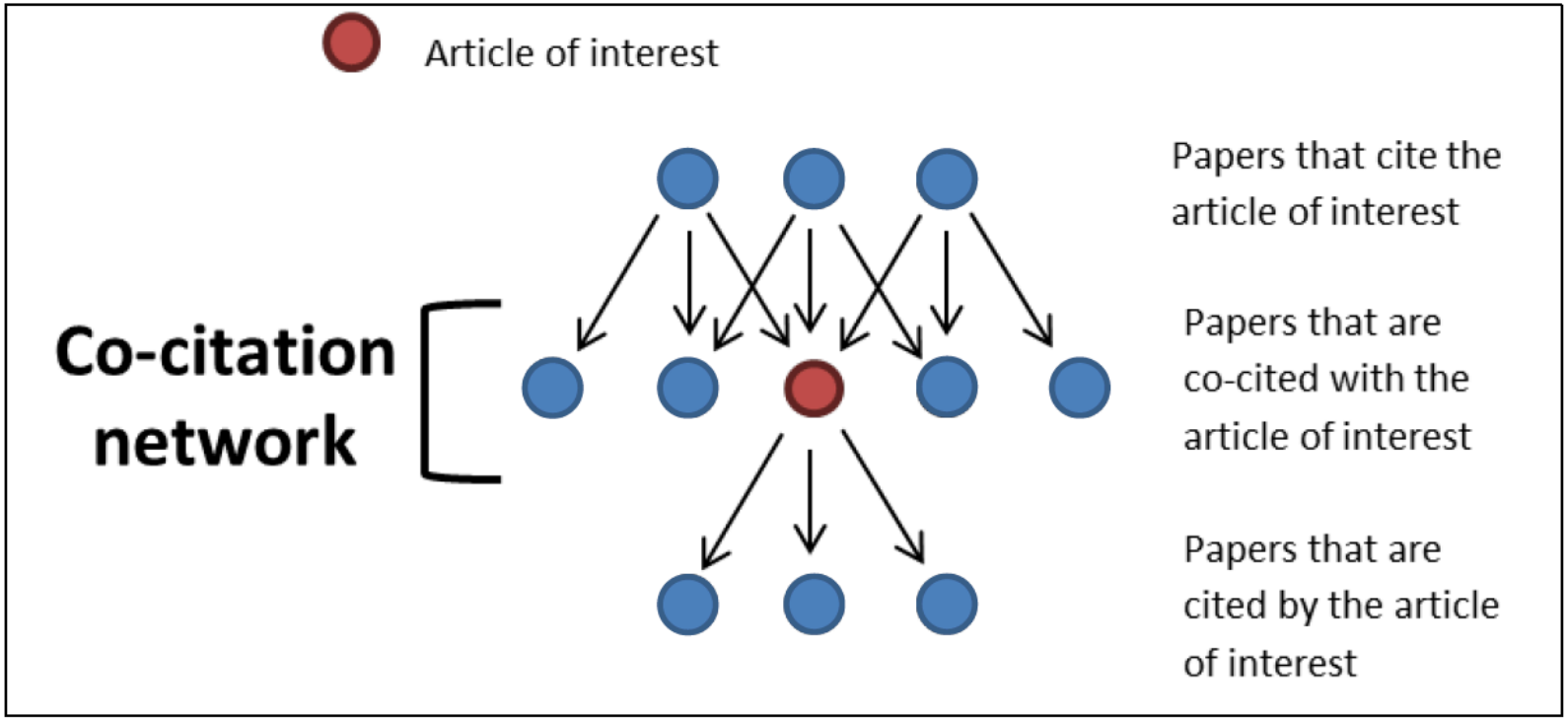
Cite the article of interest

Co-cited with article of interest:
the co-citation network

Cited by the article of interest

NIH Office of Portfolio Analysis
PLoS Biology (September 6, 2016)

What It Means

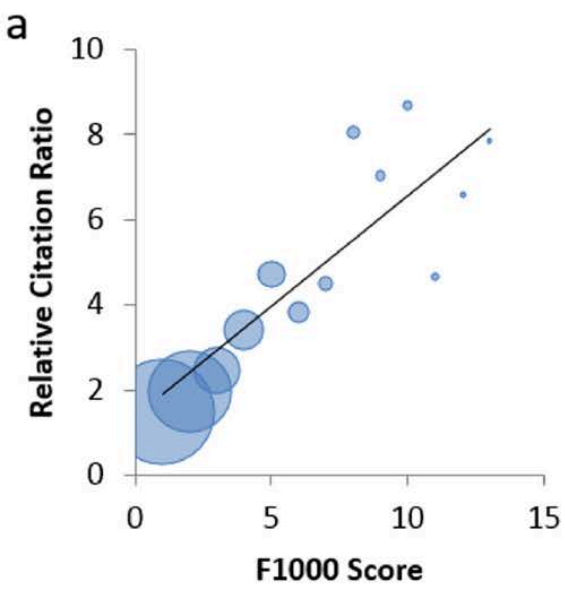


0 = never cited
1 = average
2 = twice the average
>20 = exceptionally highly cited

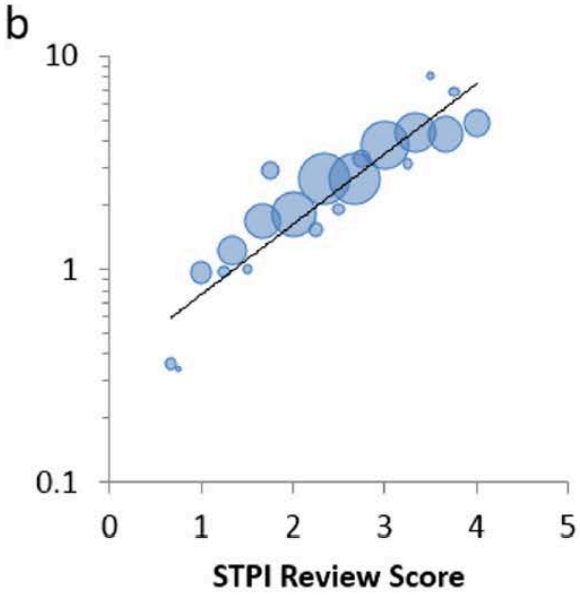
NIH Office of Portfolio Analysis
PLoS Biology (September 6, 2016)

How Do We Know Whether It Means Anything?

