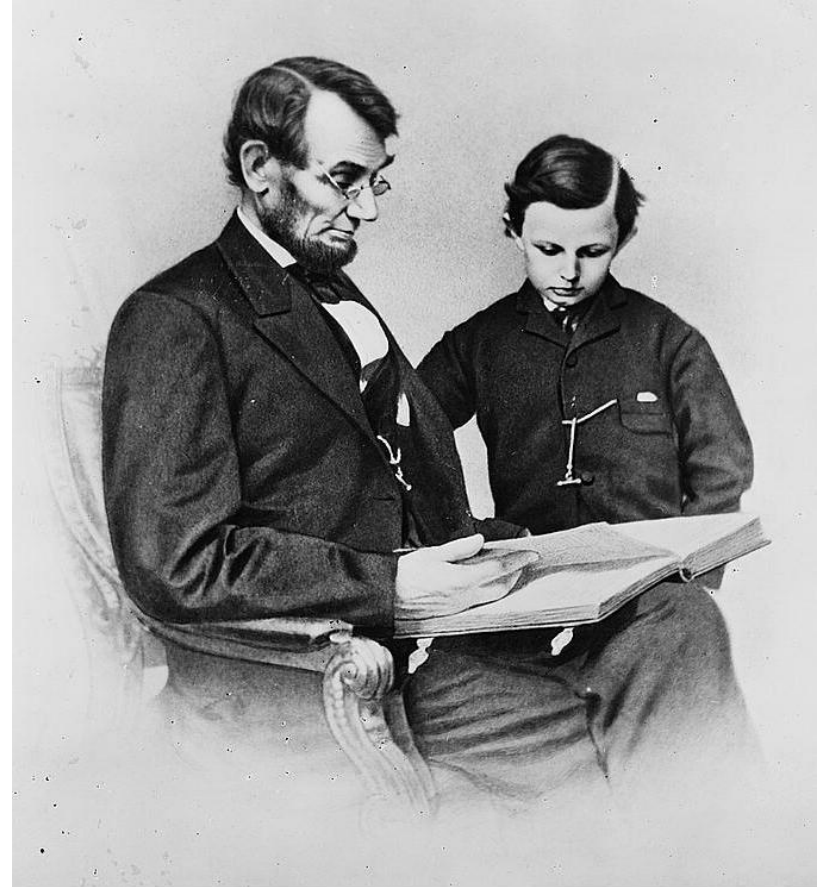


National Academies Activities on Reproducibility & Replicability

**CBMRT Biomedical Transparency Summit
January 24, 2020**

The National Academies

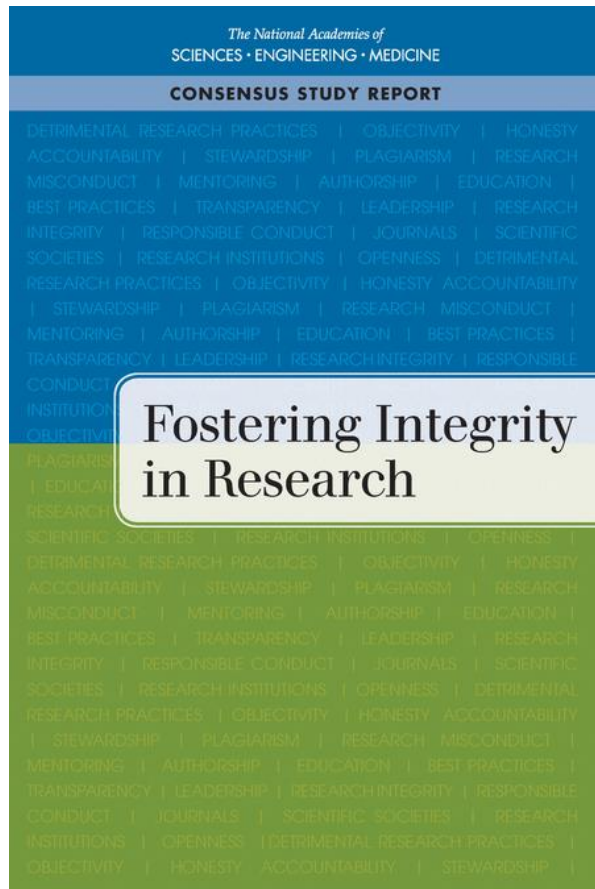
Private, nonprofit institutions that provide independent, objective analysis and advice to the nation to solve complex problems and inform public policy decisions related to science, technology, and medicine.



