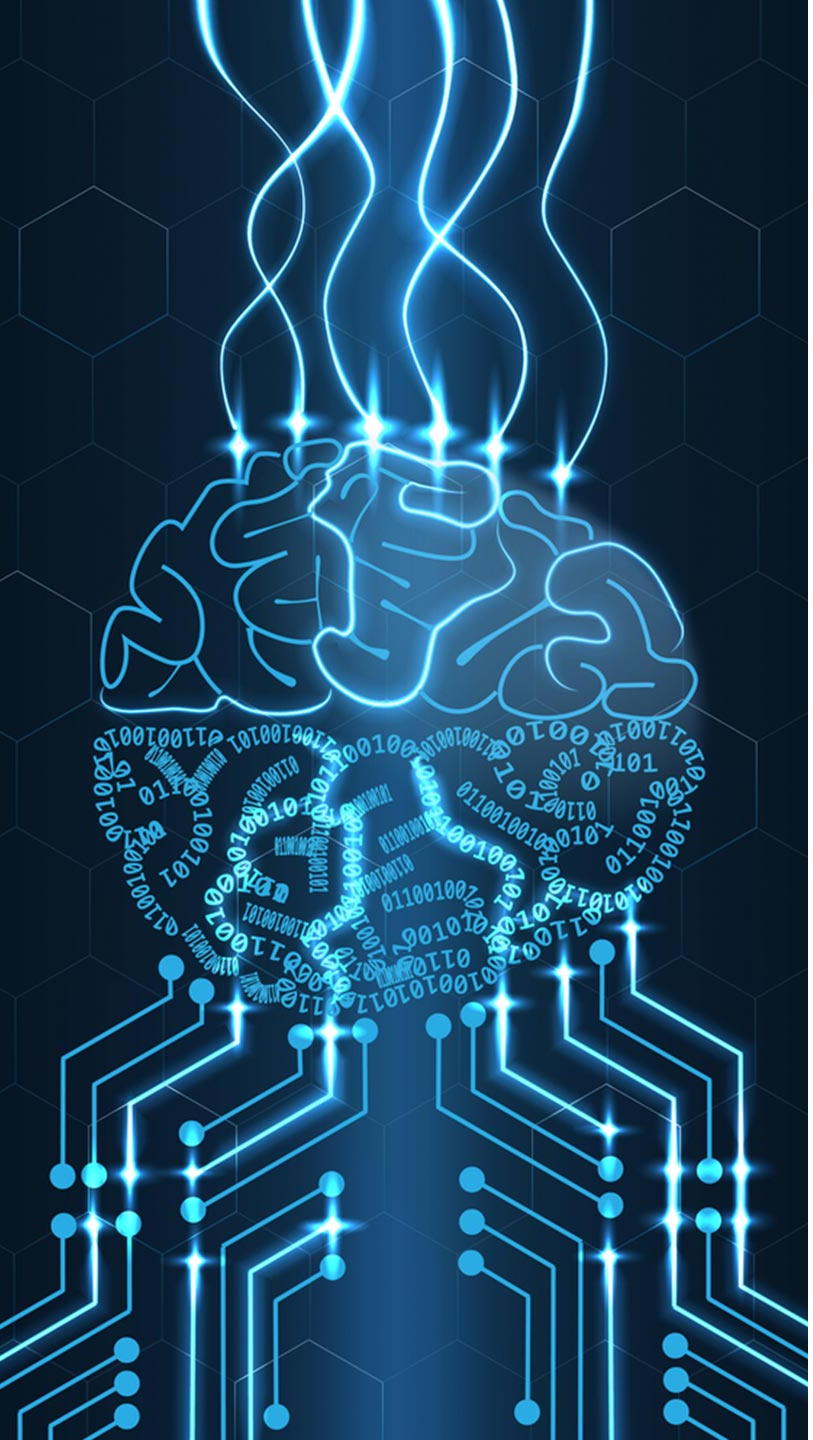


Office of Portfolio Analysis (OPA) Strategic Plan Fiscal Years 2021-2025

Division of Program Coordination, Planning, and Strategic Initiatives (DPCPSI) Office of the Director (OD) National Institutes of Health (NIH)

George Santangelo PhD
Director, OPA
Council of Councils Meeting, January 24, 2020

NIH National Institutes of Health
Office of Portfolio Analysis

OPA Strategic Plan Fiscal Years 2021-2025

Establishment of OPA/DPCPSI/NIH in 2011

(FR Doc. 2011-2848 Filed 2-8-11)

1) Prepare and analyze data on NIH sponsored biomedical research to inform trans-NIH planning and coordination

2) Serve as a resource for portfolio management at the programmatic level

3) Employ databases, analytic tools, methodologies and other resources to conduct assessments in support of portfolio analyses and priority setting in scientific areas of interest across NIH

4) Research and develop new analytic tools, support systems, and specifications for new resources in coordination with other NIH organizations to enhance the management of the NIH's scientific portfolio

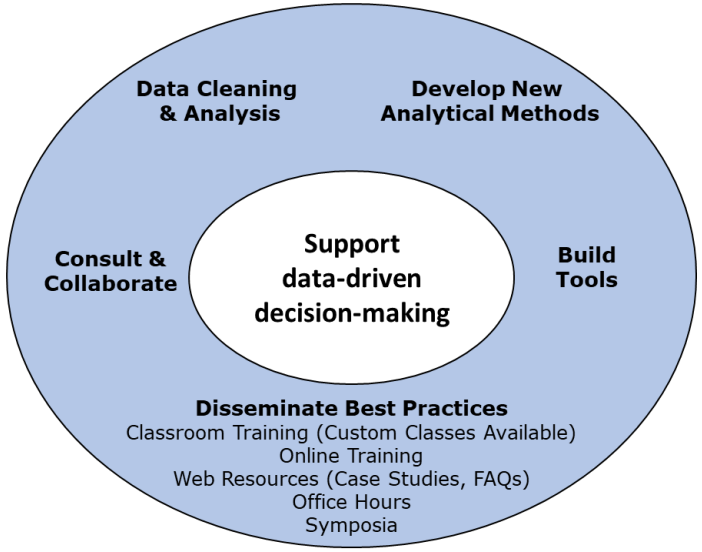
5) Provide, in coordination with other NIH organizations, training on portfolio analysis tools, procedures, and methodology

