Use of portfolio analysis in data-driven decision making

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Director, Office of Portfolio Analysis
DPCPSI/OD
National Institutes of Health

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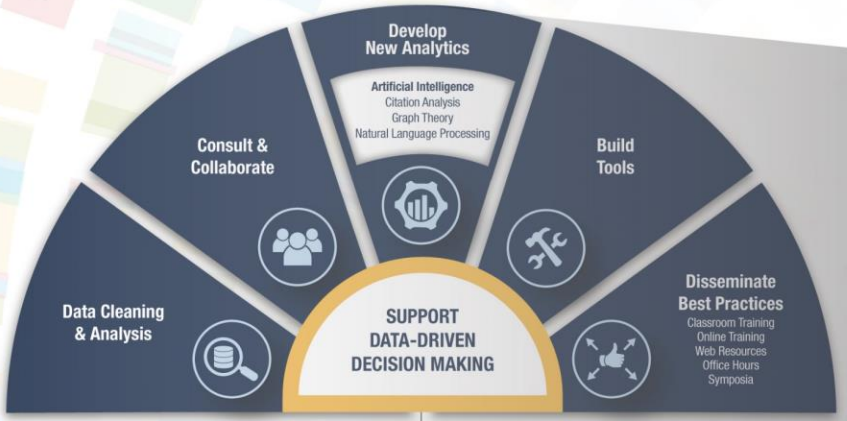
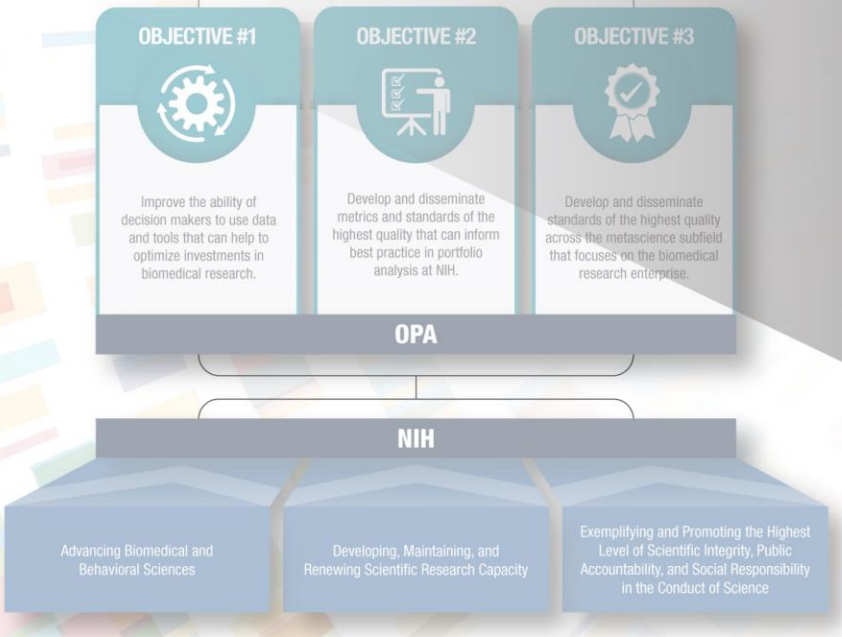
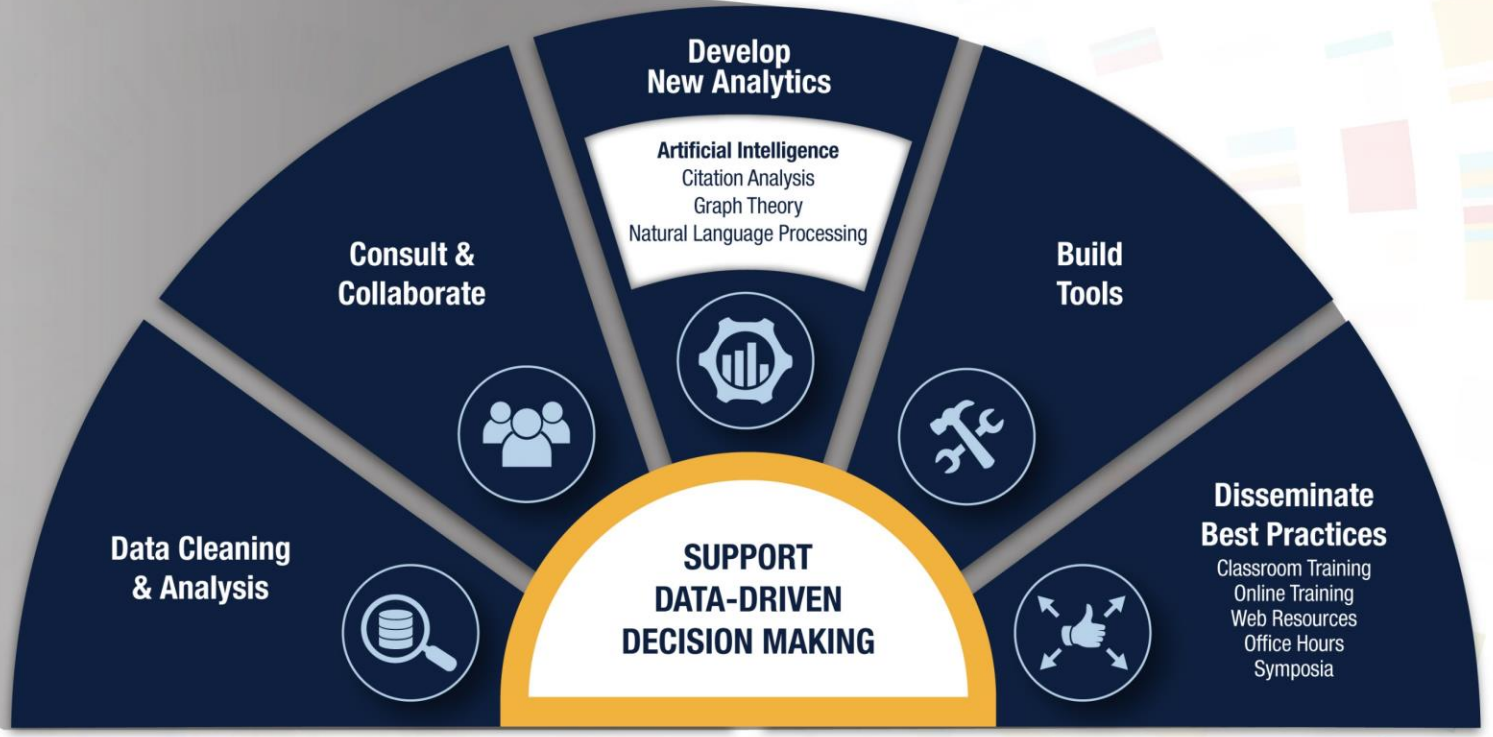
OFFICE OF PORTFOLIO ANALYSIS
STRATEGIC PLAN, FISCAL YEARS 2021–2025

OVERARCHING GOAL To accelerate biomedical research by providing access to improved methods of data-driven decision making







The complete OPA strategic plan can be found on our website: https://dpcpsi.nih.gov/opa/strategicplan

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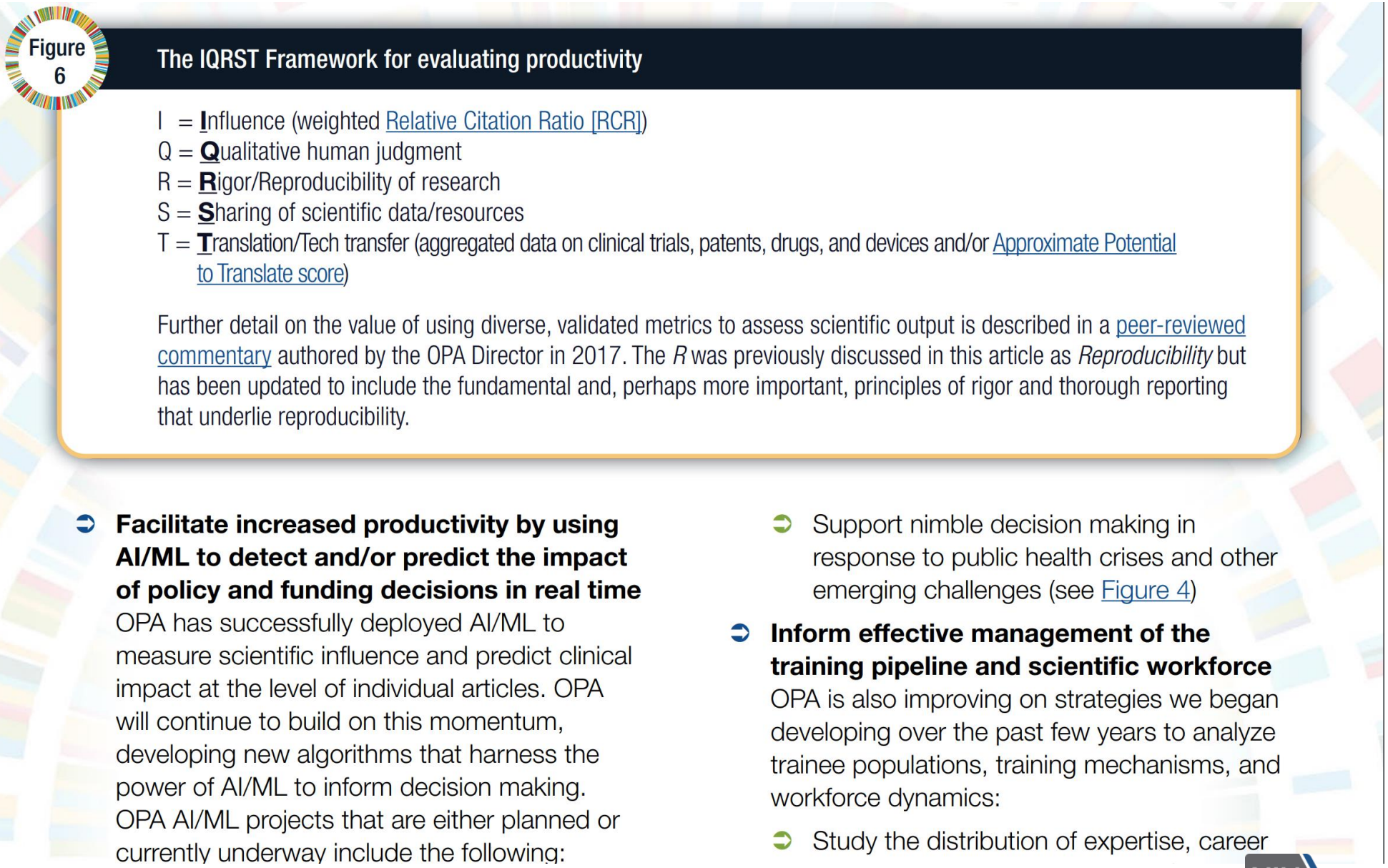
Multifaceted approach to measuring productivity: IQRST