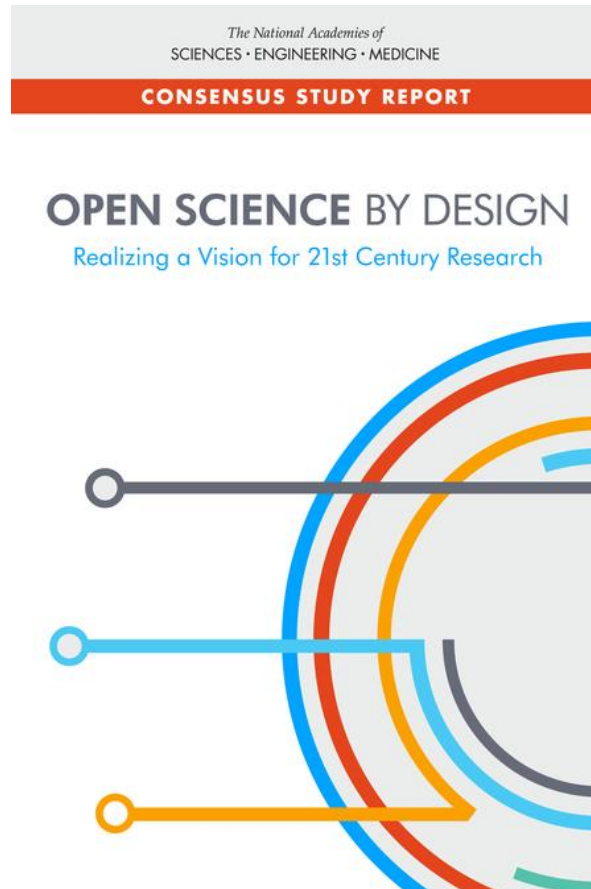
Presentation Overview

- National Academies reports
- *Reproducibility and Replicability in Science*
– A Consensus Study (2019)
- *Enhancing Scientific Reproducibility through
Transparent Reporting* – A Workshop (2019)