OPA Strategic Plan Fiscal Years 2021-2025

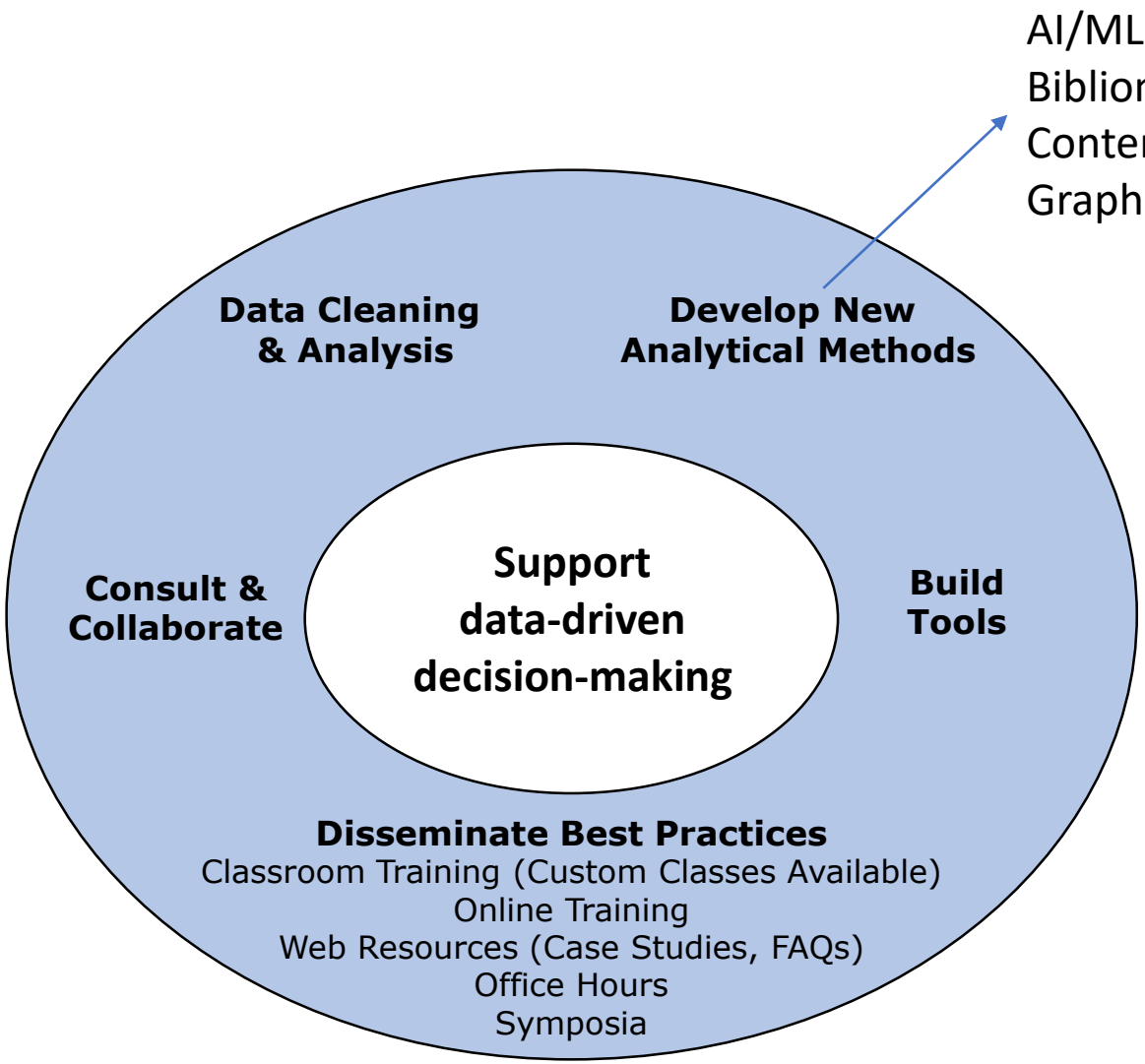
Support data-driven decision-making

- Enable NIH research administrators and decision-makers to evaluate and prioritize current and emerging areas of research that will advance scientific knowledge and improve human health

- Help ensure that the NIH research portfolio
  - is balanced
  - is free of unnecessary duplication
  - takes advantage of collaborative, cross-cutting research
  - stimulates the emergence of transformative ideas



OPA Strategic Plan Fiscal Years 2021-2025



OPA Strategic Plan Fiscal Years 2021-2025

Support data-driven decision-making

1) Training / consultations / collaborations
    a) disseminate best practices
    b) augment analytical capabilities
    c) assess the need for new methods or tools

2) R&D to develop new methodologies, including AI/ML-based "centaur" decision-making
    a) track and parameterizes decision-making at NIH and other agencies
    b) enable accurate predictions of the resulting impact
    c) analyze content at scale (deep learning: grants, publications, patents, etc.)