RCR and APT scores are freely available in our public *iCite* tool

https://icite.od.nih.gov/

2016 Hutchins BI et al. *PLoS Biology* 14:e1002541
2017 Hutchins BI et al. *PLoS Biology* 15:e2003552
2019 Hutchins BI et al. *PLOS Biology* 17:e3000385
2019 Hutchins BI et al. *PLoS Biology* 17:e3000416

Results

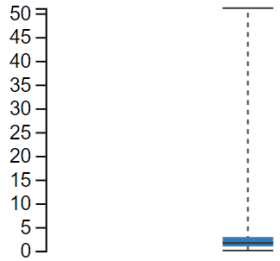
Citing Papers | Referenced Papers

Influence | Translation | Citations

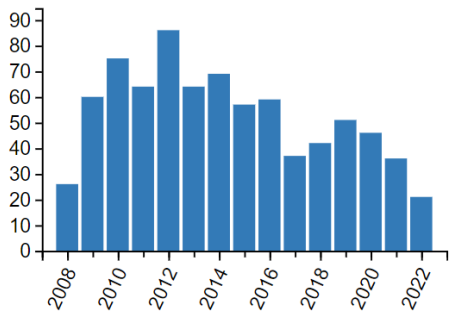
Roll over table headers for definitions; visit the Global RCR Stats page for percentile tables

Total Pubs	Pubs Per Year	Cites Per Year				Relative Citation Ratio (RCR)				Weighted RCR
		MAX	MEAN	SEM	MED	MAX	MEAN	SEM	MED	
793	52.87	143.50	7.01	0.36	4.43	51.08	2.55	0.13	1.64	1902.42

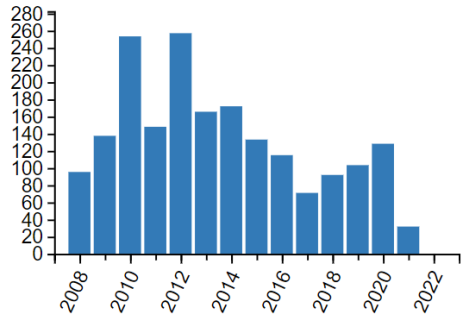
RCR Distribution



Pubs by Year



Weighted RCR by Year



Customization

As you make changes below, the summary information and charts above are updated.

Total Pubs: 793

From 2008 To 2022 | Only research articles | Only papers cited by clinical articles | Only clinical articles | Clear Filters | Export

RCR and APT scores are freely available in our public *iCite* tool

https://icite.od.nih.gov/

NIH National Institutes of Health Office of Portfolio Analysis iCite

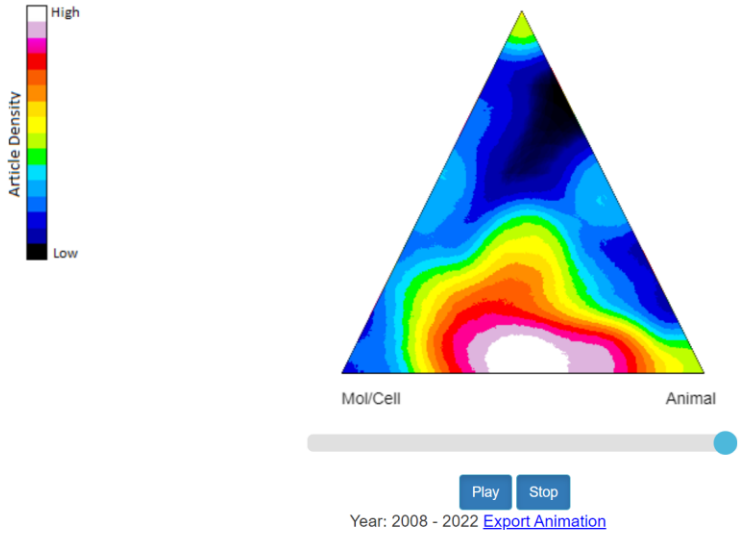
2016 Hutchins BI et al. *PLoS Biology* 14:e1002541
2017 Hutchins BI et al. *PLoS Biology* 15:e2003552
2019 Hutchins BI et al. *PLOS Biology* 17:e3000385
2019 Hutchins BI et al. *PLoS Biology* 17:e3000416

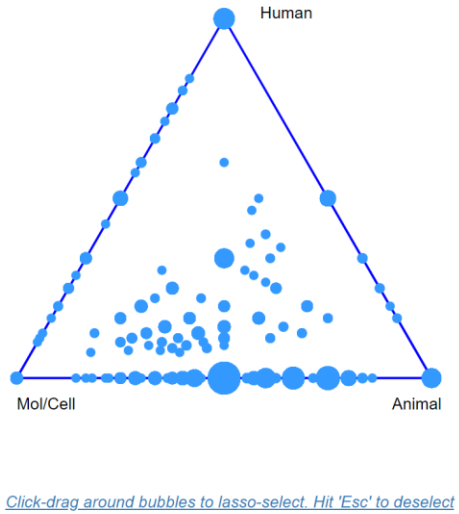
Results

Citing Papers Referenced Papers

Influence | Translation | Citations

Total Pubs	Pubs Per Year	Avg. Human	Avg. Animal	Avg. Mol/Cell	Median RCR	Avg. APT	Cited By Clin.
793	52.87	0.17	0.43	0.40	1.64	26.4%	282





Click-drag around bubbles to lasso-select. Hit 'Esc' to deselect

Customization

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NIH National Institutes of Health Office of Portfolio Analysis

iCite

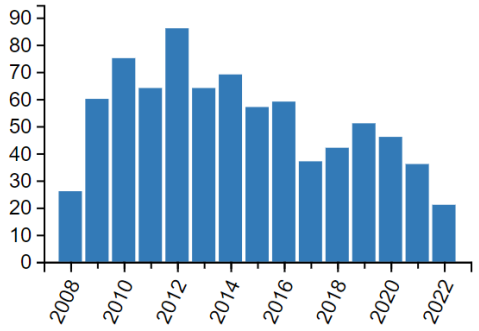
Results

Citing Papers | Referenced Papers

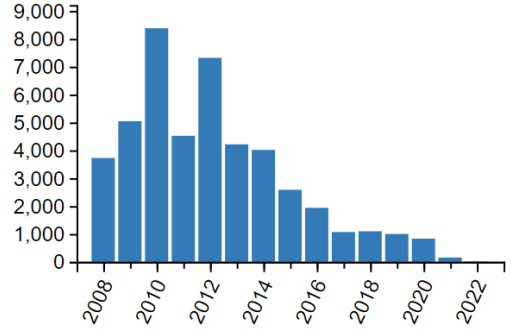
Influence | Translation | Citations

Total Pubs	Pubs Per Year	Total Citations	Citations Per Pub			
			MAX	MEAN	SEM	MED
793	52.87	45876	1722	57.85	3.71	31.00

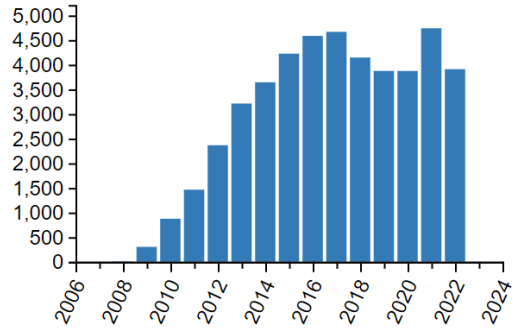
Pubs by Year



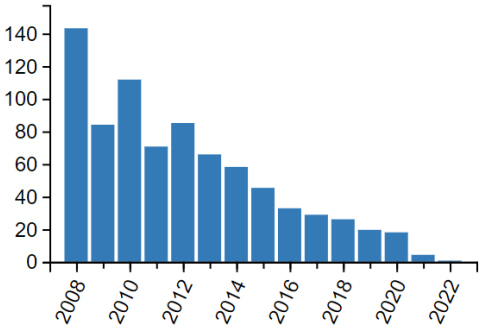
Total Citations by Publication Year



Total Citations by Year Cited



Citations per Pub by Year



Customization

As you make changes below, the summary information and charts above are updated.