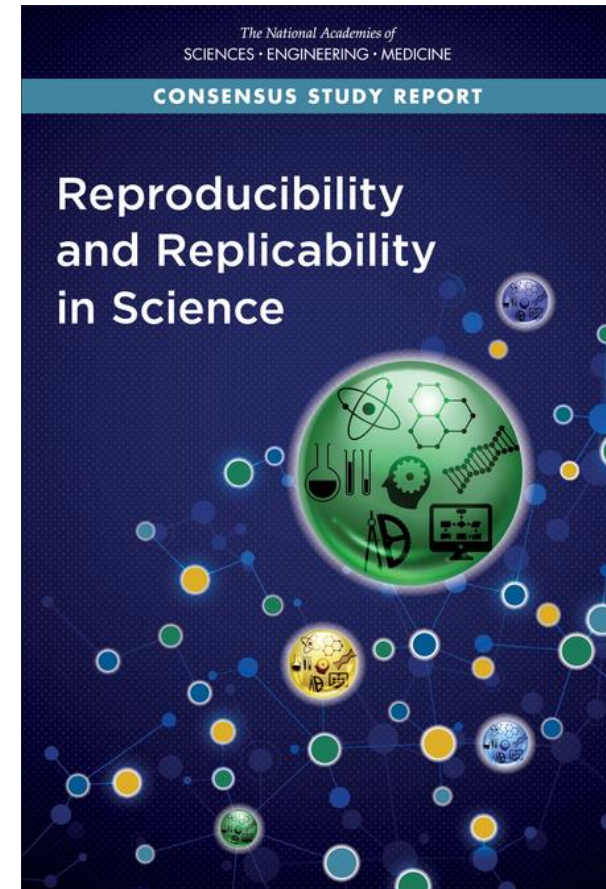
National Academies Reports



2017



2018



2019

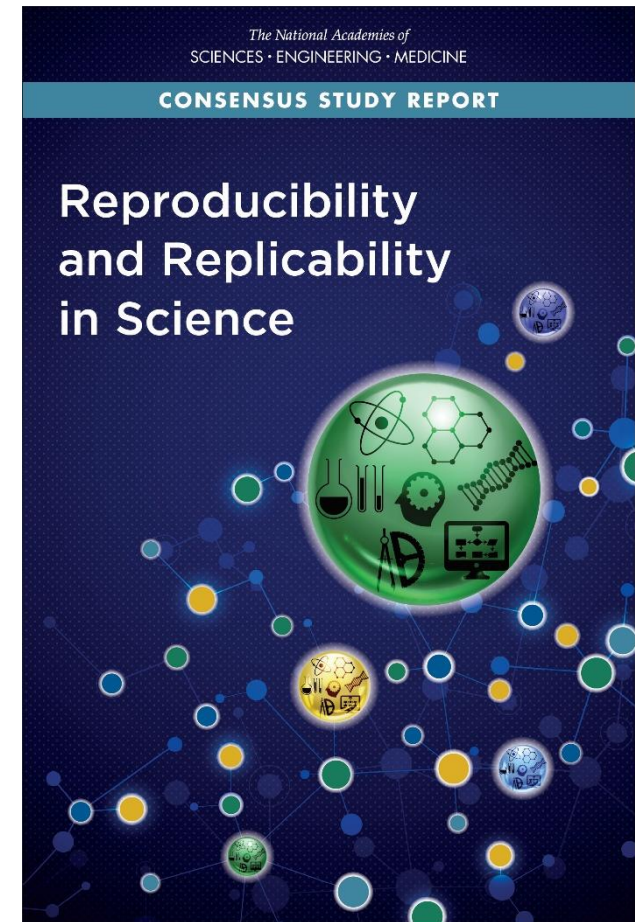
Reproducibility and Replicability in Science

Board on Behavioral, Cognitive, and Sensory Sciences
Committee on National Statistics
Division of Behavioral and Social Sciences and Education

Nuclear and Radiation Studies Board
Division on Earth and Life Studies

Board on Mathematical Sciences and Analytics
Committee on Applied and Theoretical Statistics
Division on Engineering and Physical Sciences

Board on Research Data and Information
Committee on Science, Engineering, Medicine, and Public Policy
Policy and Global Affairs



Committee on Reproducibility and Replicability in Science

Harvey Fineberg, Gordon and Betty Moore Foundation (Chair)

David B. Allison, Indiana University

Lorena A. Barba, The George Washington University

Dianne Chong, Boeing Research and Technology (Retired)

David L. Donoho,* Stanford University

Juliana Freire, New York University

Gerald Gabrielse, Northwestern University

Constantine Gatsonis, Brown University

Edward (Ned) Hall, Harvard University

Thomas H. Jordan, University of Southern California

Dietram A. Scheufele, University of Wisconsin-Madison

Victoria Stodden, University of Illinois at Urbana-Champaign

Simine Vazire,** University of California, Davis

Timothy Wilson, University of Virginia

Wendy Wood, University of Southern California

**Resigned from committee July 2018*

***Resigned from committee October 2018*

Committee's Charge

- Define reproducibility and replicability
- Examine the extent of non-reproducibility and non-replicability
- Review current activities to improve reproducibility and replicability
- Determine if the lack of R&R impacts the overall health of science and public perception

Definition of Terms

Reproducibility is obtaining consistent results using the same input data, computational steps, methods, and code, and conditions of analysis.

Replicability is obtaining consistent results across studies aimed at answering the same scientific question, each of which has obtained its own data.

Reproducibility

Context:

- Pervasive use of computation across disciplines;
- Growing adoption of reproducible science.

Extent:

- No universal standards for assessment;
- A number of systematic efforts to reproduce computational results have failed in more than half the attempts.

Sources:

- Inadequate record keeping;
- Non-transparent reporting;
- Insufficient detail in digital artifacts;
- Barriers in culture.

Replicability

Context:

- Confirm or build on previous results;
- Successful replication does not guarantee previous results were correct;
- Failed replication does not necessarily guarantee previous results were incorrect.