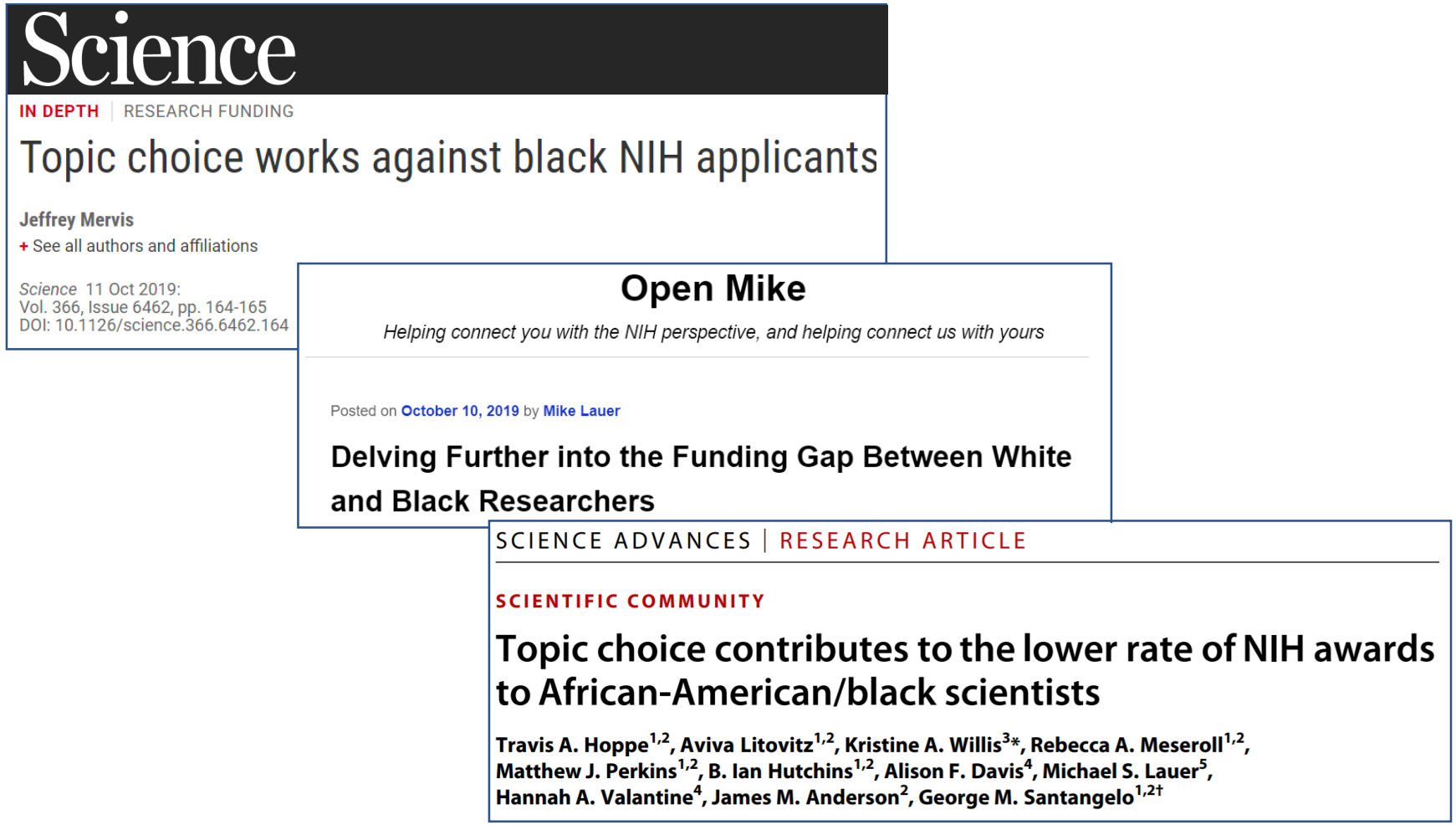
3) Web tools to deliver analytical resources to decision-makers' desktops

OPA developed the Relative Citation Ratio (RCR) metric to meet the need for a new and thoroughly validated way to measure the influence of any/all biomedical research papers

Public website to retrieve RCR data:

iCite.od.nih.gov

OPA adapted Google's word2vec AI/ML to meet the need to analyze semantic content (grant applications, publications, etc.)



Science

IN DEPTH | RESEARCH FUNDING

Topic choice works against black NIH applicants

Jeffrey Mervis

+ See all authors and affiliations

Science 11 Oct 2019:
Vol. 366, Issue 6462, pp. 164-165
DOI: 10.1126/science.366.6462.164

Open Mike

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

Posted on October 10, 2019 by Mike Lauer

Delving Further into the Funding Gap Between White and Black Researchers

SCIENCE ADVANCES | RESEARCH ARTICLE

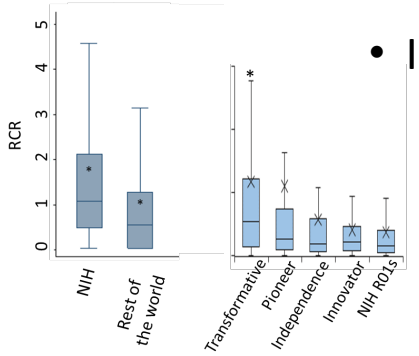
SCIENTIFIC COMMUNITY

Topic choice contributes to the lower rate of NIH awards to African-American/black scientists

Travis A. Hoppe[1,2], Aviva Litovitz[1,2], Kristine A. Willis[3]*, Rebecca A. Meseroll[1,2], Matthew J. Perkins[1,2], B. Ian Hutchins[1,2], Alison F. Davis[4], Michael S. Lauer[5], Hannah A. Valantine[4], James M. Anderson[2], George M. Santangelo[1,2†]

OPA AI to track and predict the impact of NIH decision-making

Track and parameterize:



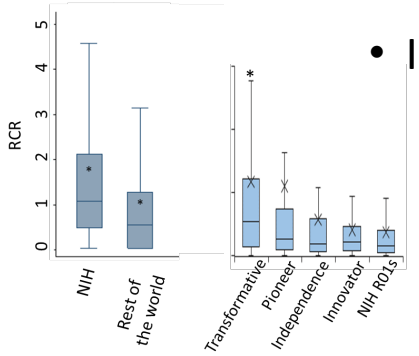
- Influence using bibliometric data

  The Relative Citation Ratio (RCR)

  - Hutchins BI et al. *PLoS Biology* 2016 14:e1002541
  - Hutchins BI et al. *PLoS Biology* 2017 15:e2003552
  - Santangelo GM *Mol. Biol. Cell* 2017 28:1401-1408

OPA AI to track and predict the impact of NIH decision-making

Track and parameterize:



- Influence using bibliometric data

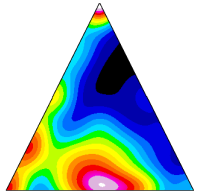
  The Relative Citation Ratio (RCR)

  - Hutchins BI et al. *PLoS Biology* 2016 14:e1002541
  - Hutchins BI et al. *PLoS Biology* 2017 15:e2003552
  - Santangelo GM *Mol. Biol. Cell* 2017 28:1401-1408

- Translational progress / clinical trials (CTs) and tech transfer / patents

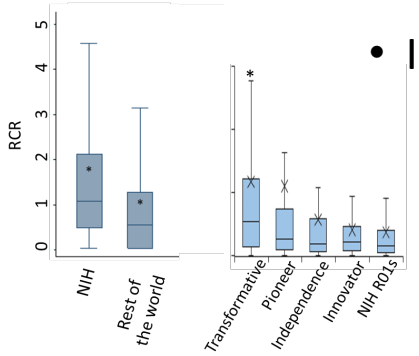
  The triangle of biomedicine, APT scores

  - Hutchins BI et al. *PLoS Biology* 2019 17(10):e3000416



OPA AI to track and predict the impact of NIH decision-making

Track and parameterize:



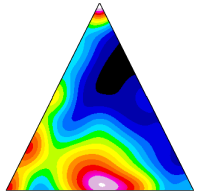
- Influence using bibliometric data
  - The Relative Citation Ratio (RCR)
    - Hutchins BI et al. *PLoS Biology* 2016 14:e1002541
    - Hutchins BI et al. *PLoS Biology* 2017 15:e2003552
    - Santangelo GM *Mol. Biol. Cell* 2017 28:1401-1408

The publicly available OPA tool

iCite 2.0

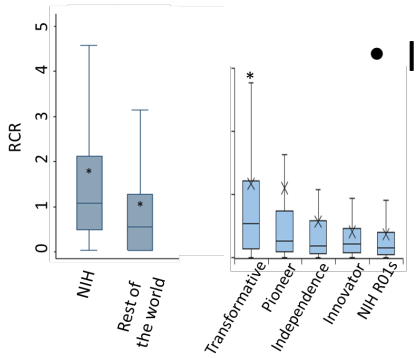
Influence module
Translation module
Open Citation Collection
Hutchins et al. *PLOS Biology* 2019 17:e3000385

- Translational progress / clinical trials (CTs) and tech transfer / patents
  - The triangle of biomedicine, APT scores
    - Hutchins BI et al. *PLoS Biology* 2019 17(10):e3000416



OPA AI to track and predict the impact of NIH decision-making

Track and parameterize:



- Influence using bibliometric data

  The Relative Citation Ratio (RCR)

  - Hutchins BI et al. *PLoS Biology* 2016 14:e1002541
  - Hutchins BI et al. *PLoS Biology* 2017 15:e2003552
  - Santangelo GM *Mol. Biol. Cell* 2017 28:1401-1408

The publicly available OPA tool

iCite 2.0

Influence module

Translation module

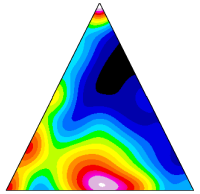
Open Citation Collection

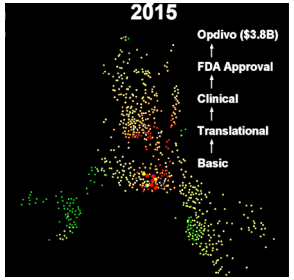
Hutchins et al. *PLOS Biology* 2019 17:e3000385

- Translational progress / clinical trials (CTs) and tech transfer / patents

  The triangle of biomedicine, APT scores

  - Hutchins BI et al. *PLoS Biology* 2019 17(10):e3000416



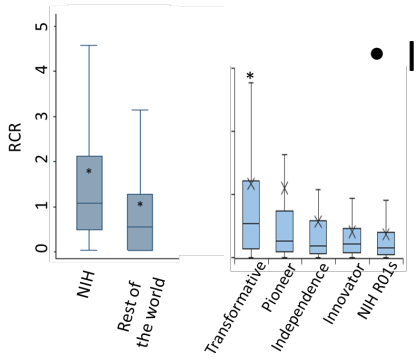


- Development of drugs and devices

  Disambiguated drug and lead compound name, FDA data

OPA AI to track and predict the impact of NIH decision-making

Track and parameterize:



- Influence using bibliometric data

  The Relative Citation Ratio (RCR)

  - Hutchins BI et al. *PLoS Biology* 2016 14:e1002541
  - Hutchins BI et al. *PLoS Biology* 2017 15:e2003552
  - Santangelo GM *Mol. Biol. Cell* 2017 28:1401-1408

The publicly available OPA tool

iCite 2.0

Influence module

Translation module

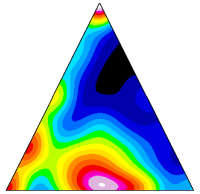
Open Citation Collection

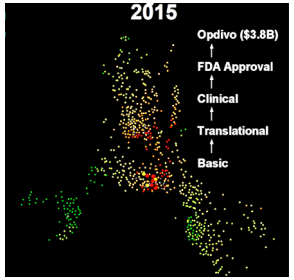
Hutchins et al. *PLOS Biology* 2019 17:e3000385

- Translational progress / clinical trials (CTs) and tech transfer / patents

  The triangle of biomedicine, APT scores

  - Hutchins BI et al. *PLoS Biology* 2019 17(10):e3000416

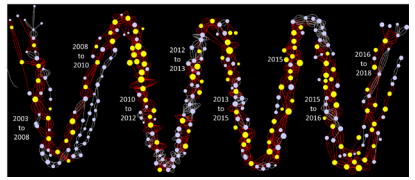




- Development of drugs and devices

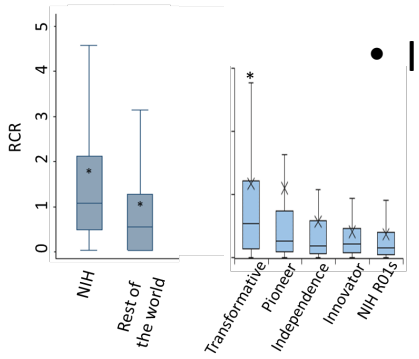
  Disambiguated drug and lead compound name, FDA data

- Rate of scientific progress and emergence



OPA AI to track and predict the impact of NIH decision-making

Track and parameterize:



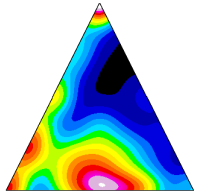
- Influence using bibliometric data
  - The Relative Citation Ratio (RCR)
    - Hutchins BI et al. *PLoS Biology* 2016 14:e1002541
    - Hutchins BI et al. *PLoS Biology* 2017 15:e2003552
    - Santangelo GM *Mol. Biol. Cell* 2017 28:1401-1408

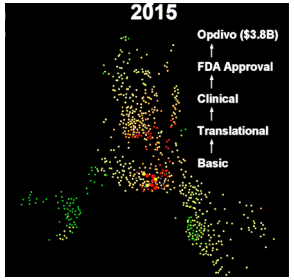
The publicly available OPA tool

iCite 2.0

Influence module
Translation module
Open Citation Collection
Hutchins et al. *PLOS Biology* 2019 17:e3000385