Total Pubs: 793

From 2008 To 2022 | ☐ Only research articles | ☐ Only papers cited by clinical articles | ☐ Only clinical articles | Clear Filters | Export

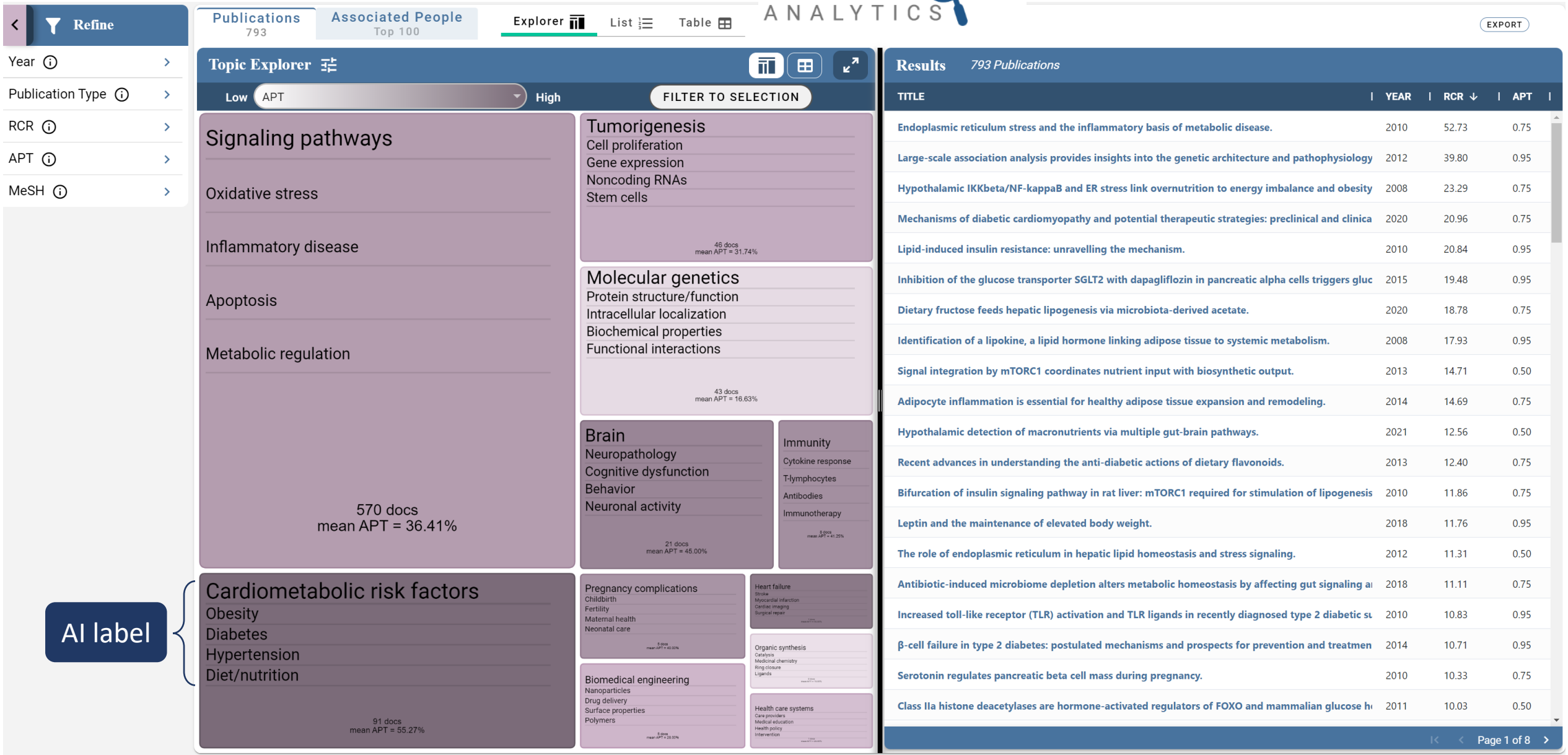
A new public OPA tool coming soon to a browser near you!

watch for our limited beta launch in a few months!

follow us on twitter for updates: @NIH_OPA

A new public OPA tool coming soon to a browser near you!

iSearch ANALYTICS



A new public OPA tool coming soon to a browser near you!

iSearch ANALYTICS

Refine

Year

Publication Type

RCR

APT

MeSH

Publications 793 | Associated People Top 100

Explorer | List | Table

EXPORT

Topic Explorer

Low NIH-funded High

FILTER TO SELECTION

- mean RCR
- APT
- NIH-funded

Signa

Oxidati

Inflammatory disease

Apoptosis

Metabolic regulation

570 docs
58.25% NIH-funded

Tumorigenesis
Cell proliferation
Gene expression
Noncoding RNAs
Stem cells
46 docs
71.74% NIH-funded

Molecular genetics
Protein structure/function
Intracellular localization
Biochemical properties
Functional interactions
43 docs
60.47% NIH-funded

Brain
Neuropathology
Cognitive dysfunction
Behavior
Neuronal activity
21 docs
66.67% NIH-funded

Immunity
Cytokine response
T-lymphocytes
Antibodies
Immunotherapy

Cardiometabolic risk factors
Obesity
Diabetes
Hypertension
Diet/nutrition
91 docs
78.02% NIH-funded

Pregnancy complications
Childbirth
Fertility
Maternal health
Neonatal care

Health care systems
Care providers
Medical education
Health policy
Intervention

Heart failure
Stroke
Myocardial infarction
Cardiac imaging
Surgical repair

Biomedical engineering
Nanoparticles
Drug delivery
Surface properties
Polymers

Organic synthesis
Catalysis
Medicinal chemistry
Ring closure
Ligands

Results 793 Publications

TITLE	YEAR	RCR ↓	APT
Endoplasmic reticulum stress and the inflammatory basis of metabolic disease.	2010	52.73	0.75
Large-scale association analysis provides insights into the genetic architecture and pathophysiology	2012	39.80	0.95
Hypothalamic IKKbeta/NF-kappaB and ER stress link overnutrition to energy imbalance and obesity	2008	23.29	0.75
Mechanisms of diabetic cardiomyopathy and potential therapeutic strategies: preclinical and clinica	2020	20.96	0.75
Lipid-induced insulin resistance: unravelling the mechanism.	2010	20.84	0.95
Inhibition of the glucose transporter SGLT2 with dapagliflozin in pancreatic alpha cells triggers gluc	2015	19.48	0.95
Dietary fructose feeds hepatic lipogenesis via microbiota-derived acetate.	2020	18.78	0.75
Identification of a lipokine, a lipid hormone linking adipose tissue to systemic metabolism.	2008	17.93	0.95
Signal integration by mTORC1 coordinates nutrient input with biosynthetic output.	2013	14.71	0.50
Adipocyte inflammation is essential for healthy adipose tissue expansion and remodeling.	2014	14.69	0.75
Hypothalamic detection of macronutrients via multiple gut-brain pathways.	2021	12.56	0.50
Recent advances in understanding the anti-diabetic actions of dietary flavonoids.	2013	12.40	0.75
Bifurcation of insulin signaling pathway in rat liver: mTORC1 required for stimulation of lipogenesis	2010	11.86	0.75
Leptin and the maintenance of elevated body weight.	2018	11.76	0.95
The role of endoplasmic reticulum in hepatic lipid homeostasis and stress signaling.	2012	11.31	0.50
Antibiotic-induced microbiome depletion alters metabolic homeostasis by affecting gut signaling ai	2018	11.11	0.75
Increased toll-like receptor (TLR) activation and TLR ligands in recently diagnosed type 2 diabetic su	2010	10.83	0.95
β-cell failure in type 2 diabetes: postulated mechanisms and prospects for prevention and treatmen	2014	10.71	0.95
Serotonin regulates pancreatic beta cell mass during pregnancy.	2010	10.33	0.75
Class IIa histone deacetylases are hormone-activated regulators of FOXO and mammalian glucose h	2011	10.03	0.50

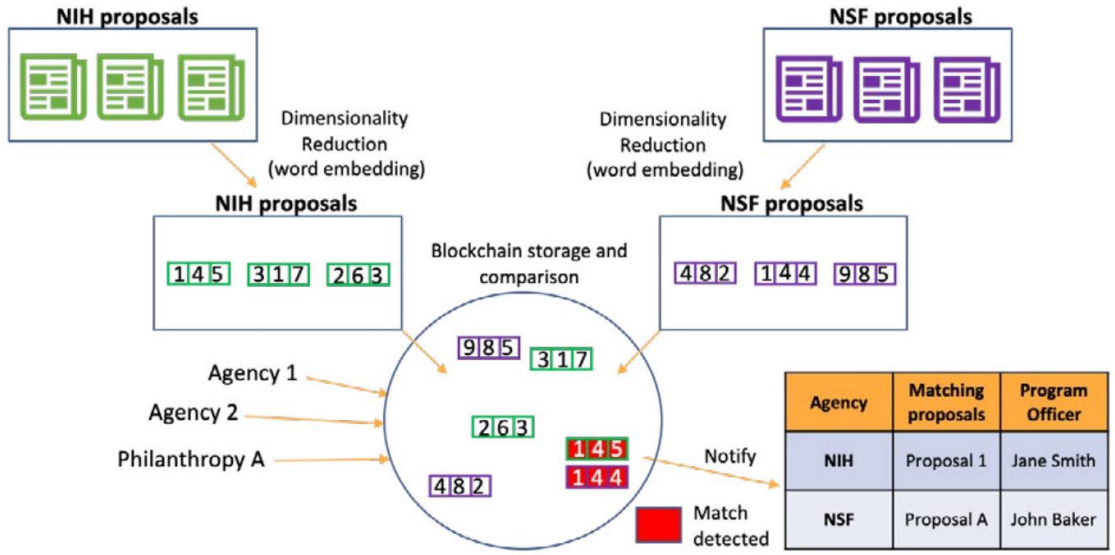
Page 1 of 8

Coordination and data sharing can help funders make better decisions

Figure 7

Pre-decisional management of overlapping proposals at funding organizations

Coordinating R&D investments across federal agencies and other public and private funders is not happening at scale. OPA data scientists and analysts are collaborating with a team from the National Science Foundation (NSF) to develop AI/ML that flags pre-decisional applications with overlapping aims, without the need to share private information or intellectual property. This approach has the potential to improve stewardship of research investments across funding entities by reducing or eliminating unnecessary duplication, managing overlapping research, and encouraging collaboration between and among researchers with similar interests.