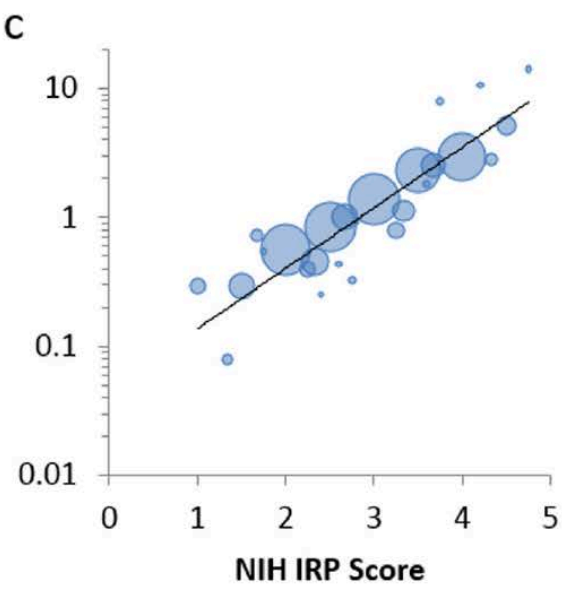
2193 R01 papers



430 HHMI/NIH papers



290 R01 papers



NIH Office of Portfolio Analysis
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