Bridging the Career Gap

Supporting the Biomedical Workforce of the Future

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Managing Research in Difficult Times
Topics

- Biomedical Research Workforce (BMW) Report
- NIH Initiatives to strengthen BMW
- NIH Grants for Career Development and Transitional Grants
- Preparing for Independence
- The Future of Biomedical Research
- Finding the Right Balance
A working group of the Advisory Council to the NIH Director (ACD) was charged to:

- Develop a model for a sustainable and diverse U.S. biomedical research workforce that can inform decision makers
- Make recommendations for actions that NIH should take to support a future sustainable biomedical infrastructure
The large pool of PhDs in the workforce makes launching a traditional, independent, academic research career increasingly difficult.

Compared with other professional careers, the biomedical research career may be less attractive to the best and brightest of our young people.

The current training programs do little to prepare people for anything besides an academic research career.
Workforce Snapshot

2008 Post-training Workforce Snapshot*

- Unemployed: 2%
- Non-science related: 18%
- Science-related non-research: 18%
- Government research: 18%
- Industry research: 18%
- Academia: 6%

*Note: The source of the numbers in the pie chart is the National Science Foundation Survey of Doctorate Recipients, and therefore this snapshot only includes US doctorates, a total of about 130,000 individuals, which is an underestimate of the total biomedical research workforce.
Biomedical Workforce Report

- Report, summary of findings, and recommendations of the ACD working group released in June 2012:
  
  http://acd.od.nih.gov/biomedical_research_wgreport
  
  http://acd.od.nih.gov/biomedical_research_wgreport.pdf
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NIH Initiatives to Strengthen BMW

1) Establish grant programs to encourage innovative training approaches
2) Improve graduate student and postdoctoral research training
3) Develop a simple and comprehensive tracking system for trainees
4) Encourage fair consideration of staff scientists on grant applications
NIH Initiatives to Strengthen BMW

5) Initiate discussion with the community to assess NIH support of faculty

6) Create an office in the NIH Office of the Director to assess the biomedical research workforce

7) Conduct ACD Working Group study on optimal research training of individuals in clinical disciplines
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**PhD Career Path - NIAID**

- **T32** - Institutional training grant (NRSA) - has pre- & postdoc slots
- **F31** - Individual (diversity) predoc fellowship (NRSA)
- **F32** - Individual postdoc fellowship (NRSA)
- **K01** - Mentored Research Scientist Award
- **K22** - Research Scholar Development Award
- **K99/R00** - Pathway to Independence Award

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**Award Types**

- **T32**
- **F31**
- **T32**
- **F32**
- **K01**
- **K99/R00**
- **K01**
- **K22**

**Career Stage**

- High School Student
- Graduate Student
- Ph.D.
- Postdoc Phase
- Faculty Position
- Independent Investigator

**Diversity Supplements**
MD Career Path - NIAID

**Award Types**
- **T35**: NRSA Short Term Institutional Research Training Grant
- **F30**: Individual predoctoral MD/PhD and Other Dual Doctoral Degree Fellows
- **T32**: Institutional training grant (NRSA)-has pre- & postdoc slots
- **F32**: Individual postdoc fellowship (NRSA)
- **K01**: Mentored Research Scientist Award
- **K08**: Mentored Clinical Scientist Research Career Development Award
- **K23**: Mentored Patient-Oriented Research Career Development Award
- **K24**: Mid-Career Investigator Award in Patient-Oriented Research
- **K22**: Research Scholar Development Award

**Career Stage**
- **Medical Student**
- **Clinical Training Phase**
- **Research Training Phase**
- **Faculty Position**
- **Independent Investigator**

*National Institute of Allergy and Infectious Diseases*
# Training Grant Success Rates

## NIAID vs NIH Success Rates*

<table>
<thead>
<tr>
<th></th>
<th>FY 2010</th>
<th>FY 2011</th>
<th>FY 2012</th>
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<tbody>
<tr>
<td></td>
<td>NIAID</td>
<td>NIH</td>
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<td><strong>Careers</strong></td>
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<tr>
<td>K01</td>
<td>40%</td>
<td>40%</td>
<td>38%</td>
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<tr>
<td>K02</td>
<td>25%</td>
<td>29%</td>
<td>40%</td>
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<tr>
<td>K08</td>
<td>38%</td>
<td>44%</td>
<td>38%</td>
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<td>K22</td>
<td>31%</td>
<td>25%</td>
<td>34%</td>
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<td>K23</td>
<td>56%</td>
<td>38%</td>
<td>53%</td>
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<td>K24</td>
<td>71%</td>
<td>61%</td>
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<tr>
<td>K99</td>
<td>14%</td>
<td>25%</td>
<td>19%</td>
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<tr>
<td><strong>Fellowships</strong></td>
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<tr>
<td>F31</td>
<td>21%</td>
<td>31%</td>
<td>27%</td>
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<tr>
<td>F32</td>
<td>19%</td>
<td>28%</td>
<td>16%</td>
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<td>F33</td>
<td>0%</td>
<td>14%</td>
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<tr>
<td><strong>Training</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>T32</td>
<td>62%</td>
<td>52%</td>
<td>35%</td>
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</tbody>
</table>

* All information was gathered through the NIH Reporter and FY 2010 includes ARRA funded awards.
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Preparing for Independence
Should I do a PhD/Postdoc?