Coordination and data sharing helps funders make better decisions

2022 Government Accountability Office (GAO) Analysis

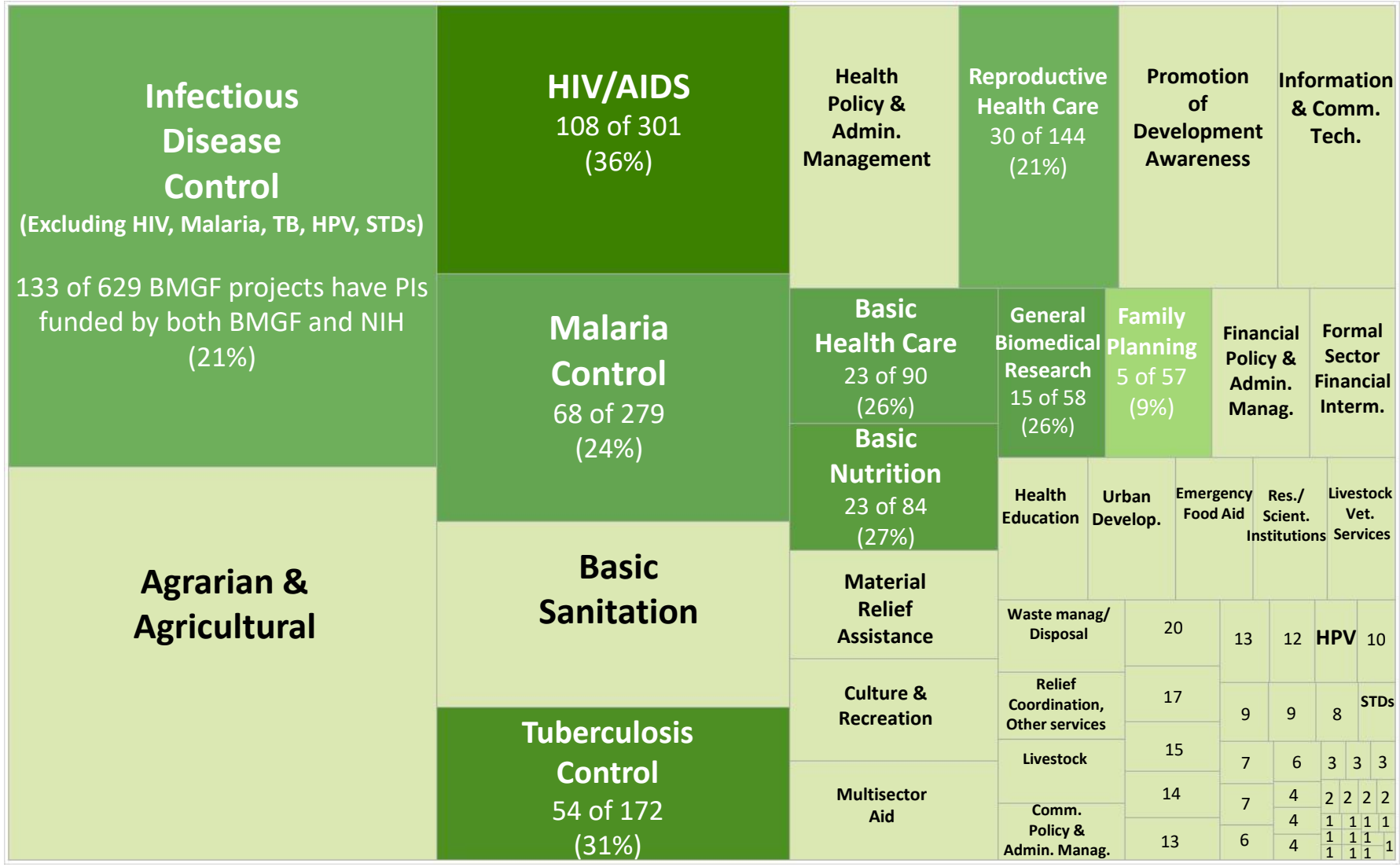
Biomedical Research:
Observations on DOD's Management of Congressionally Directed Medical Research Programs

GAO-22-105107

Published: Jan 31, 2022. Publicly Released: Jan 31, 2022.

"DOD coordinates with the National Institutes of Health (NIH) and the Department of Veterans Affairs (VA) by leveraging shared data to identify and mitigate project overlap."

Overlap between the BMGF and NIH portfolios (2009-2014)



Box size corresponds to number of awards

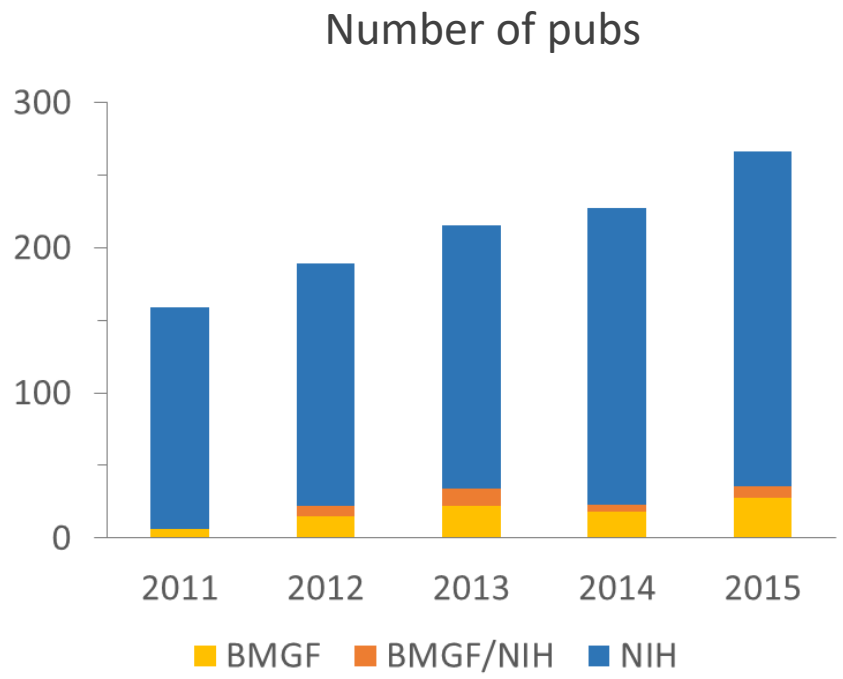
# of awards is shown in boxes without a topic label

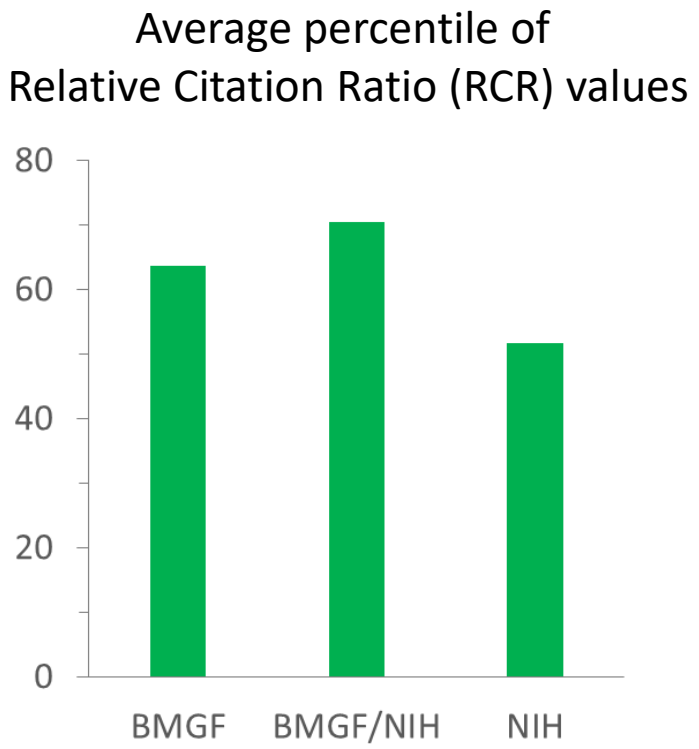
% of awards where the BMGF PIs also receive NIH funding:

National Institutes of Health
Office of Portfolio Analysis

Synergy can result from overlapping investments by different funders

A topic-wide example from clinical research:
NIH & BMGF point-of-care publications 2011-2015

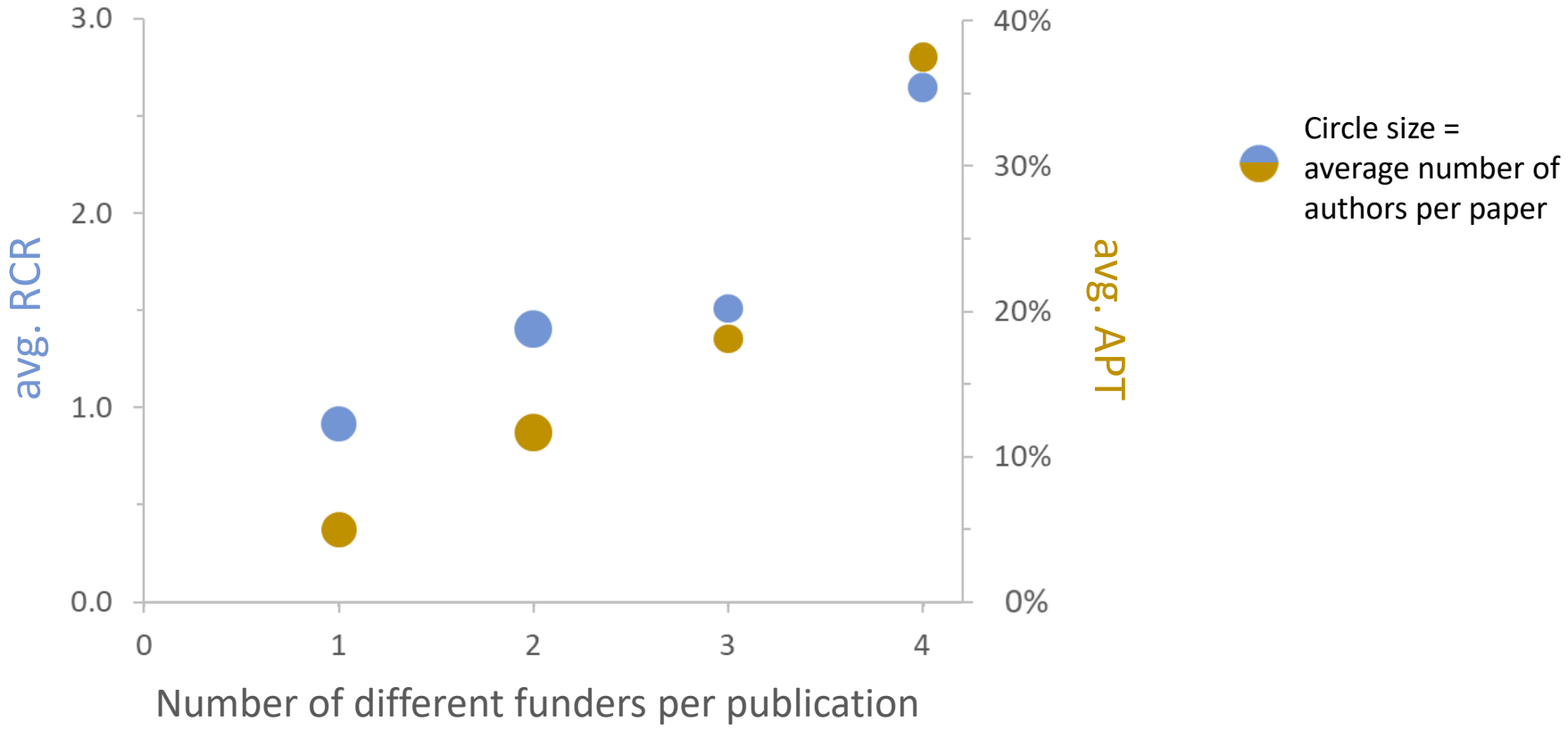




RCR of median NIH pub	1.0
percentile of median NIH pub	50%

Synergy can result from overlapping investments by different funders

An anecdotal example from fundamental research:
Publications (2016 to 2022) of a well-funded molecular immunologist