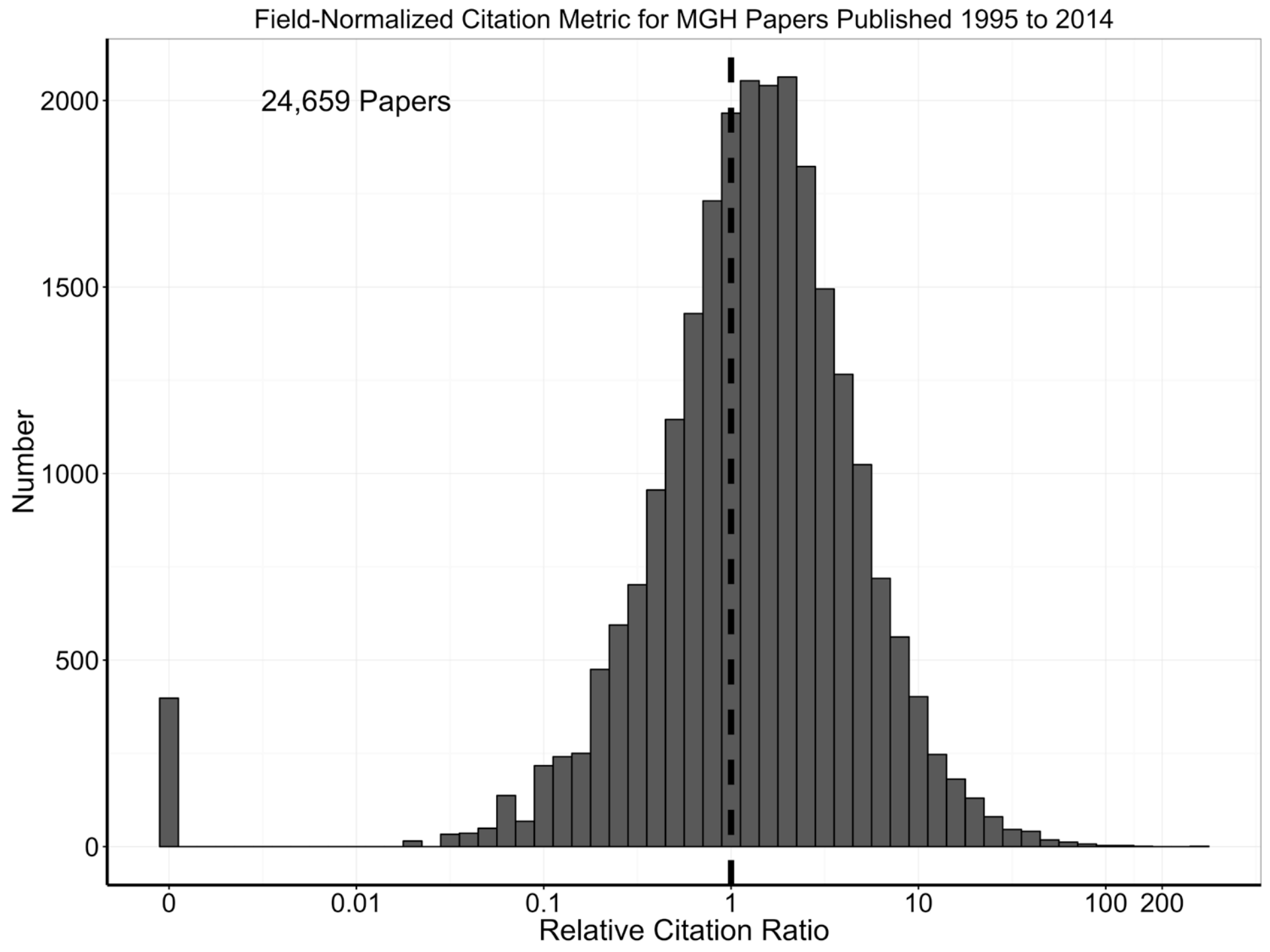
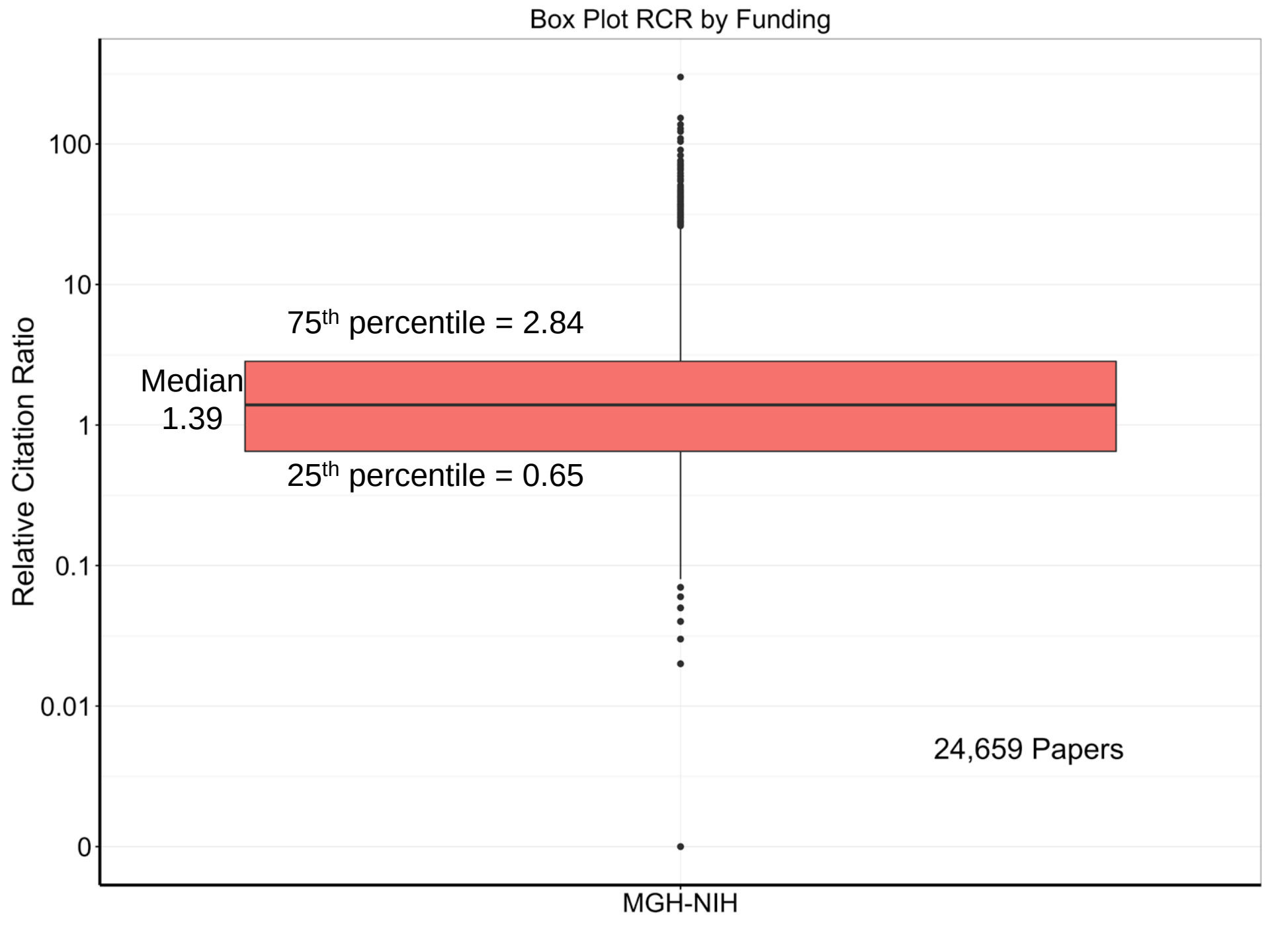
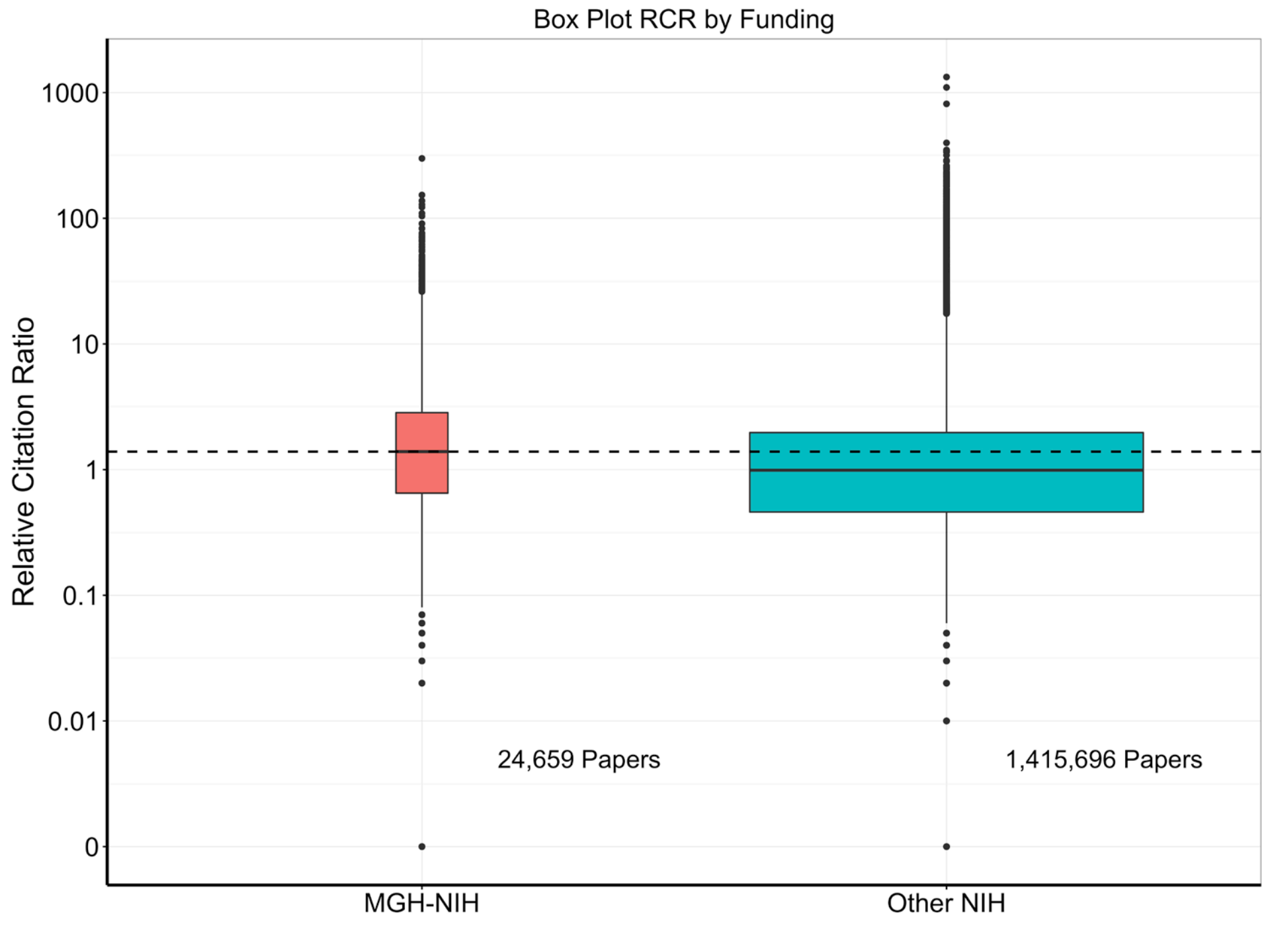
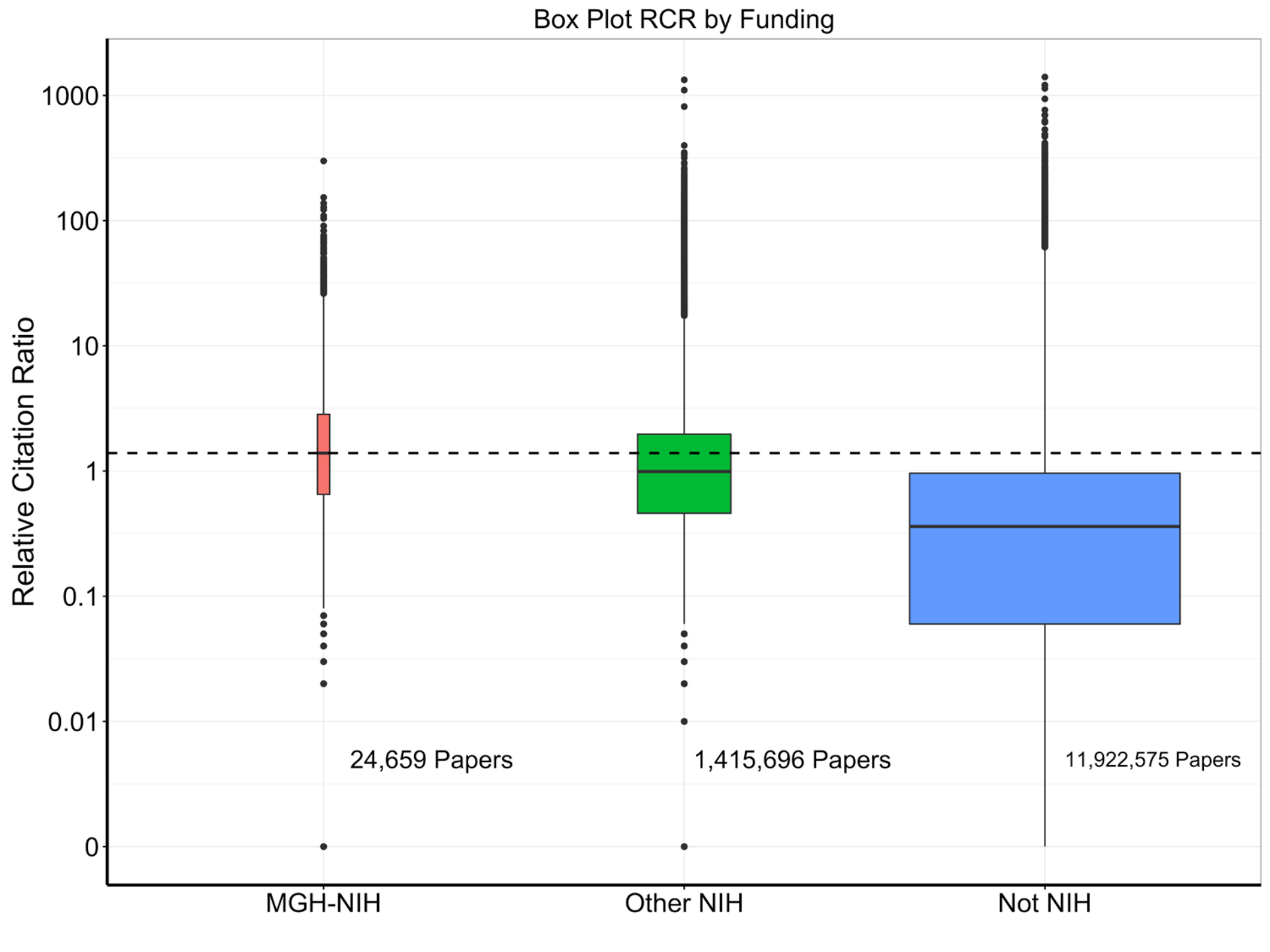
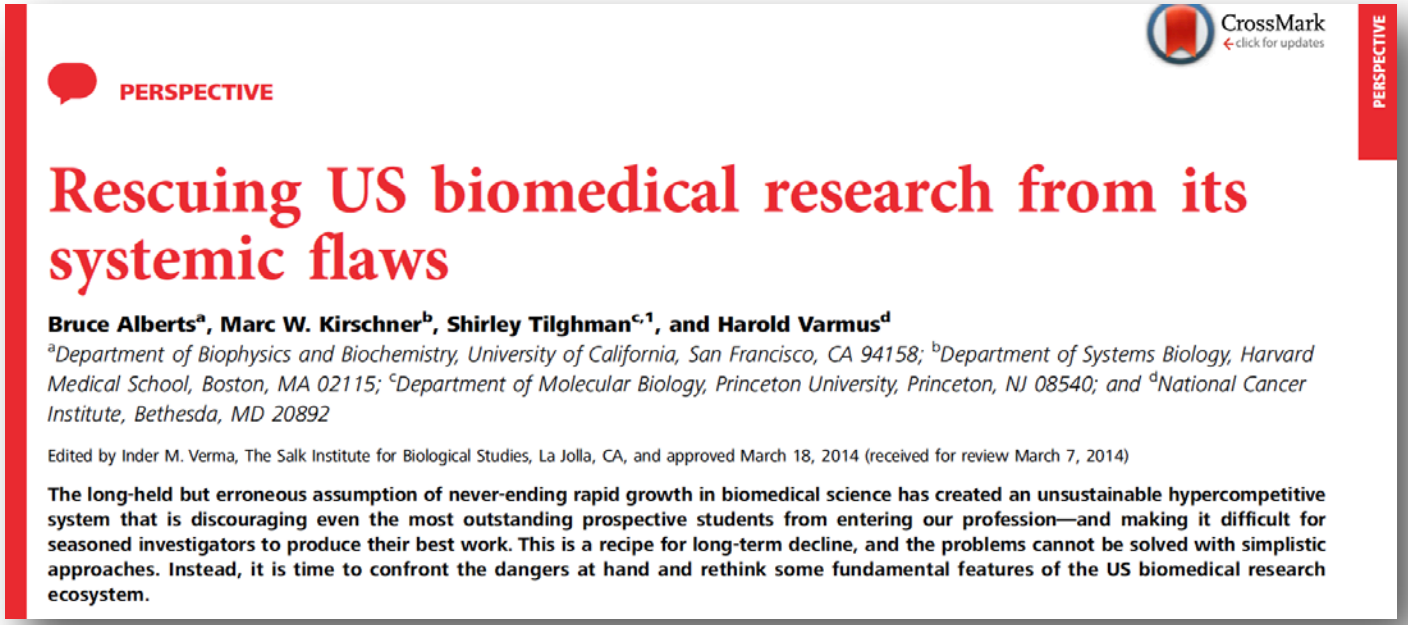