Pros

- Opportunity to hone critical skills and thinking
- Personal satisfaction
- Required credential(s) for many career options
- Higher earnings potential
- Noble pursuits – you can “make a difference”

Cons

- Long hours, low wages, sometimes feels like indentured servitude
- Postdocs beef up supervisors’ successes
- Number of PhDs outstrips number of jobs
- Glut of postdocs and paucity of academic and industry positions
Finding the Right Mentor*

* And the best mentoring environment…
What Should I Do and Know?

- Network and build relationships
- Find good mentor(s)
- Market yourself
- Remain open-minded to options
- Cast your net widely
- Gain experience
- Be patient and flexible
- Ask questions
- Don’t fixate on publications too early
What Sectors Does NIH Touch?

The NIH Medical Innovation Ecosystem

Over the past 30 years, the U.S. has become the world leader in biomedical research because of its unique innovation ecosystem. Read below to learn how funding for the National Institutes of Health strengthens our nation's health and economy from research laboratories to private industry to patients — the ultimate beneficiaries of medical research.

The Biotechnology and Pharmaceutical Industries
These industries build upon federally-funded scientific research to develop the next generation of drugs and devices to treat and cure disease.

The world market for the biopharmaceutical industry is greater than $140 billion, with more than 1 million employees in the U.S. alone.

Research Universities
Federa1y funded research conducted at these universities provides the foundation for private sector development of new drugs, technologies and treatments that aid our nation's health.

56% of basic scientific research in the U.S. takes place at research universities.

NIH:
The largest funder of biomedical research in the world, supporting the work of 135 Nobel Prize laureates. The NIH community consists of more than 330,000 scientists and research personnel at over 2,500 research institutions across all 50 states.

Research Tools and Technologies Sector
Providers of research tools and technologies develop critical equipment used for NIH-funded research, as well as private drug and diagnostic development.

The life sciences tools industry, with an annual revenue of over $42 billion, employs hundreds of thousands of workers at facilities across the country, making everything from test tubes to gene sequencers.

Start-Ups and Spin-Offs
Universities often have offices of technology transfer that seek to turn research into marketable applications and commercial ventures.

These companies continue to advance discoveries in science while providing a growing sector of entrepreneurs interested in pursuing research.
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Forces Impacting the Future of Research

- Challenging financial times
- Increasing demand for transparency and data access
- Changing workforce demographics and work/life balance
- Technology is driving cultural, scientific, and economic change
- Societal and ethical concerns impact science
- Need for legislators and the public to know the economic impact of science
International Budget Picture

Scientific R&D Spending

% Change from 2012 to 2013

National Budget Picture

Total Revenues and Outlays
(Percentage of Gross Domestic Product)

- Outlays
- Revenues

Source: Congressional Budget Office (August 2012)

NIH Budget Doubling

NIH
Little Budget Growth in Real Dollars

(Dollars in Billions)

Current Dollars  Constant Dollars

OER: NIH Budget over time
NIH Grant Success Rates

![Graph showing NIH Grant Success Rates from 1998 to 2012. The x-axis represents fiscal years from 1998 to 2012, and the y-axis represents the number of applications and awards. The graph shows a steady increase in the number of applications and awards from 1998 to 2012, with a corresponding decrease in success rate.](image-url)
Does Peer Review Pick the Best Science?

from Nicholson and Ioannidis, Nature 2012
Changes in Science Paradigms

- Empirical
- Theoretical & Modeling
- Computational biology
- High throughput methodology
- Big data tools, ‘omics, and systems biology

Time
These new tools result in significant increases in the amount of data generated, but what about the quality and reproducibility of that data?
A Crisis in Reproducibility and Validation?

Scrutiny by independent expert peer reviewers is often said to make the scientific literature particularly reliable. In practice, it is a poor way to detect many types of errors.

John Bohannon, a biologist at Harvard, recently submitted a pseudonymous paper on the effects of chemicals derived from lichens on cancer cells to 304 journals describing themselves as using peer review. The paper was concocted wholesale and stuffed with errors in study design, analysis and interpretation of results. Upon receiving this manuscript from fictitious researchers at a made up university, 157 of the journals accepted it for publication.
A Crisis in Reproducibility and Validation?

- **Other concerns:**
  - Minor statistical type 1 and type 2 errors can be magnified in “big data” studies
  - Negative data don’t tend to get published
  - Few funding agencies are interested in funding reproducibility studies
  - How much reproducibility is sufficient/needed?
  - Assay cross-validation is rarely required or performed
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Balancing Innovative, Risky, and Conventional Research

Season to Taste
for a less conventional application
... but don’t overdo it!

“Delicious!”
Reviewers love it!
Young researchers are often counseled to propose more “conservative” projects and avoid risk, but does that stifle innovation and potentially high-impact research?

“What makes a difference to the [judgment by a peer reviewer of whether there is a high probability of success or not] is whether the [experimental] approach violates or obeys the form of solution demanded by the theory being investigated (Haufe, Studies in History and Philosophy of Science, 2013).

So do grant reviewers tend to think only “inside the box”? 
Biomedical Research in an Era of Unlimited Aspirations and Limited Resources

Anthony S. Fauci

“As always, it remains critical that we make a coherent case for adequate public funding of biomedical research. However...we must acknowledge that fiscal constraints now impact our society at all levels, and we must continue to explore ways to make the best use of resources.”
Bridging the Career Gap

Questions?

- How is your research going?
- Uh, slowly. I've gotten three data points in the last 60 days.
- Let me see.
- Hmm, I think there's a clear trend happening here.
- There is??
- Your chances of graduating are asymptotically approaching zero.

(Comics from www.phdcomics.com, Jorge Cham © 2013)