Detecting synergies at scale requires data of the highest quality

An anecdotal example from fundamental research: Publications (2016 to 2022) of a well-funded molecular immunologist

	Journal	*Sci Rep*	*J Allergy Clin Immunol*	*Cell Rep*	*Trends Immunol*	*Front Immunol*	*EBioMedicine*	*Immunity*	*Sci Immunol*	*Cell Rep*	*Immunity*	*PNAS*	*Trends Immunol*	*Nat Commun*	*J Exp Med*	*Nat Commun*	*Immunol Cell Biol*	*Nat Microbiol*	*Nat Commun*	*Nat Commun*	*Sci Adv*	*iScience*
	Pub Year	2017	2019	2017	2016	2018	2021	2018	2020	2019	2016	2019	2022	2021	2019	2019	2018	2022	2019	2018	2019	2021
	Number of funders	**7**	**5**	**4**	**4**	**4**	**4**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**
	NIH	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
HRA funder	Pew Scholars in Biomed. Sci.	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓								
HRA funder	Burroughs Wellcome Fund	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓				✓				
HRA funder	Cancer Research Institute	✓		✓	✓	✓					✓											
Chinese funder	NNSF (China)	✓													✓		✓		✓			
Chinese funder	Chinese Acad. Sci.	✓	✓				✓								✓							
Chinese funder	Ministry of Sci. & Tech. of China	✓	✓																			
Chinese funder	Beijing Nat. Sci. Foundation														✓							
non-HRA funder	Amer. Soc. for Nephrology						✓															
non-HRA funder	Laffey McHugh Foundation						✓															
non-HRA funder	Natl. Multiple Sclerosis Soc.															✓						

Detecting synergies at scale requires data of the highest quality

21 publications
(2016 to 2022)

Our AI/ML algorithm identifies over 200 unique authors who have published as Liang Zhou, only one of whom is this well-funded molecular immunologist

53 results from All Databases for:

Zhou, Liang (Author) and Florida (Address) | Analyze Results | Citation Report | Create Alert

Refined By: Publication Years: 2016 or 2017 or 2018 or 2019 or 2020 or 2021 or 2022 | Clear all

Copy query link

Publications You may also like...

Refine results

Search within topic...

Filter by Marked List

Quick Filters

- Highly Cited Papers 1
- Review Article 4
- Open Access 37
- Associated Data 5

Publication Years

- 2022 5
- 2021 5
- 2020 4
- 2019 16
- 2018 11

See all >

Document Types

- Article 39
- Other 20
- Meeting 10

0/53 | Add To Marked List | Export | Sort by: Relevance | 1 of 2

1 Mitochondrial transcription factor A in ROR gamma t(+) lymphocytes regulate small intestine homeostasis and metabolism

Fu, Z; Dean, JW; (...); Zhou, L

Jul 22 2021 | NATURE COMMUNICATIONS 12 (1)

ROR gamma t is known to play critical roles in the regulation of a number of immune cell subsets. Here the authors implicate mitochondrial transcription factor A in the regulation of intestinal ROR gamma t(+) lymphocyte homeostasis and metabolic control in a murine in vivo model.
ROR gamma t(+) lymphocytes, including interleukin 17 (IL-17)-producing gamma delta T (gamma delta T17) cells, ... Show more

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3 Citations
83 References
Related records

2 An Electrothermal Cu/W Bimorph Tip-Tilt-Piston MEMS Mirror with High Reliability

Zhou, L; Zhang, XY and Xie, HK

May 2019 | MICROMACHINES 10 (5)

This paper presents the design, fabrication, and characterization of an electrothermal MEMS mirror with large tip, tilt and piston scan. This MEMS mirror is based on electrothermal bimorph actuation with Cu and W thin-film layers forming the bimorphs. The MEMS mirror is fabricated via a combination of surface and bulk micromachining. The piston displacement and tip-tilt optical angle of the mir ... Show more

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12 Citations
37 References
Related records

3 A NOVEL OUT-OF-PLANE ELECTROTHERMAL BISTABLE MICROACTUATOR

Zhou, L and Xie, HK

20th International Conference on Solid-State Sensors, Actuators and Microsystems and Eurosensors XXXIII (TRANSDUCERS and EUROSENSORS) 2019 |

16 References

AND / OR: Liang Zhou Florida

Search History | SEARCH FIELDS | TRANSFER

Refine

- Year
- Publication Type
- RCR
- APT
- MeSH

Publications 21 | Associated People Top 100 | Explorer | List | Table | EXPORT

Topic Explorer

Low — mean RCR — High | FILTER TO SELECTION

- immunology
- lymphocytes
- cytotoxicity
- killer cells

14 docs
mean RCR = 1.30

- gene expression
- signaling pathw...
- embryonic develo...
- regulatory protein

2 docs
mean RCR = 1.70

- inflammatory response
- cytokines
- macrophages
- interleukin

4 docs
mean RCR = 1.99

- gut microbiota
- fecal bacteria
- microbiome
- probiotics

1 docs
mean RCR = 0.98

Results *21 Publications*

TITLE	YEAR	RCR ↓	APT
IL-17-producing ST2^{+} group 2 innate lymphoid cells play a pathogenic role in lung inflammation.	2019	4.17	0.75
Aryl Hydrocarbon Receptor Signaling Cell Intrinsically Inhibits Intestinal Group 2 Innate Lymphoid Ce	2018	4.00	0.75
The Aryl Hydrocarbon Receptor Preferentially Marks and Promotes Gut Regulatory T Cells.	2017	3.64	0.50
AHR Function in Lymphocytes: Emerging Concepts.	2016	3.24	0.50
Hectd3 promotes pathogenic Th17 lineage through Stat3 activation and Malt1 signaling in neuroinfl	2019	2.45	0.25
Regulation of Innate Lymphoid Cells by Aryl Hydrocarbon Receptor.	2018	2.08	0.75
Kynurenine induces T cell fat catabolism and has limited suppressive effects in vivo.	2021	2.02	0.50
Ahr-Foxp3-RORγt axis controls gut homing of CD4^{+} T cells by regulating GPR15.	2020	1.50	0.25
Activation of DR3 signaling causes loss of ILC3s and exacerbates intestinal inflammation.	2019	1.35	0.05
Requirement of Mitochondrial Transcription Factor A in Tissue-Resident Regulatory T Cell Maintenan	2019	1.27	0.05
Perfluorooctane sulfonate affects intestinal immunity against bacterial infection.	2017	0.98	0.25
SjHSP60 induces CD4^{+} CD25^{+} Foxp3^{+} Tregs via TLR4-Mal-drived production of TGF-β in macrophage	2018	0.90	0.05
Bcl11b is essential for licensing Th2 differentiation during helminth infection and allergic asthma.	2018	0.84	0.05
Ikaros Inhibits Group 3 Innate Lymphoid Cell Development and Function by Suppressing the Aryl Hyc	2016	0.79	0.05
Dichotomous regulation of group 3 innate lymphoid cells by nongastric *Helicobacter* species.	2019	0.74	0.25
Bcl11b prevents fatal autoimmunity by promoting T_{reg} cell program and constraining innate lineages	2019	0.48	0.05
Yeats4 drives ILC lineage commitment via activation of *Lmo4* transcription.	2019	0.15	0.05
BCL11B is positioned upstream of PLZF and RORγt to control thymic development of mucosal-associ	2021		0.05
Mitochondrial transcription factor A in RORγt^{+} lymphocytes regulate small intestine homeostasis and	2021		0.05
Cell-intrinsic view of the aryl hydrocarbon receptor in tumor immunity.	2022		0.05