Extent:

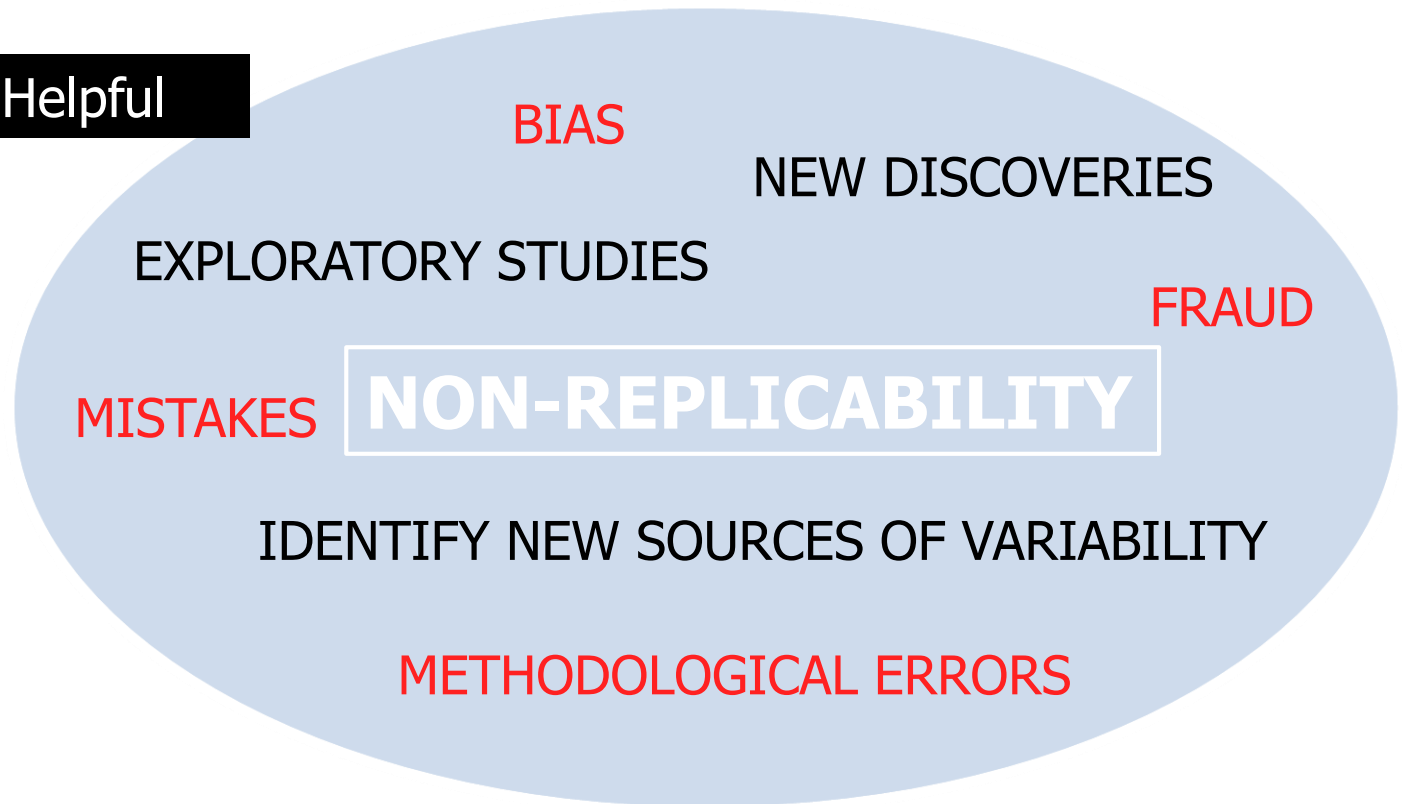
- A number of assessments of replicability have shown low replication rates in many scientific fields.

Sources of Non-Replicability

“Potentially Helpful” and “Unhelpful” to the Advancement of Scientific Understanding

Potentially Helpful

Unhelpful



Not a crisis...but no room for complacency

- Improvements needed.
- Reproducibility is important but not currently easy to attain.
- Aspects of replicability of individual studies are a serious concern.
- Neither are the main or most effective way to ensure reliability of scientific knowledge.