Field-Normalized Citation Metric for MGH Papers Published 1995 to 2014
24,659 Papers
2000
1500
1000
500
0
Number
0
0.01
0.1
1
10
100
200
Relative Citation Ratio


Box Plot RCR by Funding
Relative Citation Ratio
100
10
1
0.1
0.01
0
75th percentile = 2.84
Median
1.39
25th percentile = 0.65
24,659 Papers
MGH-NIH


Box Plot RCR by Funding
Relative Citation Ratio
1000
100
10
1
0.1
0.01
0
24,659 Papers
1,415,696 Papers
MGH-NIH
Other NIH


Box Plot RCR by Funding
Relative Citation Ratio
1000
100
10
1
0.1
0.01
0
24,659 Papers
1,415,696 Papers
11,922,575 Papers
MGH-NIH
Other NIH
Not NIH

A Policy Concern…



PERSPECTIVE

Rescuing US biomedical research from its systemic flaws

Bruce Alberts[a], Marc W. Kirschner[b], Shirley Tilghman[c,1], and Harold Varmus[d]

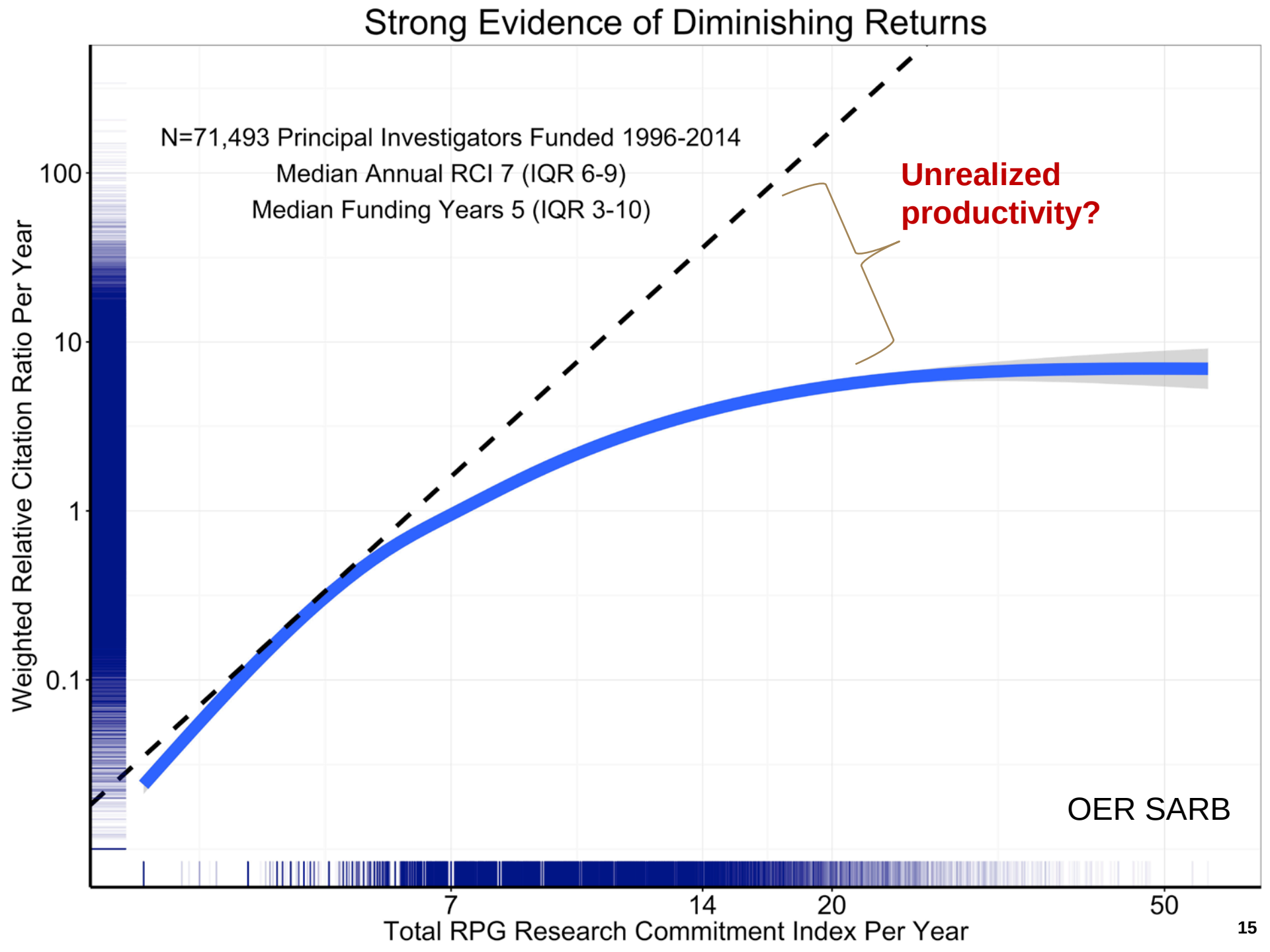
[a]Department of Biophysics and Biochemistry, University of California, San Francisco, CA 94158; [b]Department of Systems Biology, Harvard Medical School, Boston, MA 02115; [c]Department of Molecular Biology, Princeton University, Princeton, NJ 08540; and [d]National Cancer Institute, Bethesda, MD 20892

Edited by Inder M. Verma, The Salk Institute for Biological Studies, La Jolla, CA, and approved March 18, 2014 (received for review March 7, 2014)

The long-held but erroneous assumption of never-ending rapid growth in biomedical science has created an unsustainable hypercompetitive system that is discouraging even the most outstanding prospective students from entering our profession—and making it difficult for seasoned investigators to produce their best work. This is a recipe for long-term decline, and the problems cannot be solved with simplistic approaches. Instead, it is time to confront the dangers at hand and rethink some fundamental features of the US biomedical research ecosystem.

