National Institute of General Medical Sciences

How the NIH funds people, projects, and infrastructure in STI modeling

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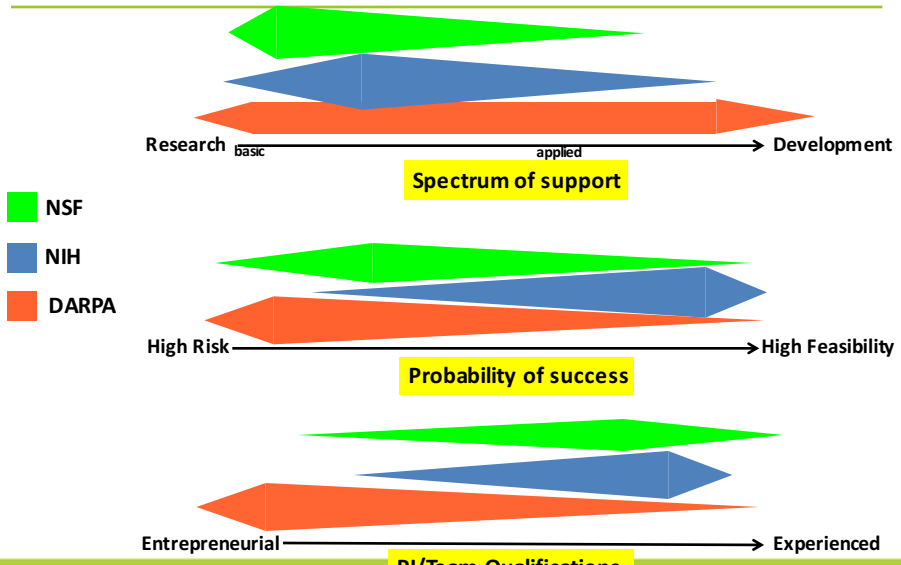
Outline

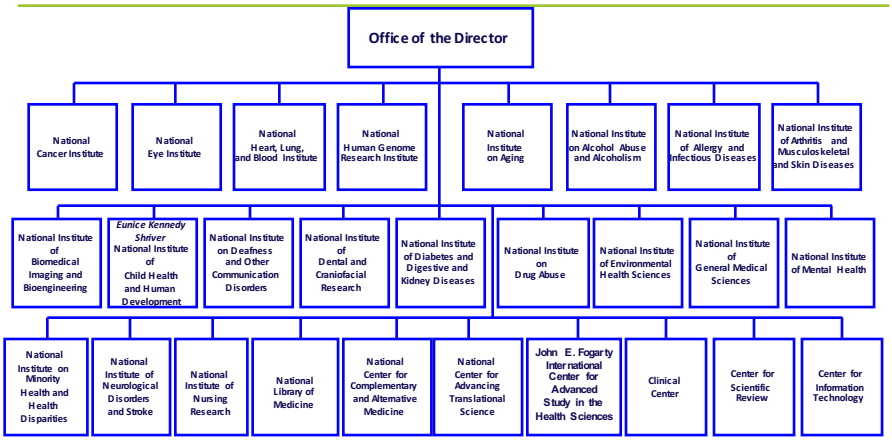
- Part I – How NIH funds research
- Part II – Specific funding announcements
- Part III – Case study of model in action at NIH
- Part IV – Reasons models are not (yet) used

Part I

Different Agencies, Different Cultures



National Institutes of Health



27 Institutes and Centers (ICs)

NIH Mission

To seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability.

FY2016 Priorities:

- **Unraveling Life's Mysteries through Basic Research**
- **Translating Discovery into Health**
- **Harnessing Data and Technology to Improve Health**
- **Preparing a Diverse and Talented Biomedical Research Workforce**

How NIH funds research

- NIH mostly funds projects, though some programs fund people and infrastructure
- Mix of unsolicited ("investigator-initiated") and requested ("directed") research
- Main mechanisms (n = 237) include:
  - Research Grants (R & U series)
  - Career Development Awards (K series)
  - Research Training and Fellowships (T & F series)
  - Program Project/Center Grants (P series)
  - Resource Grants (various series)
  - Trans-NIH Programs