Linking publications to people: disambiguation

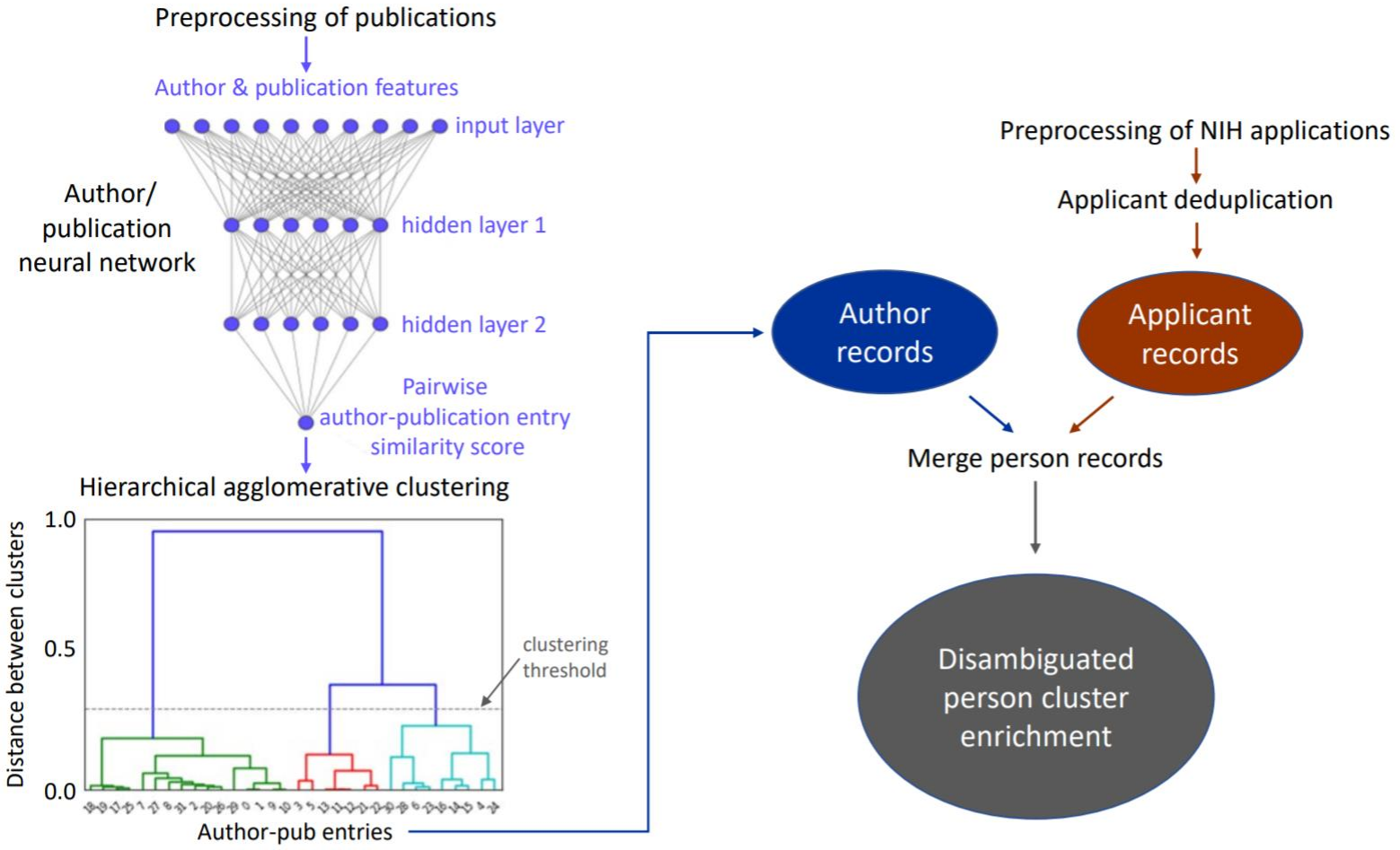


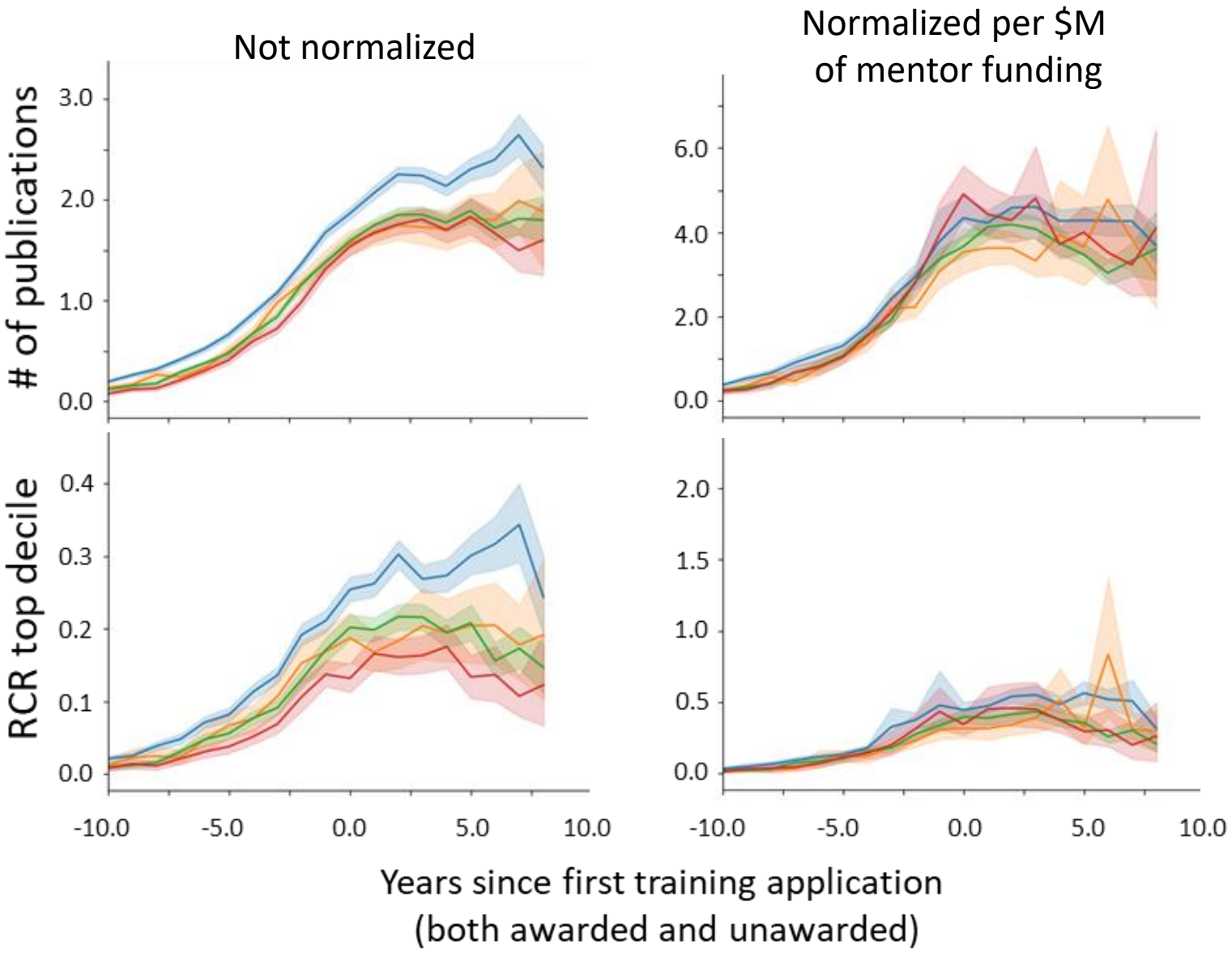
Figure 2 from Yu et al. The effect of mentee and mentor gender on scientific productivity of applicants for NIH training fellowships. bioRxiv 10.1101/2021.02.02.429450 (February 3, 2021)

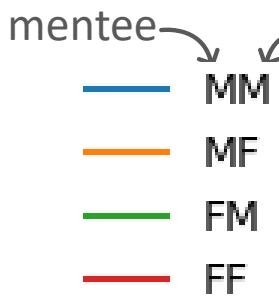
OPA analysis of the effect of mentee and mentor gender on the scientific productivity of applicants for NIH fellowships

We analyzed the relationship between mentoring and productivity with a carefully designed analytical approach and high quality data:

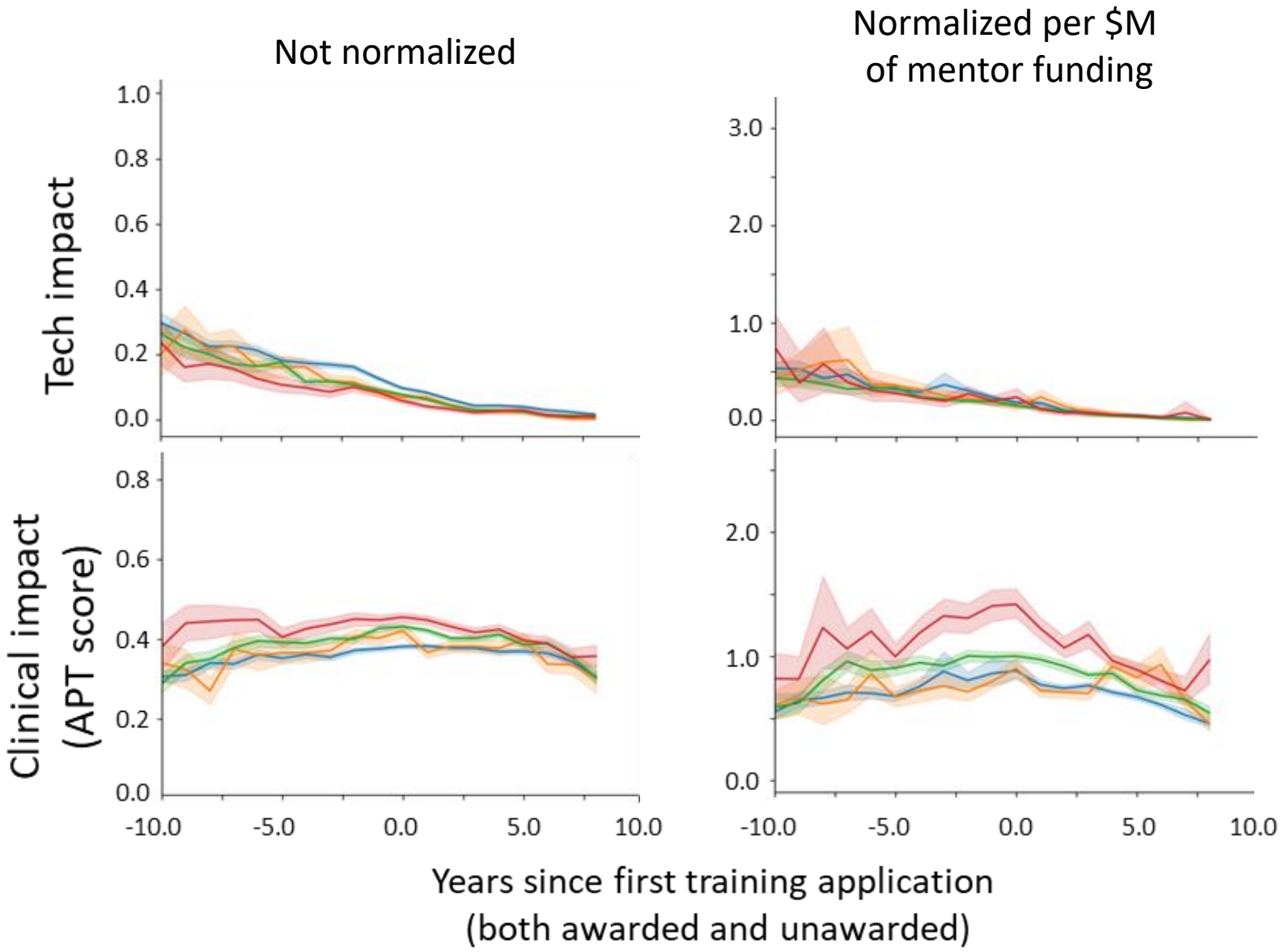
- 18,600 pre- and post-doctoral fellowship applications
  - F30, F31 and F32, K01, K08, K23, K99 respectively
  - FY2011 through FY2017
- Separated into four mentee-mentor dyads: FF, FM, MF, and MM
- Mentees identify their mentor(s) in every application
- Since fellowships are salary only, productivity relies upon (and was therefore normalized to) the research funds available to the mentor
- Publications were linked to mentees with high quality disambiguation, and productivity was measured with a multi-faceted framework