"Agencies should be sensitive to the total numbers of dollars granted to individual laboratories…—although different research activities have different costs—at some point, **returns per dollar diminish**."

Alberts B et al. PNAS. 2014;111:5773-7


Strong Evidence of Diminishing Returns
N=71,493 Principal Investigators Funded 1996-2014
Median Annual RCI 7 (IQR 6-9)
Median Funding Years 5 (IQR 3-10)
Unrealized productivity?
Weighted Relative Citation Ratio Per Year
100
10
1
0.1
7
14
20
50
Total RPG Research Commitment Index Per Year
OER SARB

P: Literature

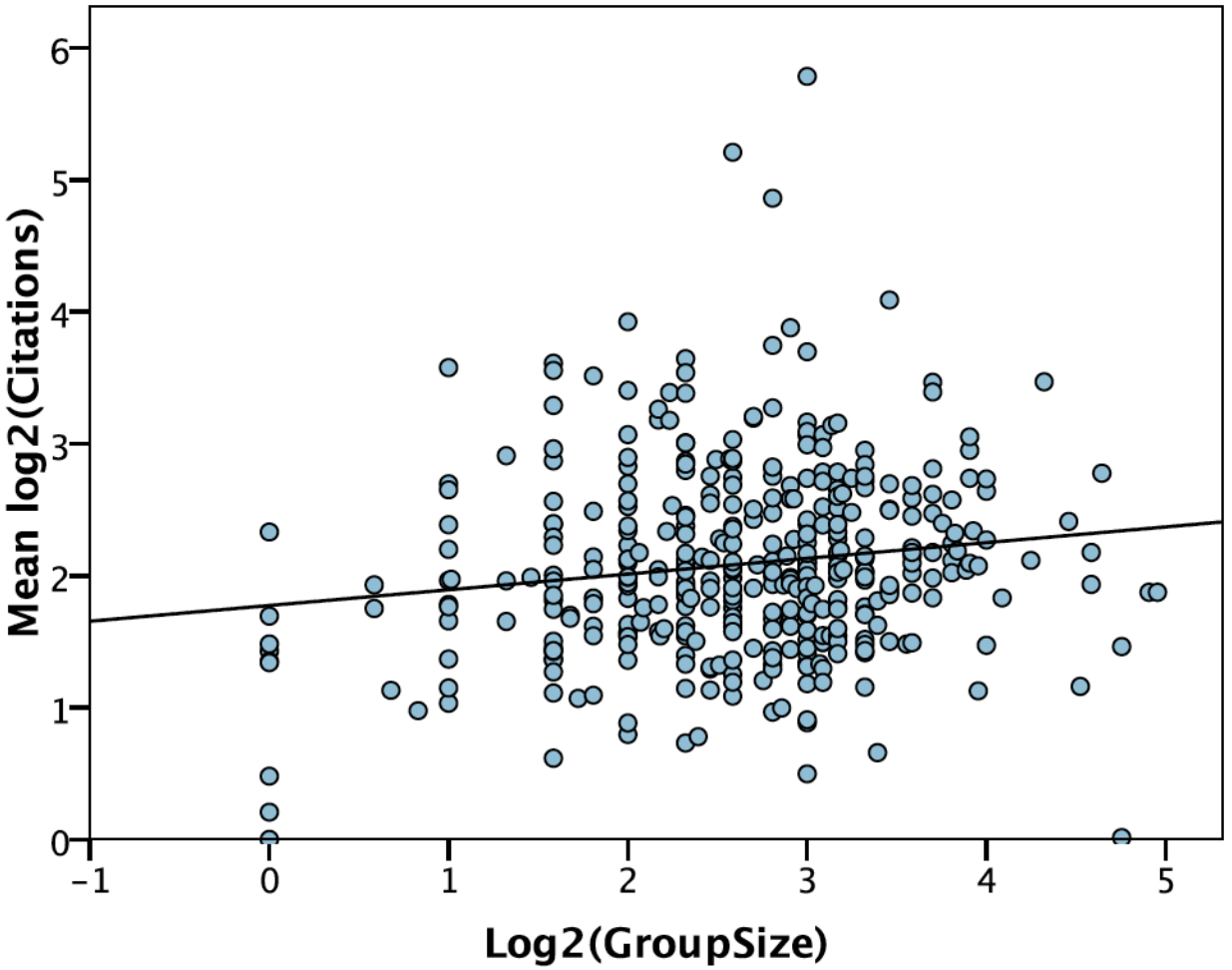
PeerJ

Research groups: How big should they be?

Isabelle Cook, Sam Grange and Adam Eyre-Walker

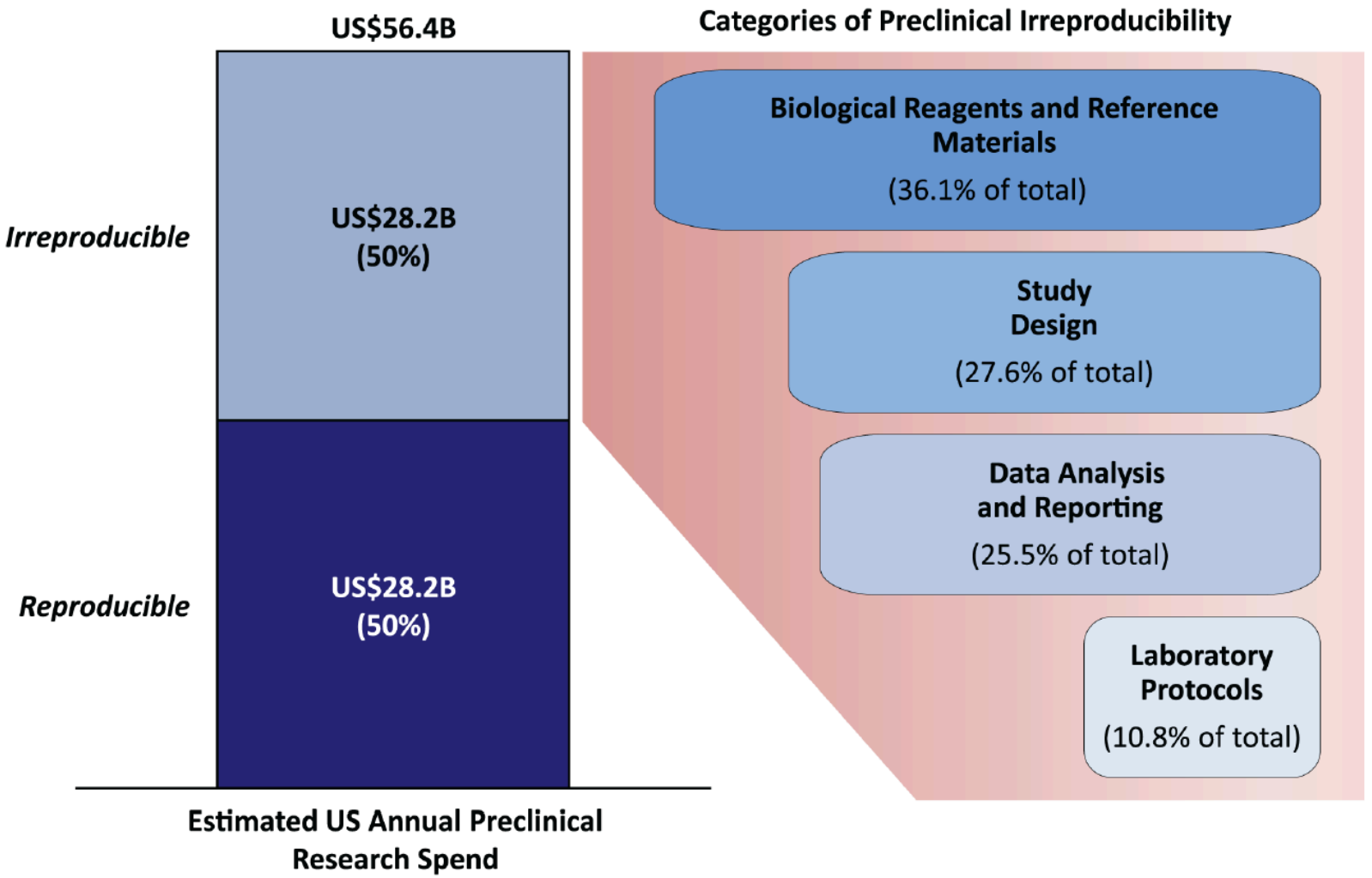
School of Life Sciences, University of Sussex, Brighton, United Kingdom

