National Institutes of Health Funding in Rhode Island

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ABSTRACT

OBJECTIVES: We present an overview of the National Institutes of Health (NIH) funding in Rhode Island through analysis of 935 NIH grants received during the fiscal years of 2012 to 2016.

RESULTS: NIH funded over 2,600 grants from 2012 to 2016, of which approximately 900 were new grant awards, and the remainder were annual grant renewals. The most funded type of research in Rhode Island is mental health and substance abuse, followed by infectious disease, neurology, and public health. Research funding of cardiovascular diseases, on a per capita basis, are on par with the rest of the nation, while cancer research funding is less than one half the national average. The largest NIH institutional funding source is the National Institute of General Medical Sciences (NIGMS), followed by National Institute of Mental Health (NIMH) and National Institute on Alcohol Abuse and Alcoholism (NIAAA). While research grants (R01s) remain the predominant source of NIH funding, investigators in Rhode Island have secured additional funding through program project (P) grants with the aim of bolstering research resources and collaboration throughout the state.

KEYWORDS: NIH funding, research funding, NIH grants, Rhode Island research, RI research

INTRODUCTION

The National Institutes of Health (NIH), established in 1930, is a vast network comprising 21 individual institutes encompassing the myriad disciplines within biomedical research, as well as 6 multidisciplinary centers that operate across all of the institutes. In addition to conducting research on its own campus in Bethesda, MD, the NIH also serves as the largest funding mechanism for federally supported biomedical research in the United States. The NIH budget was $32 billion in 2016. Other biomedical federal agencies include the following with respective FY16 Budgets: Centers for Disease Control (CDC) ($11.7 billion), the Food and Drug Administration (FDA) ($5.1 billion), the Agency for Healthcare Research and Quality (AHRQ) ($0.428 billion). The Department of Defense (DOD), furthermore, awards medical research grants through the Congressionally Directed Medical Research Programs (CDMRP) initiative and in 2016 spent over $0.836 billion nationwide on medical research.[1,2]

On average, over 80% of the NIH budget is awarded annually to support investigators at over 2,500 universities, medical schools, hospitals, biotechnology companies, and other research organizations. The main vehicle of NIH research funding is the research grant, referred to as "R" series of grants, with R01 grants being the most common. Using this mechanism, the various institutes of the NIH disbursed $17.8 billion (55.6% of total budget) in 2016 to researchers across the nation. The NIH also spent $5.4 billion supporting training, fellowship, and career-development grants ("T", "F" & "K" grants) as well as project grants, which are thematic research programs that integrate a group of investigators across multiple institutions ("P" grants). The $23 billion in total external research funding is in contrast to $3.58 billion that the NIH spent for its own intramural research activities in the 2016 fiscal year.[3]

NIH FOOTPRINT IN RHODE ISLAND

The NIH is a significant source of biomedical research funding in the state of Rhode Island. Last year, RI received $150 million in NIH funding, and $707 million combined over the past five years.[3] In contrast, non-NIH agencies supplied $112 million over the same time period. Since 2008, Rhode Island has received additional NIH support as it is one of the targets of NIH's institutional development awards (IDeA), which promote translational research activity and collaboration in states that have had historically low NIH grant success rates. These IDeA grants are primarily designed to foster research career development, research collaboration, and fund Centers of Biomedical Research Excellence (COBREs) and IDeA Networks of Biomedical Research Excellence (INBRE) initiatives. COBREs are NIH-designated multi-disciplinary research units within institutions that provide material support to projects sharing a central theme (ie, cancer, skeletal repair, etc). Currently there are nine active IDeA-funded COBREs in Rhode Island, located at Rhode Island Hospital, the Providence VA Medical Center, Women and Infants Hospital, the University of Rhode Island and Brown University.[4] The INBRE grants are aimed at strengthening research manpower, through funding of faculty, post-doctoral fellowship, graduate and undergraduate research positions. Currently one INBRE initiative is active in the state, based at the

University of Rhode Island. Furthermore, Rhode Island was recently awarded a five-year $19.5 million grant from the National Institutes of General Medical Sciences (NIGMS) to establish the Rhode Island Advance Clinical and Translational Research center (Advance-CTR), which serves as a funding source for translational research project as well as providing research services for junior investigators.[7,8]

Figure 1a. Total discretionary budget authority during FY 2016 of US federal agencies that award grants towards biomedical research. CDMRP is the Department of Defense's biomedical granting agency.