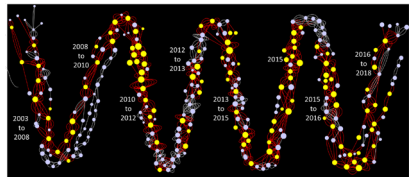
- Translational progress / clinical trials (CTs) and tech transfer / patents
  - The triangle of biomedicine, APT scores
    - Hutchins BI et al. *PLoS Biology* 2019 17(10):e3000416

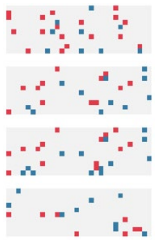




- Development of drugs and devices
  - Disambiguated drug and lead compound name, FDA data

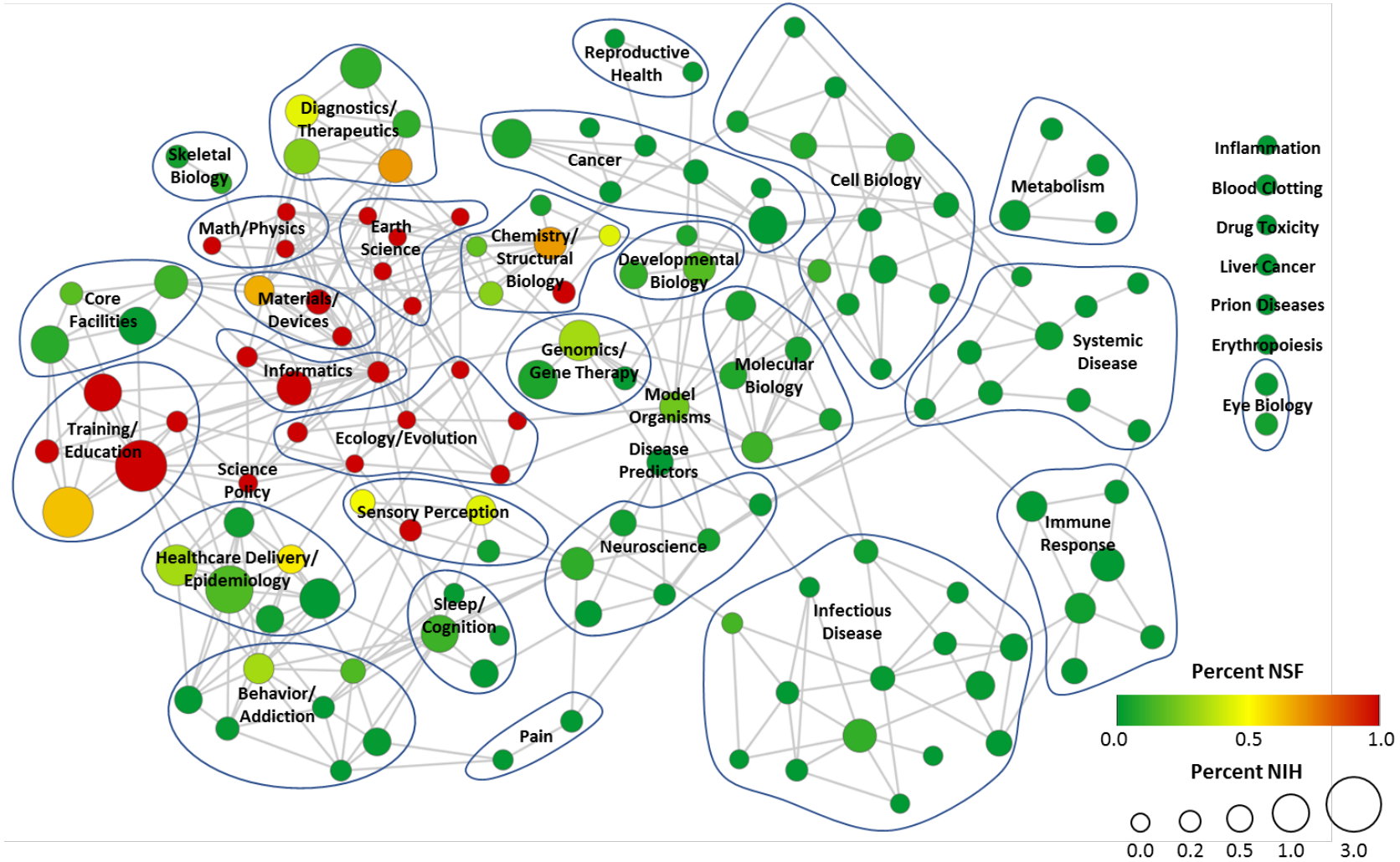
- Rate of scientific progress and emergence