"They all show a pattern of diminishing returns…"



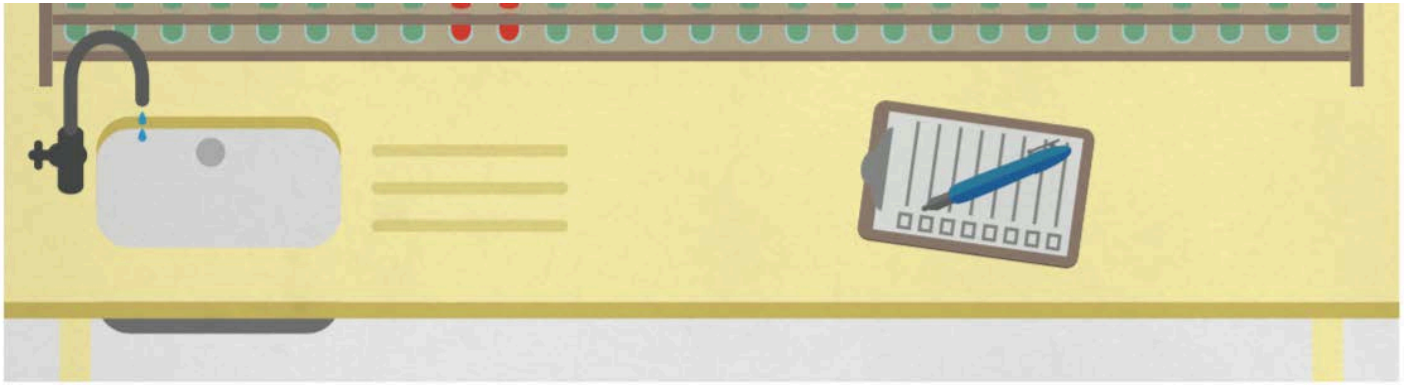
Cook et al. (2015), Research groups: How big should they be?. PeerJ 3:e989; DOI 10.7717/peerj.989

R: Replication



Freedman LP, Cockburn IM, Simcoe TS (2015) The Economics of Reproducibility in Preclinical Research. PLoS Biol 13(6): e1002165. doi:10.1371/journal.pbio.1002165

Q and R: Rigor, Reproducibility, and …



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

Q and R: Beginning to Be Recognized

USAF/GETTY

Experiments that use only a small number of animals are common, but might not give meaningful results.

MEDICAL RESEARCH

UK funders demand strong statistics for animal studies

Move addresses concerns that some experiments are not using enough animals.

BY DANIEL CRESSEY

Replace, refine, reduce: the 3 Rs of ethical animal research are widely accepted around the world. But now the message for animal experiments. Funding applicants must now show that their work will provide statistically robust results — not just explain how it is justified and set out the ethical implications — or risk having their grant application rejected. Sert, who works on experimental design at the National Centre for the Replacement, Refinement and Reduction (NC3Rs) of Animals in Research in London. "These animals are going to be wasted."

Cressey D. Nature 2015;520:271-2

BioLINCC
Biologic Specimen and Data Repository Information Coordinating Center

The BioLINCC Handbook

Guide to Accessing the NHLBI Biologic Specimen and Data Repositories

https://biolincc.nhlbi.nih.gov

Funding Opportunity Title

Maximizing the Scientific Value of the NHLBI Biorepository: Scientific Opportunities for Exploratory Research (R21)

S: Sharing

BU Today

Science & Tech

$30 Million from AHA Bolsters Framingham Heart Study

Sponsors collaboration between BU, University of Mississippi

12.09.2013 By Leslie Friday

Editorial

OPEN

Reinvestment in Government-Funded Research

A Great Way to Share

Paul D. Sorlie, PhD; Phyliss D. Sholinsky, MSPH; Michael S. Lauer, MD

Circulation. 2015;131:17-18

T: Ability to Respond to Emergencies …

PERSPECTIVES

INFECTIOUS DISEASE

Zika vaccine trials

There are new and familiar challenges in the race for timely and effective vaccines

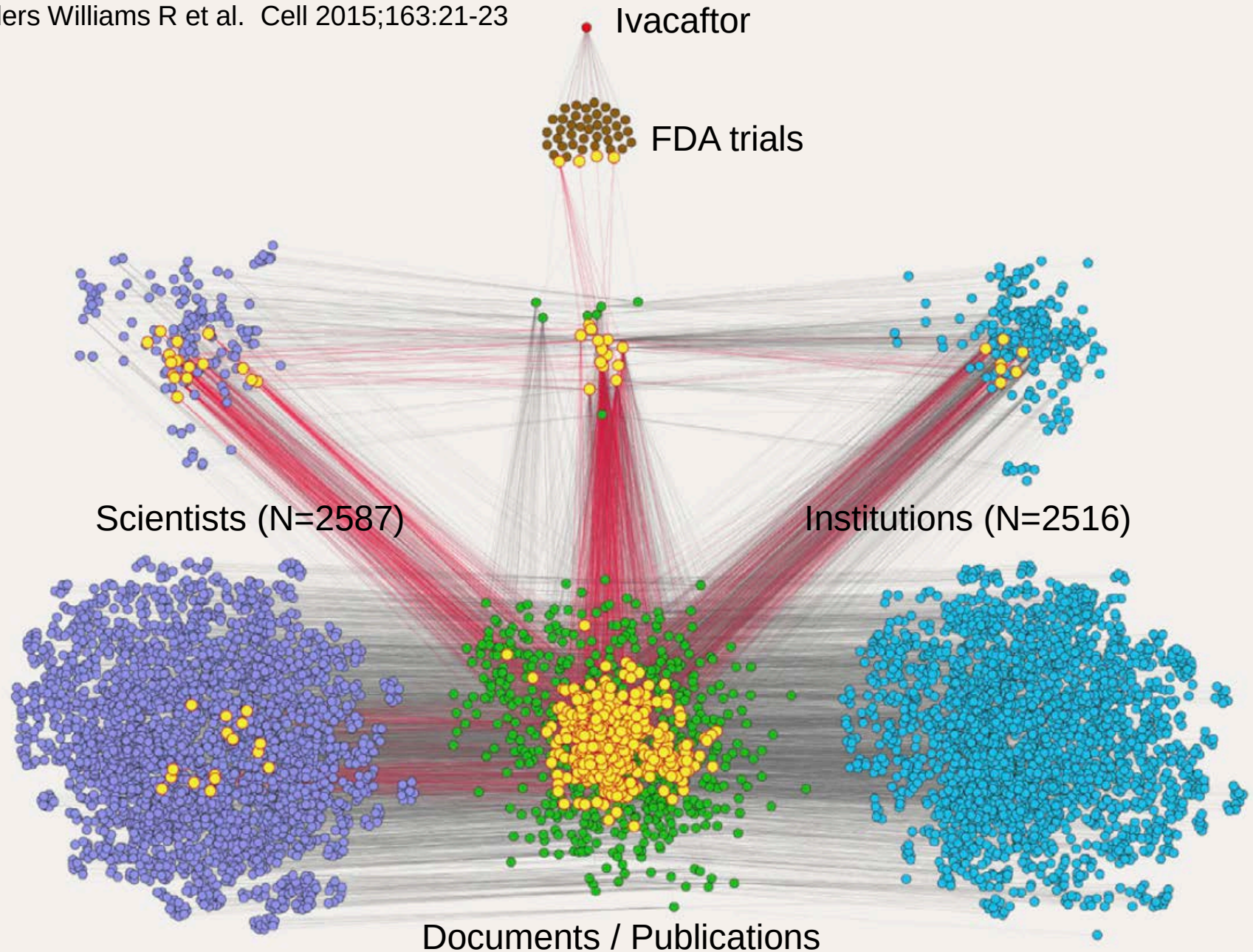
By **Marc Lipsitch**[1] *and* **Benjamin J. Cowling**[2]

Science 2016;353:1094-5

Earlier this year, the U.S. National Institute of Allergy and Infectious Diseases launched a safety and immunogenicity clinical trial of a vaccine candidate to prevent Zika virus infection.