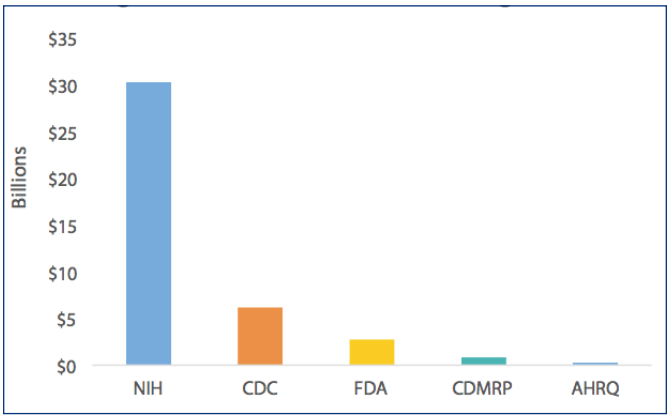


Figure 1b. Breakdown of the sources of federal funding for biomedical research in Rhode Island from 2012 to 2016. Information from AHRQ and CDMRP are from obtained from respective agencies' grants databases.[4,5]

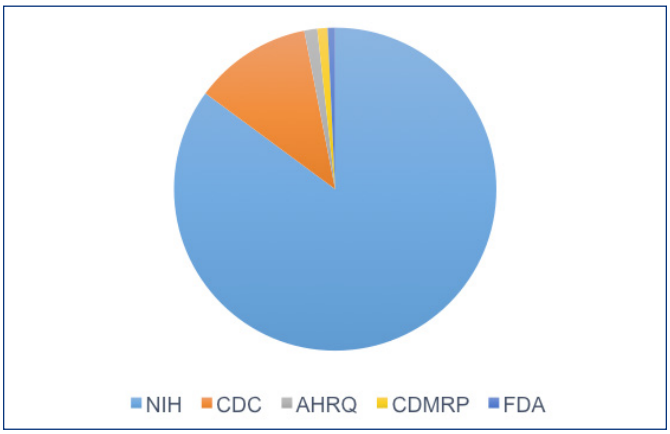
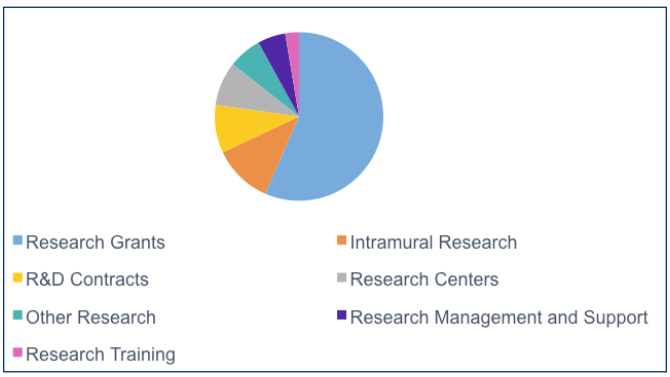


Figure 1c. Breakdown of the national NIH budget in 2016.



METHODOLOGY

We took a snapshot of all NIH grants awarded to Rhode Island recipients between January 1, 2012 and December 31, 2016, from the NIH RePORTER database. As a measure of productivity, we quantified all of the publications in 2016 that were the result of research projects funded by the NIH. We primarily analyzed R and P series of grants for specific areas of biomedical research being funded by the NIH. To minimize overlap and double counting, we utilized NIH study sections, which are panels of researchers with shared expertise in one designated field, as the basis for categorization. For studies where multiple fields are involved, we used the funding agency as the primary category. For example, in a project involving diabetes and heart disease that is funded by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), we considered diabetes as the primary category. Furthermore, for studies evaluating diseases within a specific subpopulation with a particular medical condition (ie, heart disease in diabetics), the primary category was classified as the specific disease being studied rather than the medical condition. The NIH also forms ad-hoc panels (designated as special emphasis panels) to review grants in areas which are not routinely studied. In these cases, we utilized the primary funding agency and project terms field as the basis for categorization. A detailed breakdown by grant type is listed in **Figure 3a.**