Key Recommendations

Researchers: Provide clear, specific, and complete description of how the reported results were reached.

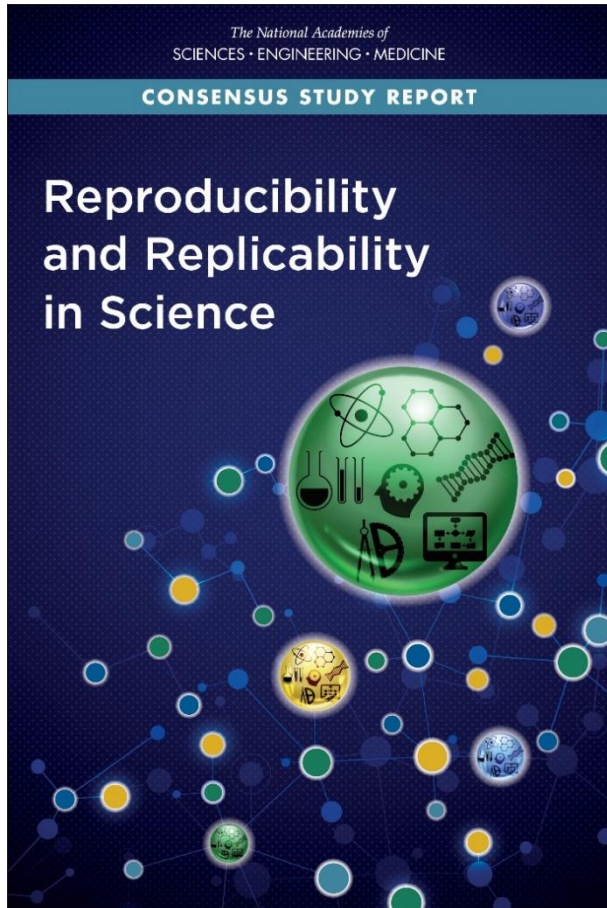
Funders: Consider investing in open-source, usable tools, infrastructure, and related training to support reproducibility across domains.

Journals: Consider ways to help ensure computational reproducibility.

Professional/Scientific Societies: Educate members and the public; include discussions on uncertainty.

Policy Makers: Seek convergent evidence when contemplating important action based on a single study.

Additional Information



- Download free PDF
- Overview Video
- Report Highlights and Combined Highlights with related Reports
- 10 Things to Know About Reproducibility and Replicability

nationalacademies.org/ReproducibilityinScience

Enhancing Scientific Reproducibility in Biomedical Research through Transparent Reporting

Forum on Drug Discovery,
Development, and Translation

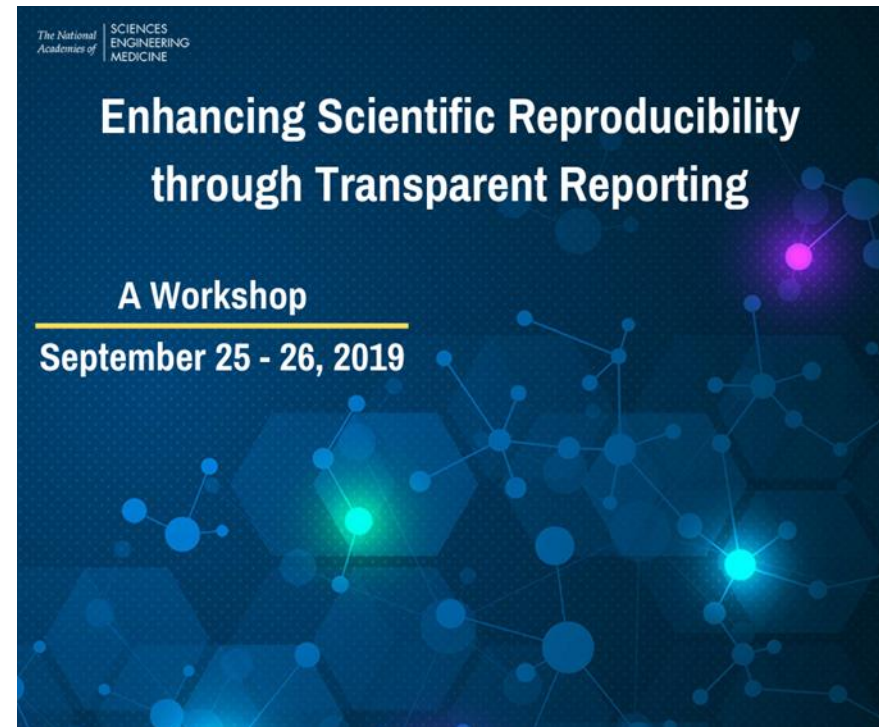
Forum on Neuroscience and Nervous
System Disorders