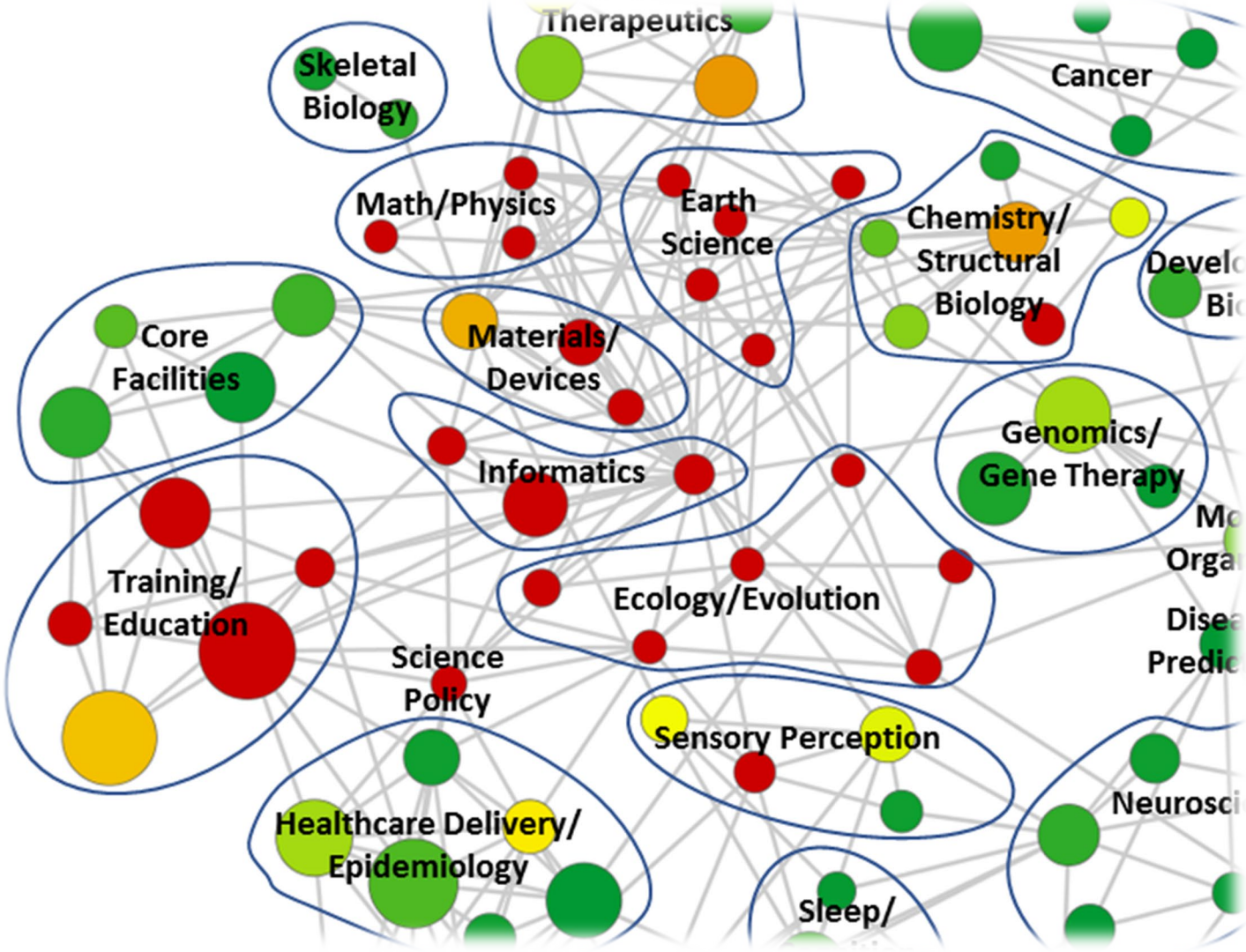


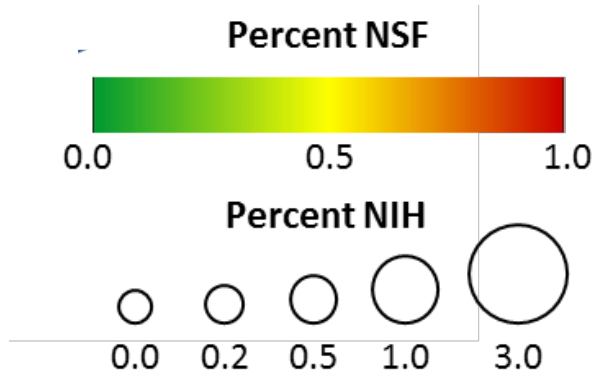
- AI to detect overlapping proposals submitted to different funders
  - Hoppe et al. *Science Advances* 2019 5:eaaw7238

Word2vec identifies overlap between the NIH and NSF portfolios



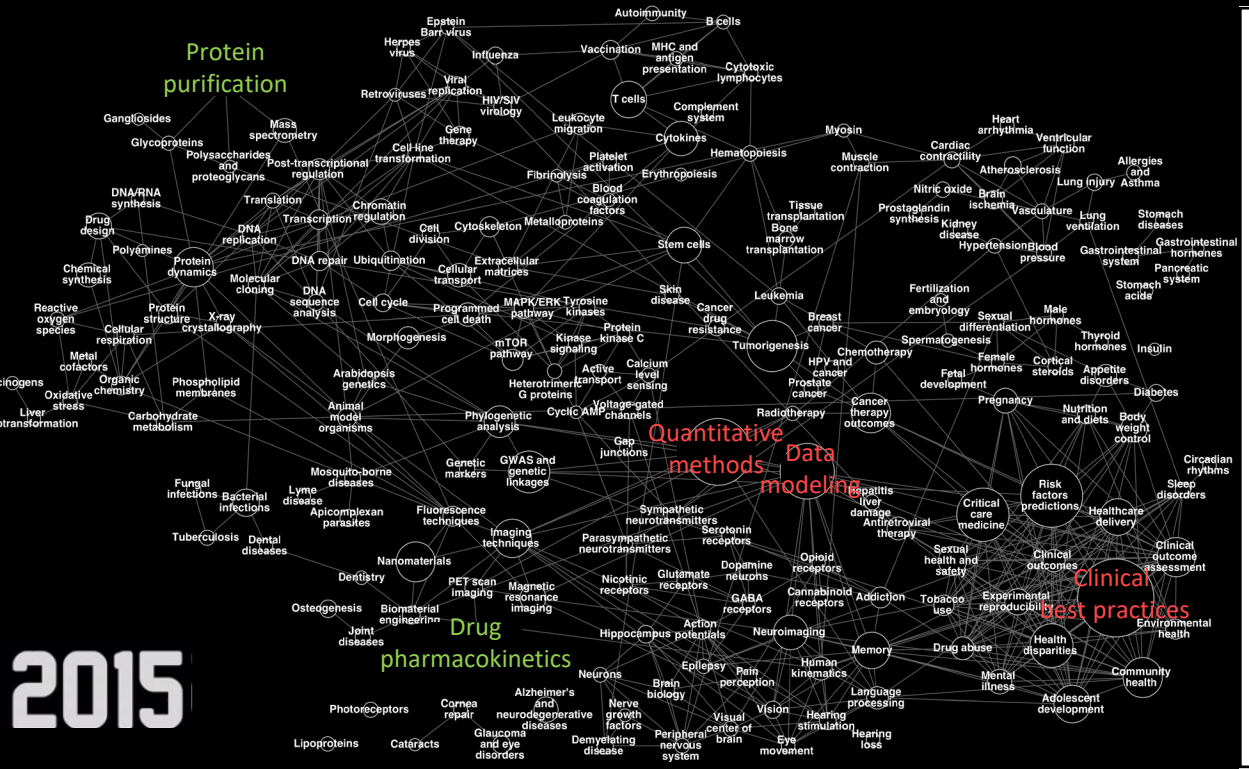
Word2vec identifies overlap between the NIH and NSF portfolios





Word2vec map of NIH-funded publications: 1981-2015

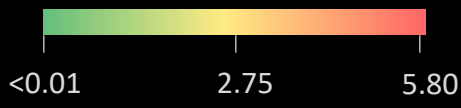
Heat-mapping: percentage of (fractionated, inflation-adjusted 2016) dollars provided by R01s