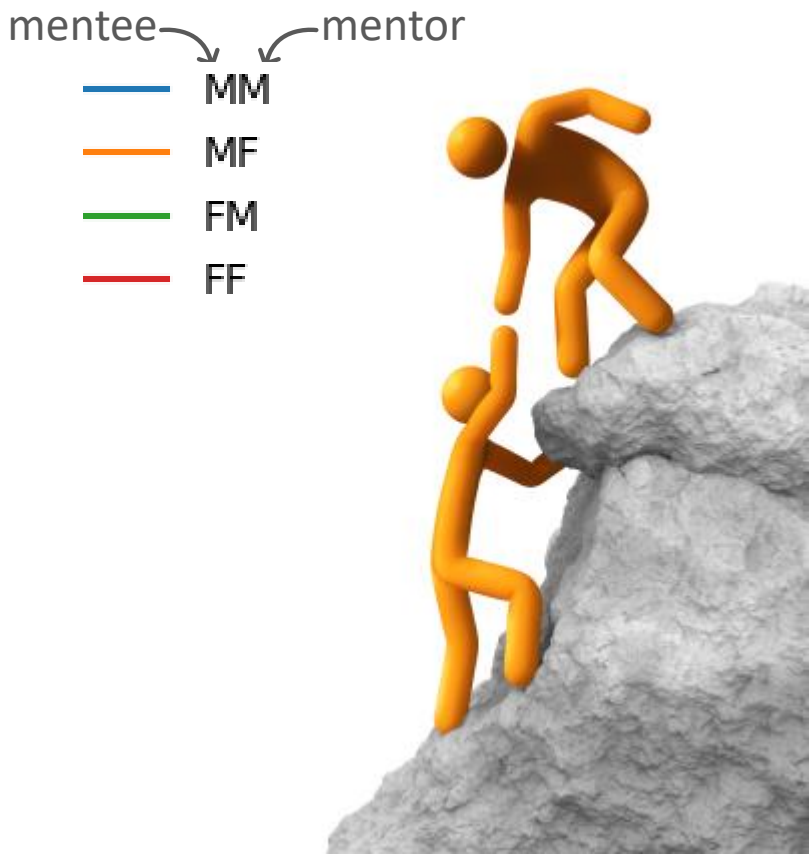
The effect of mentee/mentor gender on mentee productivity





The effect of mentee/mentor gender on mentee productivity





New OPA analytics

- Detecting emerging areas of biomedical research and measuring how rapidly (or slowly) each topic is progressing
- Tracking the development of past transformative breakthroughs
- Predicting which topics will produce future transformative breakthroughs in the next 2 to 12 years

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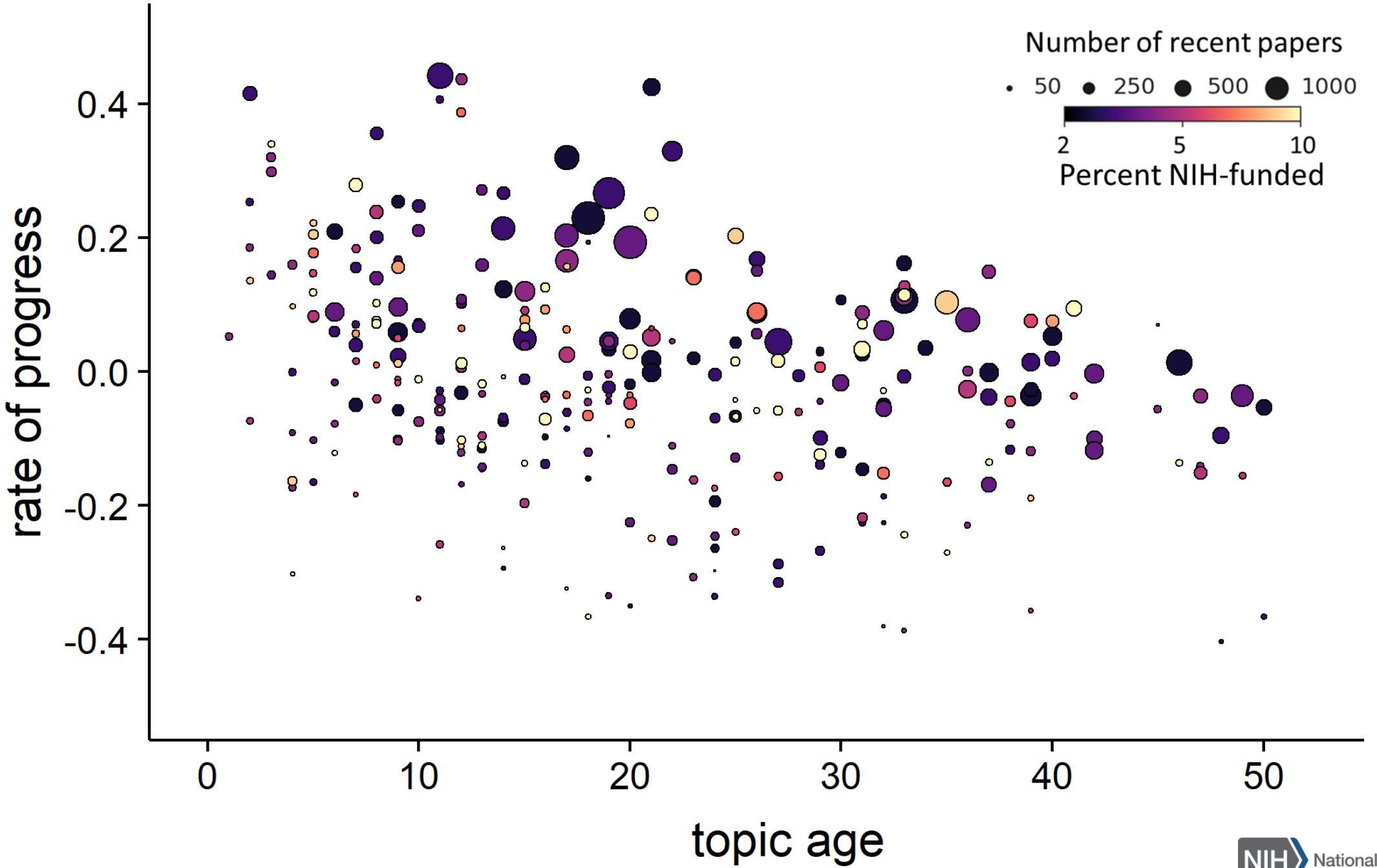