B

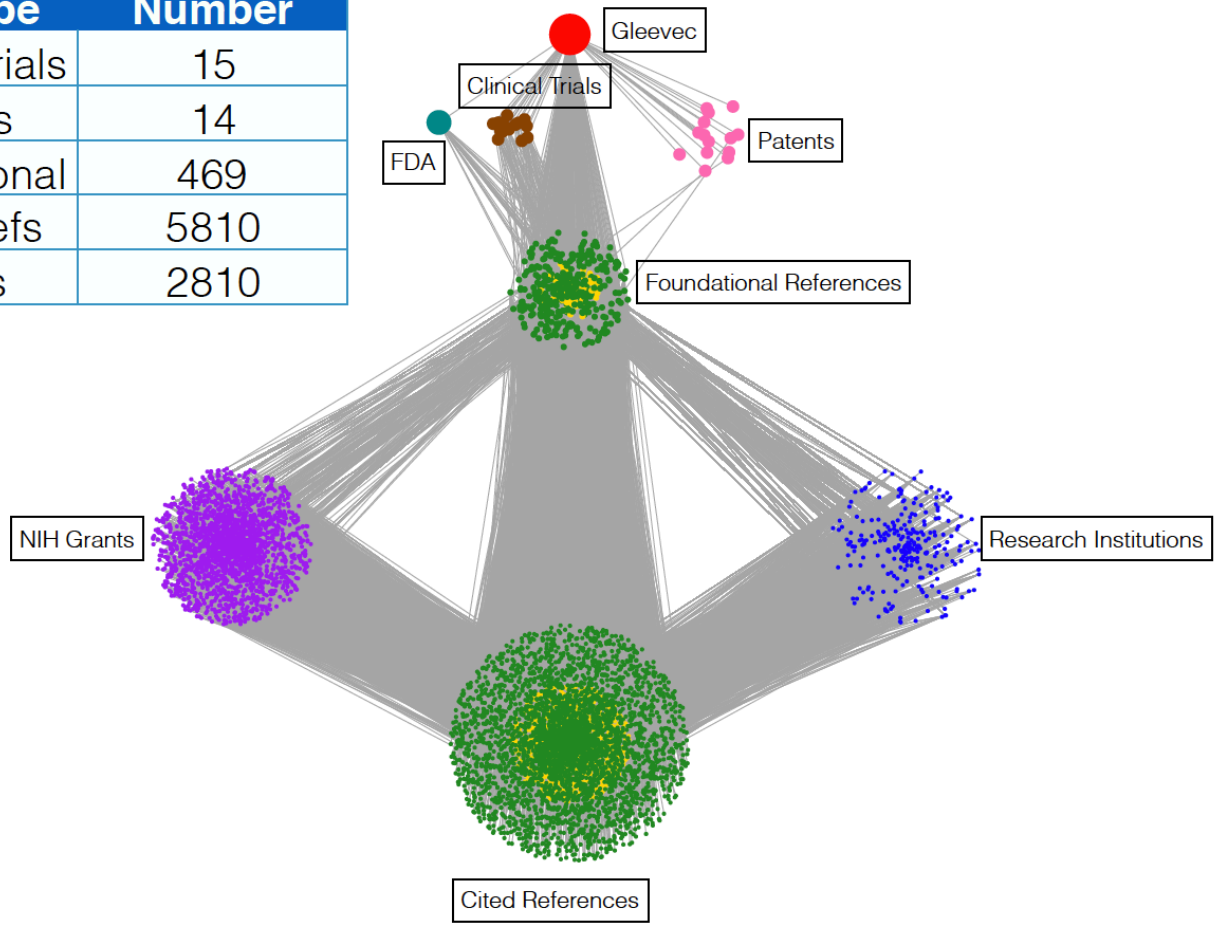
Sanders Williams R et al. Cell 2015;163:21-23



T: A Data-Based Outcome Story

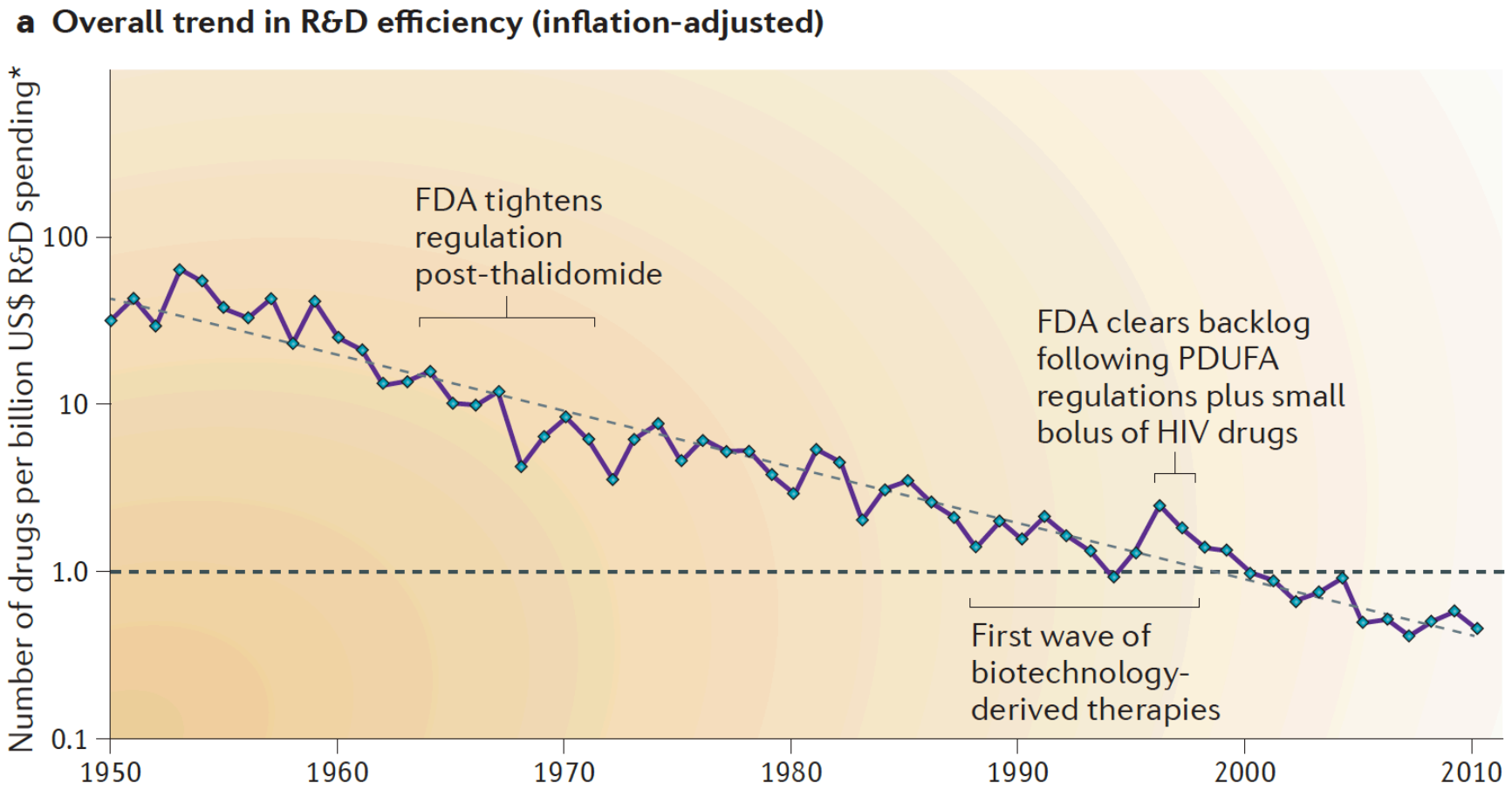
Gleevec

Nodetype	Number
Clinical Trials	15
Patents	14
Foundational	469
Gen2 Refs	5810
Grants	2810