Research Project Success Rates by NIH Institute for 2014

NIH Institute/Center	Number of Applications Reviewed	Number of Applications Awarded	Award Amount	Success Rate
Common Fund	1,587	166	$170,178,021	10.5%
FIC	165	15	$3,588,062	9.1%
NCATS	6	1	$4,855,653	16.7%
NCCAM	516	45	$20,665,969	8.7%
NCI[3]	8,539	1,207	$450,476,095	14.1%
NEI	1,085	290	$115,634,256	26.7%
NHGRI	282	50	$24,406,618	17.7%
NHLBI	4,077	743	$399,448,407	18.2%
NIA	2,429	385	$260,874,543	15.9%
NIAAA	939	180	$60,450,851	19.2%
NIAID	5,731	1,258	$979,422,074	22%
NIAMS	1,595	288	$86,020,738	18.1%
NIBIB	1,430	188	$60,600,268	13.1%
NICHD	3,325	414	$166,548,022	12.5%
NIDA	1,888	339	$150,358,397	18%
NIDCD	694	179	$63,971,400	25.8%
NIDCR	778	167	$66,470,182	21.5%
NIDDK	3,116	715	$382,238,652	22.9%
NIEHS	1,141	171	$59,901,950	15%
NIGMS	3,864	957	$355,265,749	24.8%
NIMH	2,830	548	$241,574,134	19.4%
NIMHD	293	35	$13,763,233	11.9%
NINDS	4,002	750	$297,139,590	18.7%
NINR	458	53	$22,488,015	11.6%
NLM[2]	124	24	$10,048,413	19.4%
OD ORIP-SEPA*	97	19	$4,437,297	19.6%
OD Other**	82	54	$23,343,160	65.9%
FY Totals	51,073	9,241	$4,494,169,749	18.1%

NIH research grant programs

- NIH Research Project Grant Program (R01)
  - Single PD/PI or Multi-PD/PI (team-science)
- NIH Small Grant Program (R03)
- NIH Exploratory/Developmental Research Grant Award (R21)
- Small Business Innovative Research (SBIR) (R43/R44)
- Research Project Cooperative Agreement (U01)
  - Substantial NIH programmatic involvement with awardee
- Research Program Project Grant (P01)
- Specialized Center (P50)

The High-Risk, High-Reward Research Program

- Funding opportunities for exceptionally creative scientists who propose highly innovative approaches to major challenges in biomedical research but whose potentially high-impact ideas may be too novel, span too diverse a range of disciplines, or be at a stage too early to fare well in traditional peer review process:
  - NIH Director's Pioneer Awards (DP1)
  - NIH Director's New Innovator Awards (DP2)
  - NIH Director's Transformative Research Awards (T-R01)
  - NIH Director's Early Independence Awards (DP5)

Part II

Funding Opportunity Announcements

- The Scientific Workforce Analysis and Modeling (SWAM) Program, RFA-GM-14-011 (U01)
- Modeling Social Behavior, PAR 13-374
  - Develop and test innovative theories and computational, mathematical, or engineering approaches to deepen our understanding of complex social behavior
- Systems Science and Health in the Behavioral and Social Sciences, PAR 15-048
  - Develop and apply modeling- and simulation-based systems science methodologies to important public health challenges

SWAM Objective

- Uses systems-based computational models to better understand dynamics of scientific workforce in U.S., especially those that produce successful scientists and increase the diversity of the scientific workforce
- Models may inform program development and management, identify questions that need additional research, and guide the collection and analysis of the data to answer these questions
- Considers academic job market but also focuses on larger system of workforce dynamics

SWAM History

- 8 awards (first 2 in 2010), 4 currently active
- OBSSR co-funding one project focused on the behavioral and social sciences workforce
- Formal program will end in 2018; funding announcement will not be reissued
- NIGMS recognizes the importance of this research; will consider funding high scoring unsolicited R01s
- NIH is looking to broaden the base of support for research in this area

Funded Grants (n=8)