National Cancer Policy Forum

Roundtable on Genomics and Precision
Health

Board on Health Sciences Policy

Board on Healthcare Services



Workshop Planning Committee

Harvey Fineberg, Gordon and Betty Moore Foundation (Chair)

Otis Brawley, Johns Hopkins University

Barry Coller, The Rockefeller University

Stuart Hoffman, U.S. Department of Veterans Affairs

Veronique Kiermer, PLOS

Benedict Kolber, Duquesne University

Jill Mesirov, UC San Diego School of Medicine

Alexa McCray, Harvard Medical School

Martin Murphy, CEO Roundtable on Cancer

Franklin Sayre, Thompson Rivers University

Ida Sim, UCSF Clinical and Translational Sciences Institute

Valda Vinson, Science

Workshop Overview

“Discuss the current state of transparency in reporting biomedical research (e.g. disclosure of the availability and location of data, materials, analysis, and methodology) and to **explore the possibility of improving the harmonization of guidelines across journals and funding agencies so that biomedical researchers propose and report data in a consistent manner.**”

Workshop sponsored by the National Institutes of Health, Cell Press, *The Lancet*, and Nature Research.

Workshop Topics

1. Cultivating transparent reporting in biomedical research
2. Lessons learned and best practices
3. Stakeholder perspectives on checklists and guidelines
4. Towards minimal reporting standards for preclinical biomedical research



1. Cultivating transparent reporting

- Education about transparent reporting of biomedical research should be targeted toward early career faculty, postdoctoral fellows, graduate students, and undergraduates
- Investigators and trainees who are contributing towards a culture of transparency and reproducibility should be recognized and rewarded



2. Lessons learned and best practices

- Transparency begins with study design
- Rewards can inspire good behavior, but enforcement is needed
- Reporting guidelines should be promoted as beneficial (vs burdensome) for researchers
- Funders have an opportunity to impact the rigor and reproducibility of research they fund
- A research culture that promotes research integrity should be inclusive, comprehensive, multifaceted, pragmatic, and empowering

3. Stakeholder perspectives on checklists and guidelines

- Checklists can improve reporting and impact research practice, but endorsement is not sufficient
- A need for coordination across stakeholders
- Consider assessment and accountability
- Less is more
- Culture change is a shared responsibility