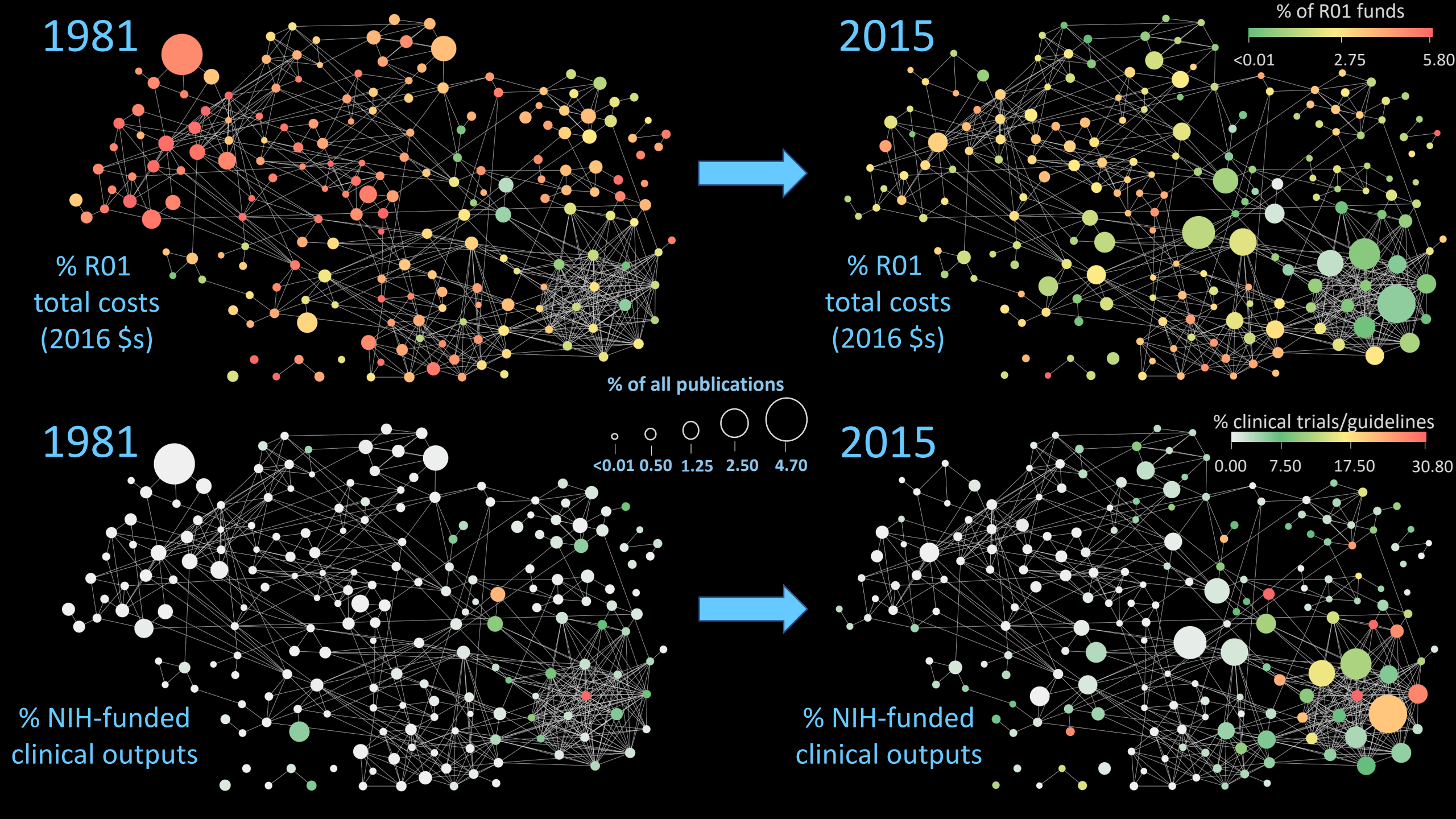


Green label = shrinking
Red label = growing

% of all publications

% of R01 funds




1981
% R01
total costs
(2016 $s)
2015
% R01
total costs
(2016 $s)
% of R01 funds
<0.01
2.75
5.80
% of all publications
<0.01
0.50
1.25
2.50
4.70
1981
% NIH-funded
clinical outputs
2015
% NIH-funded
clinical outputs
% clinical trials/guidelines
0.00
7.50
17.50
30.80

OPA Strategic Plan Fiscal Years 2021-2025

Overview of OPA's strategy

- **Objective 1:** Improve our ability to use data that can help to optimize biomedical research investments

- **Objective 2:** Exemplify and promote the highest standards of transparency, reproducibility, data sharing, dissemination, and implementation of OPA validated R&D that improves decision-making

- **Objective 3:** Exemplify and promote the highest standards for science of science investigators who focus on the biomedical research enterprise

OPA Strategic Plan
Fiscal Years
2021-2025

Objective 1: Improve our ability to use data that can help to optimize biomedical research investments

- Determine the rate of return on investment by quantifying the advancement of scientific knowledge
  - Eliminate double- or over-counting to better assign credit and influence
- Improve methods to fractionate input, output, outcome, and impact measurements
- Adjust for the unique properties and contributions of different areas of research and types of investigators (e.g. fundamental vs. clinical)

OPA Strategic Plan Fiscal Years 2021-2025

Objective 1: Improve our ability to use data that can help to optimize biomedical research investments

The **IQRST** framework

Influence, **Q**uality, **R**eproducibility,
data **S**haring, **T**ranslation/**T**ech transfer

I = weighted RCR
Q = human judgment
R = reproducibility metric (TBD)
S = data-sharing metric (TBD)
T = clinical trials, translational potential, patents, drugs, and devices

Santangelo GM *Mol. Biol. Cell* 2017 28:1401-1408

OPA Strategic Plan
Fiscal Years
2021-2025

Objective 1: Improve our ability to use data that can help to optimize biomedical research investments