RESULTS

R series of grants comprised the majority of NIH funding, with over $456 million awarded, funding over 1,600 grants in Rhode Island from 2012 to 2016, accounting for 64% of total NIH grant funding in the state. The next most common funded type of grants are P grants, which are larger in scope than R grants, and funds the COBRE and INBRE programs initiated by the NIH ongoing since 2008. From 2012 to 2016, the NIH dispersed $130 million to 74 P grants, accounting for 18.2% of grant funding. In terms of funding by institutes, the National Institute of General Medical Sciences (NIGMS) has been the largest source of funding to RI within the NIH, spending over $114 million over the past 5 years, covering 195 grants. Three-quarters of NIGMS grants have been related to COBRE and INBRE research efforts, to which $77 million was dedicated. Following NIGMS by order of funding are: the National Institutes of Mental Health (NIMH) at $86 million, National Institutes on Alcohol Abuse and Alcoholism (NIAAA) at $63 million, and the NIDA (National Institute on Drug Abuse) at $56 million. Full detailed list of institutes by funding amount and number of grants is in **Figure 3b**.

By subject matter, behavioral sciences, which for the purposes of this report, includes mental health, addiction, and substance abuse, is the most funded category, receiving $122 million over the past 5 years. The next most funded category is infectious disease and immunology, receiving $63

Figure 2. List of COBREs based in Rhode Island

Skeletal Health and Repair	Rhode Island Hospital
Central Nervous System Function	Brown University
Endothelial Injury and Repair: Cardiopulmonary Vascular Biology	Ocean State Research Institute
Immune-Based Interventions Against Infectious Diseases	University of Rhode Island
Cancer Research Development	Rhode Island Hospital
Stem Cell Biology	Rhode Island Hospital
Cancer Signaling Networks	Brown University
Computational Biology of Human Disease	Brown University
New Approaches to Tissue Repair	Roger Williams Hospital
Perinatal Biology	Women and Infants Hospital
Reproductive Health	Women and Infants Hospital

Figure 3a. Funding breakdown of grant types awarded in Rhode Island from 2012 to 2016.

Grant	Funding
R grants	$450,834,262
P grants	$130,392,809
U grants	$47,010,502
K grants	$34,054,063
T grants	$25,101,740
N grants	$7,638,149
F grants	$5,895,991
D grants	$5,538,048
S grants	$599,598
G grants	$372,491
Total	$707,437,653

Figure 3b. Funding breakdown of research grants in Rhode Island by individual NIH institutes between 2012 to 2016.

Institute	Funding
National Institute of General Medical Science	$114,640,535
National Institute of Mental Health	$86,386,085
National Institute on Alcohol Abuse and Alcoholism	$63,008,833
National Institute on Drug Abuse	$62,124,652
National Institute of Child Health and Human Development	$56,187,848
National Heart, Lung, and Blood Institute	$54,582,623
National Institute of Allergy and Infectious Diseases	$52,473,505
National Institute of Neurological Disorders and Stroke	$33,406,380
National Institute on Aging	$31,785,013
National Institute of Diabetes and Digestive and Kidney Diseases	$29,192,508
National Institute of Environmental Health Sciences	$27,334,290
National Cancer Institute	$27,275,489
National Institute of Arthritis and Musculoskeletal and Skin Diseases	$17,454,724
National Eye Institute	$10,060,908
National Institute of Nursing Research	$8,848,457
National Center for Complementary and Integrative Health	$7,915,690
National Center for Advancing Translational Sciences	$4,316,504
National Human Genome Research Institute	$4,246,730
John E. Fogarty International Center	$3,845,767
National Institute on Deafness and Other Communication Disorders	$3,501,335
National Institute of Biomedical Imaging and Bioengineering	$2,819,166
Office of the Director	$2,418,023
National Library of Medicine	$2,157,133
National Institute on Minority Health and Health Disparities	$800,233
National Institute of Dental and Craniofacial Research	$655,222
Total	$707,437,653

million in the same period, followed by neurology and neurosciences ($45 million), and public health and healthcare delivery ($33 million). The complete list of research categories with funding information is detailed in **Figure 3c.** Of note, the miscellaneous category includes diverse fields ranging from general surgery, speech/communication disorders, drug delivery systems, and nursing research.