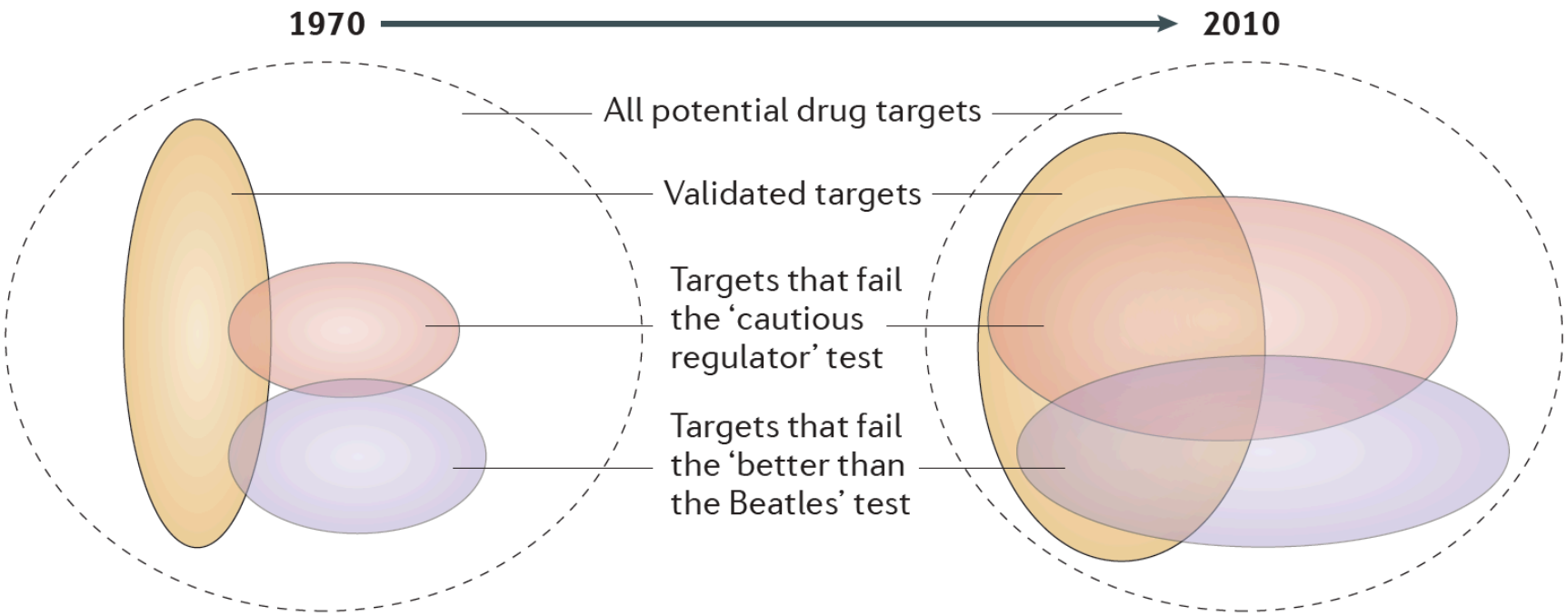
Thanks Jim Onken, Brian Haugan, George Chacko, Shixin Jiang, Samet Keserci, Alex Pico, and Lindsay Wan

T: Why Should We Care? "Eroom's Law"



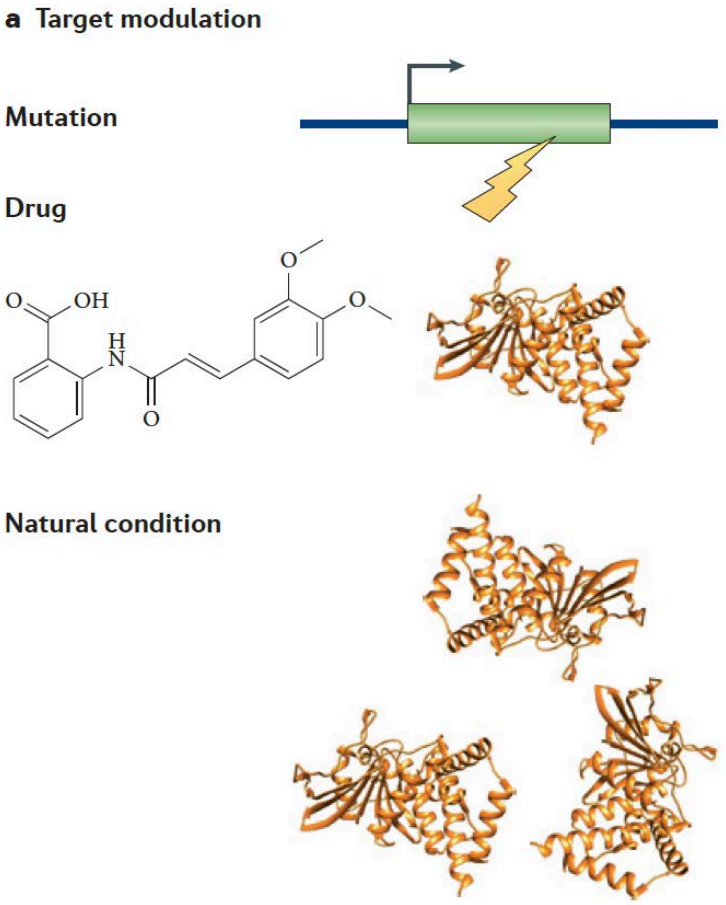
Scannell JW et al. Nature Reviews Drug Discovery 2012;11:191-200

T: Why Might This Be Happening?



Scannell JW et al. Nature Reviews Drug Discovery 2012;11:191-200

T: Some Think Our Paradigm May be Wrong…



Gittelman M. J Research Policy 2016;45:1570-85
Plenge RM et al. Nature Reviews Drug Discovery 2013;12:581-594

PQRST

- P = productivity
  - Publish trial results
  - Highly-cited papers: Relative Citation Ratio
- Q = quality
- R = replication
- S = sharing
- T = translation

Ioannidis JP, Khoury MJ. JAMA 2014 (June 9)

Looking Forward to Open Dialogue …

NIH National Institutes of Health
Office of Extramural Research

Extramural Nexus

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Open Mike

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

Updates on Addressing Rigor in Your NIH Applications

Posted on **January 11, 2016** by **Mike Lauer**

As NIH moves ahead with implementing measures to enhance rigor, transparency and reproducibility in NIH-supported research, I'd like to give a brief update on these efforts, and highlight some important timeline changes for implementation in applications for institutional training grants (T), institutional career development awards (K12), and individual fellowships (F). …. Continue reading →

Dr. Michael Lauer is NIH's Deputy Director for Extramural Research, serving as the principal scientific leader and advisor to the NIH Director on the NIH extramural research program.

http://nexus.od.nih.gov/all/category/open-mike/