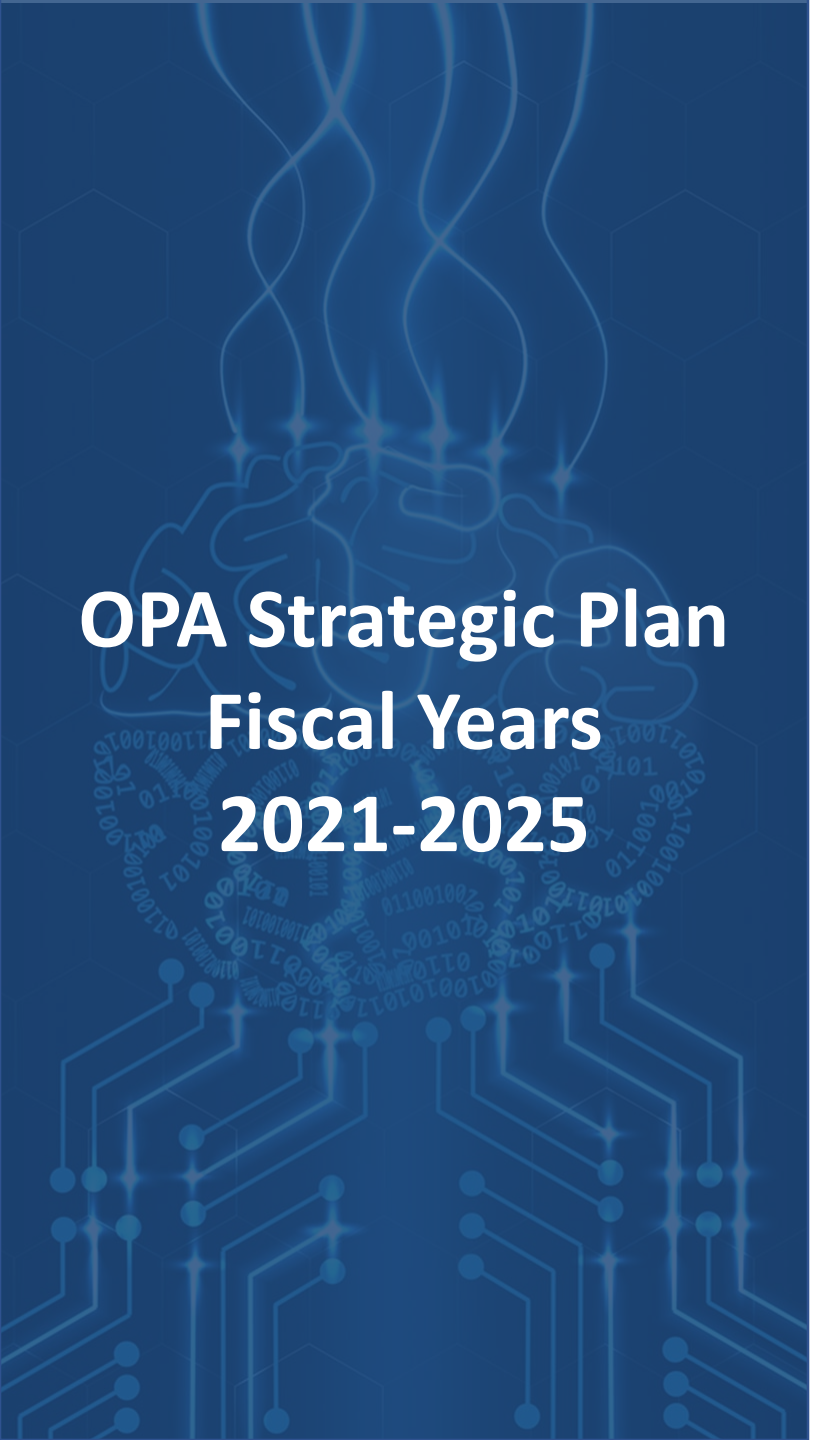
- Track and parameterize interdisciplinary and team science to assess the relative contributions of various approaches
- Quantify the possibility of diminishing returns at the level of awards and investigators to leverage resources more efficiently
- Continue to collaborate with science of science researchers in academia, the private sector, and at funding agencies
  - Improve decision-making by elucidating the parameters of success across the biomedical research enterprise
  - Develop AI/ML and other new methodologies as needed

OPA Strategic Plan
Fiscal Years
2021-2025

Objective 2: Exemplify and promote the highest standards of transparency, reproducibility, data sharing, dissemination, and implementation of OPA validated R&D that improves decision-making

- Catalyze adoption of data-driven approaches to decision-making across NIH and beyond
  - Deliver, maintain, and further develop web tools (*iSearch* and *iCite*)
  - Offer training in person and through online resources
  - Host symposia and workshops
  - Coordinate efforts with other NIH ICOs

- Improve public dissemination of OPA resources
  - Publish new methods in peer-reviewed journals
  - Share raw data and code that can be made public



Analytical shops regularly seek our assistance with tools, approaches, databases, and recruiting

Many consider OPA a model for building an analytical team

Partners and collaborators

U.S. government agencies

- Office of Naval Research (ONR)
- Air Force Office of Scientific Research (AFOSR)
- Department of Energy (DOE)
- Advanced Research Projects Agency-Energy (ARPA-E)
- National Institute of Standards and Technology (NIST)
- National Oceanic and Atmospheric Administration (NOAA)
- Agency for Healthcare Research and Quality (AHRQ)
- Intelligence Advanced Research Projects Activity (IARPA)
- National Science Foundation (NSF)

Other funders

- Wellcome Trust
- Canadian Institutes of Health Research (CIHR)
- Fondazione Telethon
- Patient-Centered Outcomes Research Institute (PCORI)
- Howard Hughes Medical Institute (HHMI)

OPA Strategic Plan
Fiscal Years
2021-2025

Objective 3: Exemplify and promote the highest standards for science of science investigators who focus on the biomedical research enterprise

- Continue to coordinate efforts at NIH and share OPA resources and best practices with other funders
- Leverage OPA resources in the private sector, where applicable
- Engage with other practitioners and stakeholders to establish analysis of biomedical research enterprise as a high-quality, well-defined, and widely recognized subdiscipline

OPA Strategic Plan Fiscal Years 2021-2025

Bold Prediction

NIH will be the first funder of science, including both the government and private sector, to succeed in predicting the outcomes of its investments with data analytics and AI/ML

- OPA has developed an AI/ML-based method to identify topics of research that are likely to experience a breakthrough
- OPA is developing methods to quantify the relationship between investments and the advancement of scientific knowledge
- NIH decision-makers can use these data improvements to prioritize support and potentially accelerate discovery in both mature and emerging areas of biomedical research

Thank you!