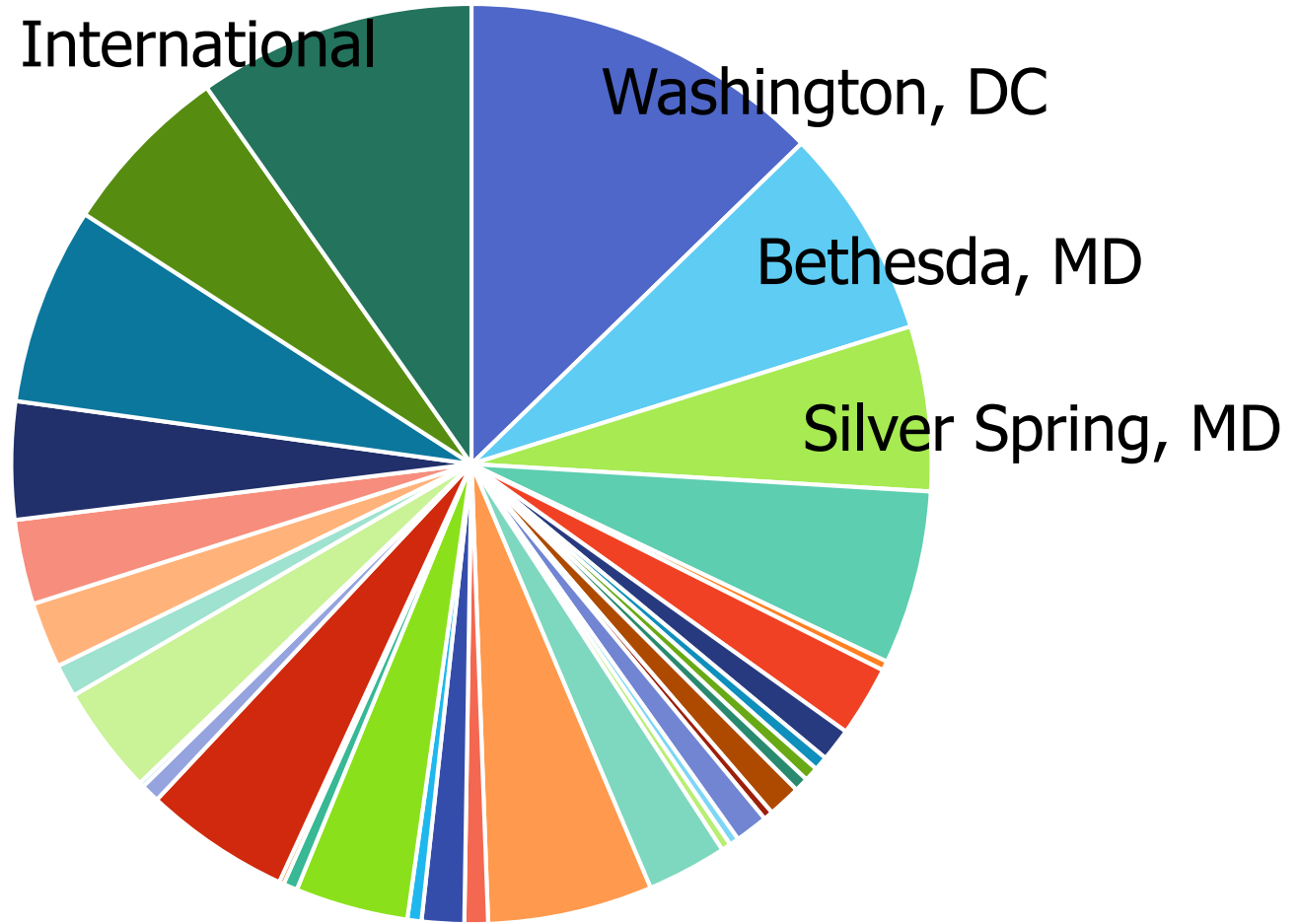


4. Towards minimal reporting standards

- Consider ways to
 - Separate review of different sections (e.g. statistics vs methods)
 - Train reviewers on how to evaluate reproducibility or adherence to guidelines
 - Leverage existing resources through institutional libraries
 - Show “the chain of precise induction”
- Technical solutions (e.g. checklists, reporting standards) do not substitute for knowledge and understanding.



Workshop Outreach



Workshop Outreach



NIH Women's Health @NIH_ORWH · Sep 16

A5: .@NIH has guiding principles that help applicants to consider issues related to the rigor of their studies. Applicants must consider biological factors such as sex in research design & analyses to help enhance rigor and achieve robust & unbiased results. #ReproducibilityChat

#ReproducibilityChat

National Academies @theNASEM



Steven Goodman @goodmanmetrics · Sep 25

Wonderful start to Day 2 of NAS mtgs on #reproducibilityinscience.

@BrianNosek @ACasadevall1 @CWolinetzNIH struggles of early career researchers as well as NIH, trying to do the right, transparent thing.



Sowmya Swaminathan @SowmyaSwaminat1

In the breakout session @mcintold shares this "make better science easier". This should be on #ReproducibilityInScience

2

10

14



Yarimar Carrasquillo @YarCarLab · Sep 26

Rodent basic scientists- after attending the @theNASEM #ReproducibilityInScience workshop, I am very curious to know what we consider raw data in the field. Please help me out and RT.