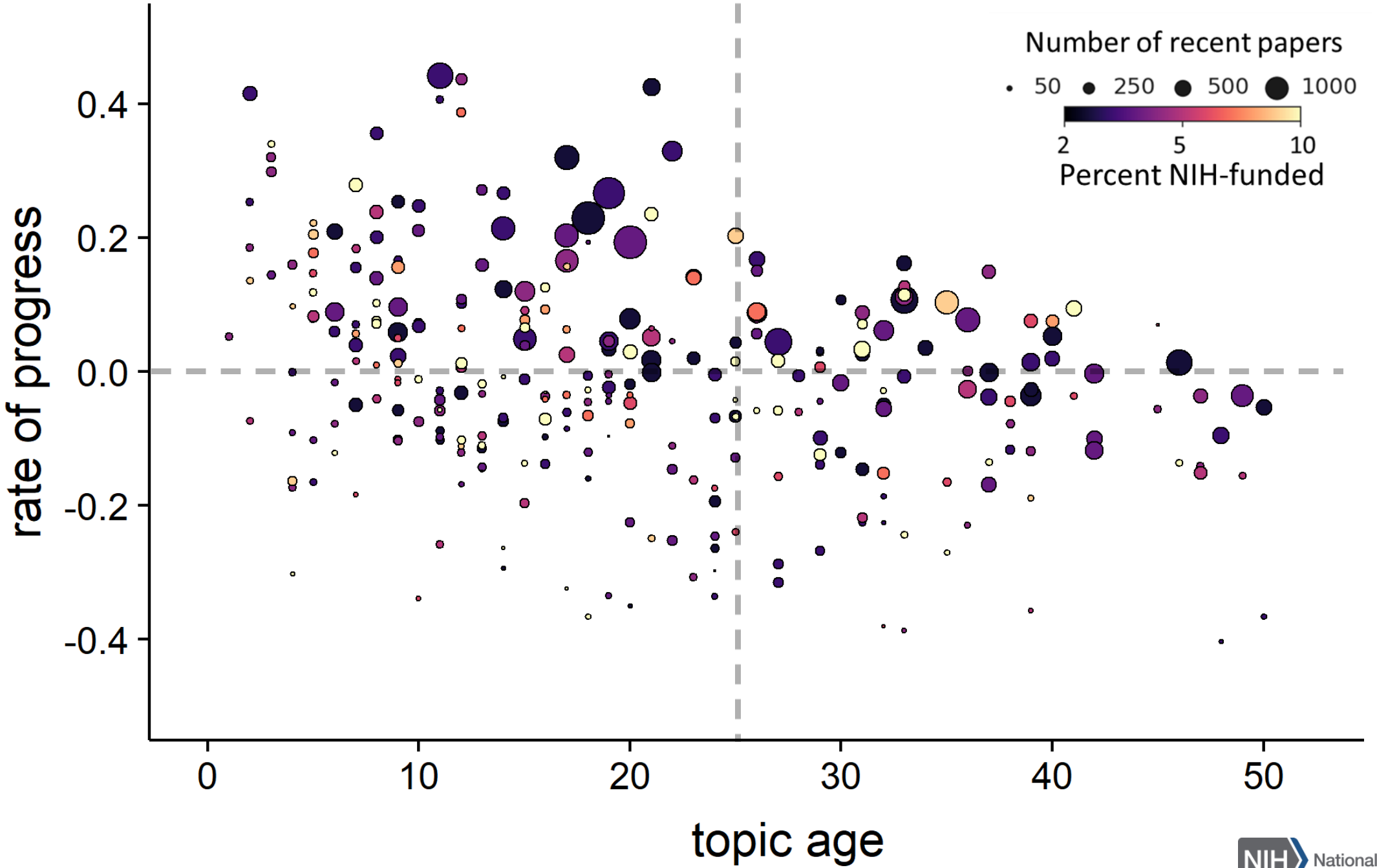

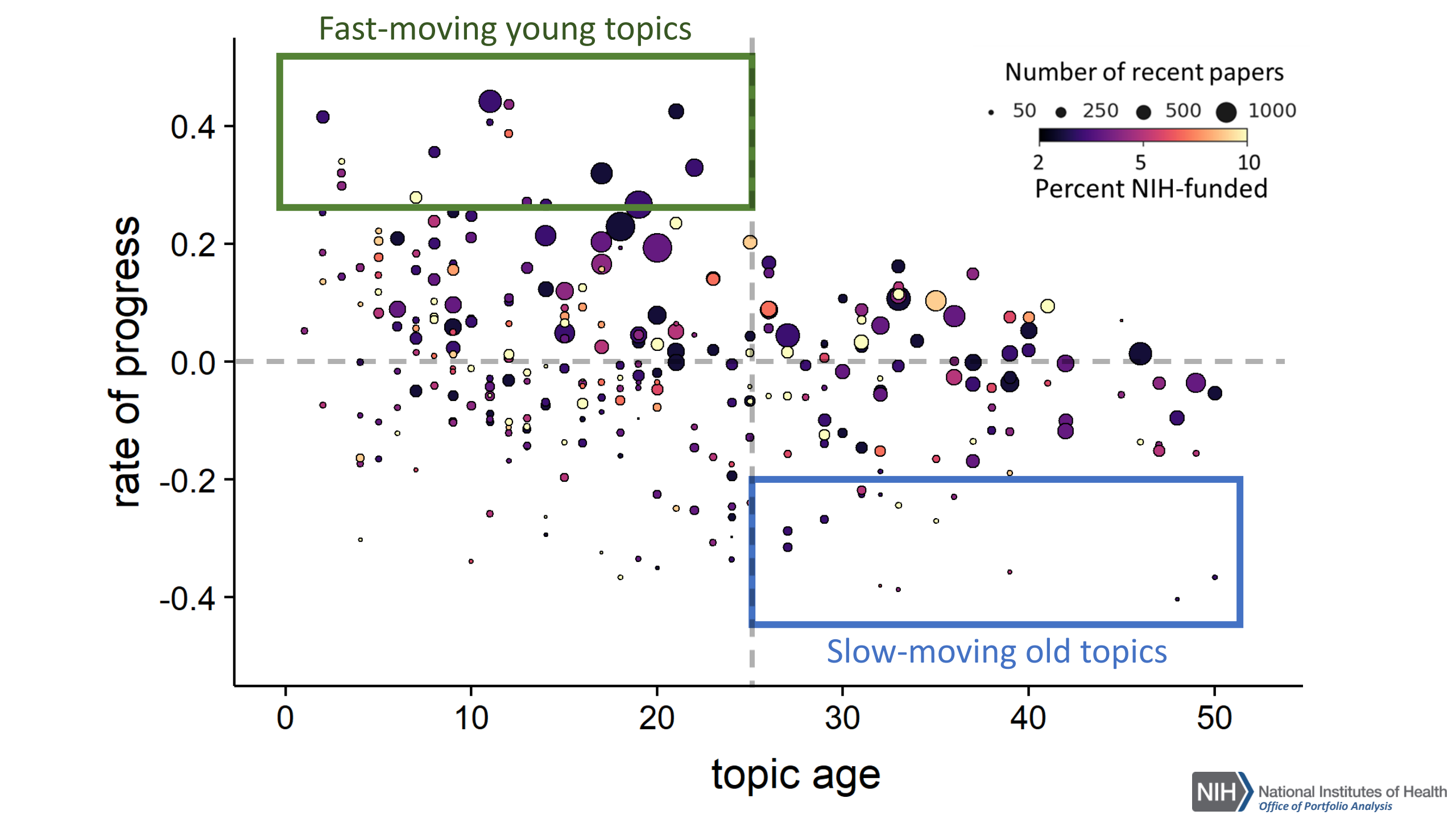

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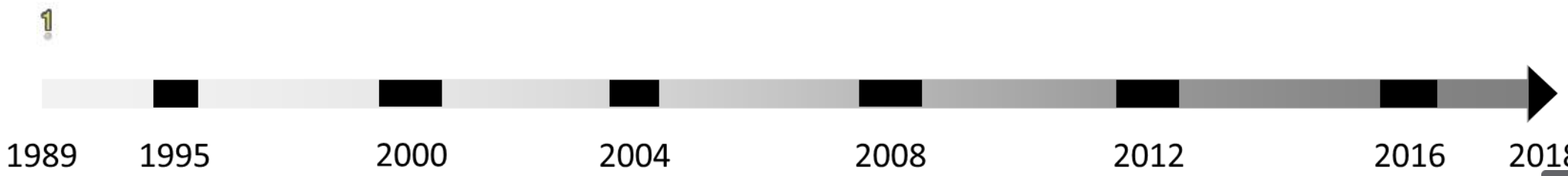
Emergence of mRNA vaccines: Progression of key publications

1 Cationic liposome-mediated RNA transfection
RCR 8.19
Proc Natl Acad Sci 1989

Clinical trial or guideline =

0 1 3 12
Clinical impact

0 110 220
Tech impact



Emergence of mRNA vaccines: Flow of information

1 RCR 8.19 Cationic liposome-mediated RNA transfection
Proc Natl Acad Sci 1989

2 RCR 2.26 Characterization of a messenger RNA polynucleotide vaccine vector
Cancer Res 1995

3 RCR 3.12 In vivo application of RNA leads to induction of specific cytotoxic T lymphocytes and antibodies
Eur J Immunol 2000

4 RCR 1.46 Polarization of immunity induced by direct injection of naked sequence-stabilized mRNA vaccines
Cell Mol Life Sci 2004

5 RCR 12.70 Suppression of RNA recognition by Toll-like receptors: the impact of nucleoside modification and the evolutionary origin of RNA
Immunity 2005

6 RCR 2.75 Results of the first phase I/II clinical vaccination trial with direct injection of mRNA
J Immunother 2008

7 RCR 7.86 Incorporation of pseudouridine into mRNA yields superior nonimmunogenic vector with increased translational capacity and biological stability
Mol Ther 2008

8 RCR 3.45 Incorporation of pseudouridine into mRNA enhances translation by diminishing PKR activation
Nucleic Acids Res 2010

9 RCR 2.43 Nucleoside modifications in RNA limit activation of 2'-5'-oligoadenylate synthetase and increase resistance to cleavage by RNase L
Nucleic Acids Res 2011

10 RCR 5.75 Generating the optimal mRNA for therapy: HPLC purification eliminates immune activation and improves translation of nucleoside-modified, protein-encoding mRNA
Nucleic Acids Res 2011

11 RCR 6.60 Protective efficacy of in vitro synthesized, specific mRNA vaccines against influenza A virus infection
Nat Biotechnol 2012

12 RCR 4.05 Validation of the wild-type influenza A human challenge model H1N1pdMIST: an A(H1N1)pdm09 dose-finding investigational new drug study
Clin Infect Dis 2015

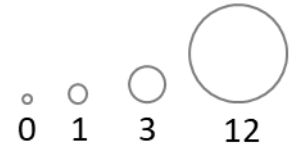
13 RCR 7.44 Optimization of Lipid Nanoparticle Formulations for mRNA Delivery in Vivo with Fractional Factorial and Definitive Screening Designs
Nano Lett 2015

14 RCR 8.56 Expression kinetics of nucleoside-modified mRNA delivered in lipid nanoparticles to mice by various routes
J Control Release 2015

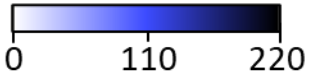
15 RCR 12.92 Preclinical and Clinical Demonstration of Immunogenicity by mRNA Vaccines against H10N8 and H7N9 Influenza Viruses
Mol Ther 2017

16 RCR 7.50 Safety and immunogenicity of a mRNA rabies vaccine in healthy adults: an open-label, non-randomised, prospective, first-in-human phase 1 clinical trial
Lancet 2017

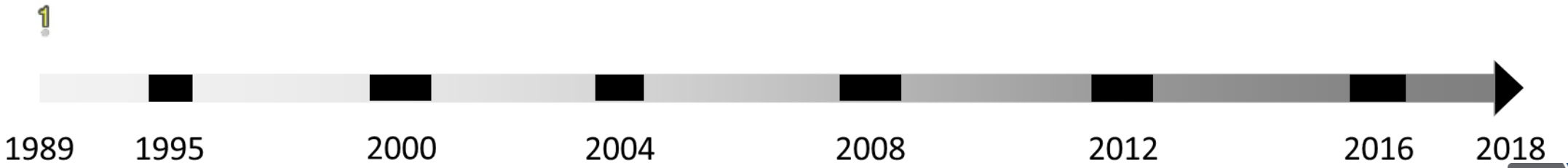
Clinical trial or guideline =



Clinical impact



Tech impact



Summary

- Our existing *iCite* tool is a freely available source of data that fully supports multifaceted assessments of the return on investments in biomedical research

- We will release a limited beta version of our new analytical tool with the next few months
  - Transformative features include AI/ML-driven visualizations, high quality disambiguation, and full coverage of both PubMed and biomedically relevant preprints
  - Let us know if you'd like a live demo for your group, and/or early access as a beta tester!

- Effective analyses of research portfolios requires high quality data

- Synergy can result from overlapping investments by different funders
  - We're eager to collaborate and learn from each other
  - We work on an academic rather than a commercial model; all shared data is kept confidential and held solely within our team

- We can accelerate progress in improving human health by working together to detect emerging areas, measure the rate of scientific advancement, capture the development of past transformative breakthroughs, and predict which topics will produce future breakthroughs