- **GM094141-06, HAWLEY, JOSHUA**: A Model-Based Examination of Behavioral & Social Science Workforce: Improving Health Outcomes, 2010-2018 (ACTIVE)
- **GM094142-04, LARSEN, MICHAEL**: A Linked and Enhanced SDR for Modeling Scientific Workforce Dynamics, 2010-2015
- **GM098913-04, CORLEY, COURTNEY DAVID** (1st PI: Sanfilippo, Antonio): Modeling the Impact of Science Policies on Scientific Workforce Growth, 2011-2016 (ACTIVE)
- **GM098959-04, BORNER, KATY**: Monitoring, Modeling & Forecasting Tools for Fostering Innovative S&T Workforce, 2011-2015
- **GM098976-03, LEE, MARLENE ANN**: Modeling STEM Workforce Dynamics Using Microsimulation & Multi-State Life Tables, 2011-2014
- **GM099002-02, BLUME-KOHOUT, MARGARET ELIZABETH**: Effects of Federal R&D Funding on the Biomedical Sciences Workforce, 2011-2013
- **GM112599-02, LEVIN, SHARON G**: Investigating the Scientific Workforce in the Biomedical and Behavioral Sciences, 2015-2017 (ACTIVE)
- **GM112623-02, WEBER, GRIFFIN M**: Modeling Scientific Workforce Dynamics using Social Network Analysis, 2015-2018 (ACTIVE)

SWAM Program Findings and Resources

- Overall trend shows only 1 faculty position for every 6.3 Ph.D. graduates in biomedical sciences, leading to an oversupply of some research fields. (Hawley)
- STEM fields in academia may be oversupplied by the Ph.D. training system but STEM employers in industry and government have targeted needs that are unfilled. (Hawley)
- Increasing federal funding – U.S. citizens stay in post-doctoral positions longer with no change in publications but foreign postdocs produce more conference papers and publications without significant changes in postdoc duration. (Hawley)

SWAM Program Findings and Resources

- UCSD Map of Science can be used to chart career trajectories, location of emerging research frontiers, expertise profiles of institutes or nations. (Borner)
- New workflows in open source Science of Science (Sci2) Tool supports analysis of career trajectory structure and dynamics (Borner)
- Women's careers may be enhanced by helping them identify and compete in high growth subfields such as biomedical engineering and cellular biology. (Lee, unpub)
- Efforts to limit foreign-born postdocs would not necessarily increase employment of native-born postdocs in many subfields. (Lee, unpub)

SWAM Program Findings and Resources

- Increases in grant funding have been associated with increases in temporary and "soft money" positions but with little to no impact on hiring for more permanent academic positions. (Blume-Kohout)
- Enrollments and completions in biomedical science PhD programs are responsive to market conditions at time of students' enrollment. There is close correspondence between graduate student enrollments and completions, and changes in availability of NIH-funded traineeships, fellowships, and research assistantships. (Blume-Kohout)

Part III

Value of focused, validated, data-based models

- Previous NIH Director asked how many new R01 investigators did NIH need to stabilize the age distribution of the PI pool and thus the biomedical workforce through FY 2020 and beyond?
- PI Aging Simulation Model 2009, Walter T. Schaffer, NIH;
- J. Chris White, Twilighttraining.com; Margaret Rush, NIH

Case Study

- By manipulating the age and rate of new PI entry, you could simulate the effects of various policy changes on the age distribution of the full population
- Unexpectedly the distribution became bi-modal if you pushed in too many new PIs
- This model was used to set numeric goals for new PIs; policy has been in place since 2009
- While model answered the question the exercise also raised other interesting and unanticipated questions
  - E.g., Data revealed interesting observations about when people enter and leave the pool of PIs

Part IV

Reasons models are not (yet) used

- Incomplete buy-in of stakeholders; poor communication
- Limitations of input data (garbage in, garbage out)
- Untenable assumptions
- Wrong outcome measures and metrics
- Too much time needed
- Changing or new realities
- Discordance between info needed by decision-maker and info provided by modeler

Reasons models are not (yet) used

- Models contain too much math
- Models are too complicated, even with recent advances in visualization
- Unresolved tension between reductionist and holistic thinking and between simple and complex models
- Boundary space that was either too narrowly or too widely defined; unresolved tension between problem and solution focused thinking
- Desire for a single answer when in reality “it depends” almost always holds true

Reasons models are not (yet) used

- Models lack "face validity;" failed efforts to replicate and validate model
- Unresolved differences in expectations about modeling process and what can be realistically achieved
- Model results that are unwelcome
- Summary – poor communication and failure to find enough common ground between modeler and user

NIGMS: Investing in Discovery

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