24% numbers used for graphs

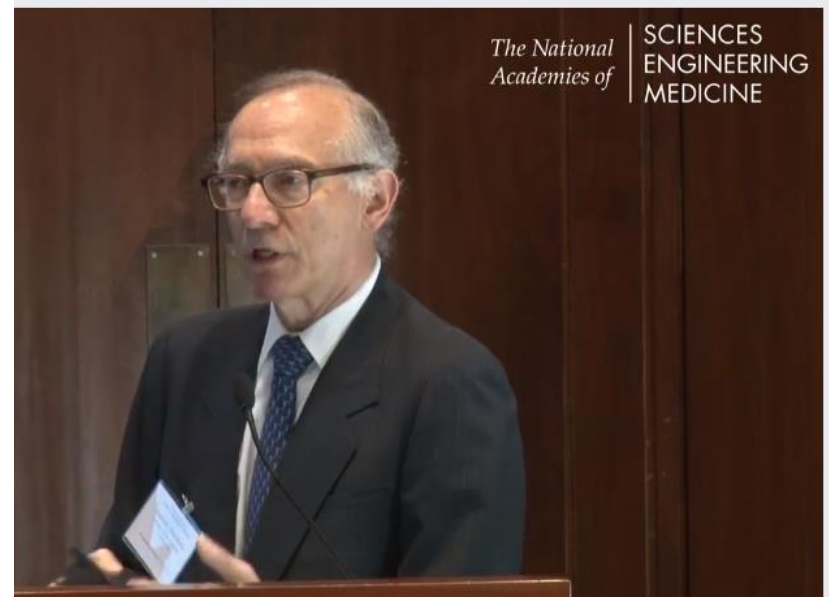
76% images/videos/traces, etc

0% something else

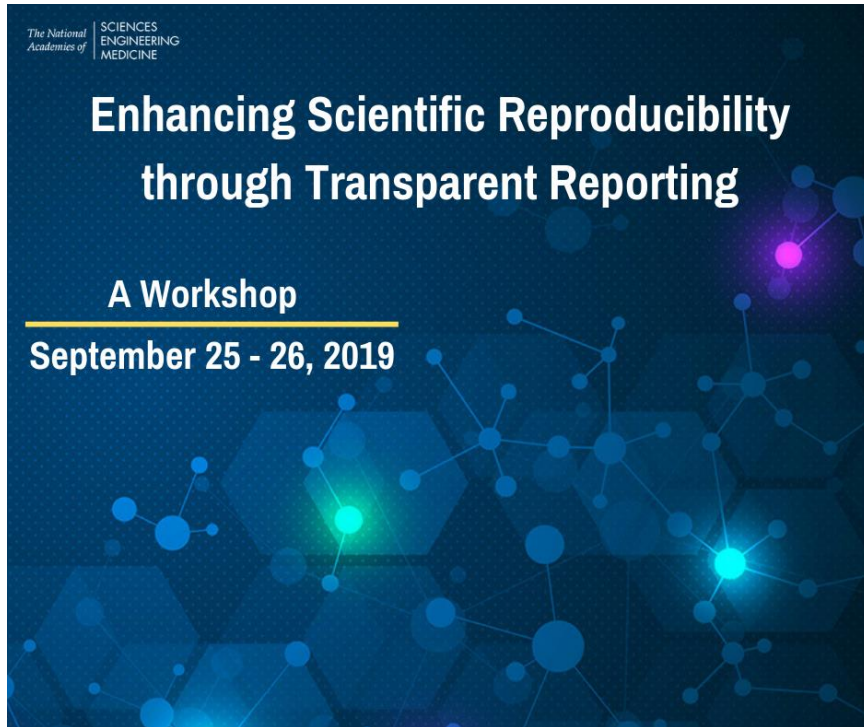
17 votes • Final results

Encouraging Transparent Reporting

- Dr. Fineberg: data sharing and transparent reporting as an *expectation* of the scientific community.
- Dr. McNutt: use “indicators of trust” for clearer assessment of published work, esp. by the public.



Additional Information



- Agenda and materials
- Videos and presentations
- Summary coming in early March 2020

bit.ly/ReproducibilityTransparentReporting