RESEARCH PRODUCTIVITY IN RHODE ISLAND

NIH-funded projects in Rhode Island produced 896 publications in 2016. 299 publications were in the field of behavioral sciences (including substance use and addiction), followed by infectious disease at 160 publications, pediatrics (69), and neurology and neurosciences (52). The ranking of research subject matter in terms of funding is roughly similar to that of research funding, with the number one and two slots occupied by behavioral sciences/mental health and infectious disease, respectively.

DISCUSSION

From 2012 to 2016, RI has received over $811 million from federal agencies, and $707 million from the NIH alone, covering 935 grants (excluding annual renewals). Annual NIH grant funding dropped from a high of $178 million in 2009 to a nadir of $131 million in 2014 and 2015, although funding has now climbed back up to $150 million in 2016 (**Figure 5**). The high amount of funding in 2009 and 2010 mirrored trends across the nation, and was the result of additional federal dollars from the American Recovery and Reinvestment

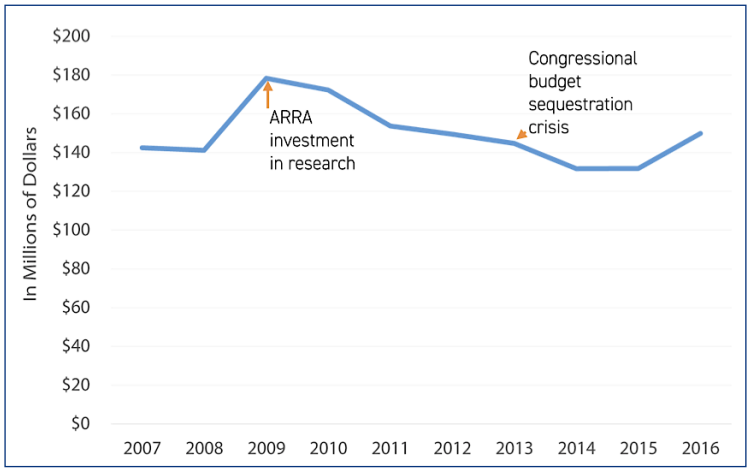
Figure 3c. Funding breakdown of research (R) and project (P) grants in Rhode Island by research category.

Research Category	Funding
Mental Health	$122,867,999
Infectious Diseases and Immunology	$62,920,363
Neurology and Neurosciences	$45,008,725
Healthcare Delivery & Public Health	$33,300,791
Cardiovascular Diseases	$30,711,118
Basic Sciences	$30,259,161
Geriatrics and Aging	$24,282,173
Pediatrics	$19,548,558
Nutrition and Metabolic Diseases	$18,822,095
Occupational and Environmental Health	$13,406,899
Musculoskeletal Diseases	$9,356,860
Reproductive Health	$9,104,904
Pulmonary Diseases	$7,992,412
Cancer	$5,816,619
Biomedical Technology & Imaging	$4,059,725
Kidney Diseases	$3,068,102
Preventive Medicine	$2,681,372
Eyes, Ear, Nose, and Mouth	$2,312,529
Gastrointestinal Diseases	$1,938,278
Hematology	$1,647,276
Misc	$1,556,143
All	$450,662,102

Act (ARRA) stimulus funding. Over the past 5 years, RI has on average received $140 million annually from NIH grants, which is consistent with years prior to 2009. Mental health, substance use, and addiction continue to be the target focus of research activity in the state, which is also reflected by the sources of funding: NIMH, NIAAA, and NIDA, (which are the #2, 3, and 4 by research funding) as well as by the number of publications produced by NIH-supported research projects. This is in contrast to the rest of the United States, where the National Cancer Institute (NCI) is the leading source of funding, followed by the National Institute of Allergy and Infectious Disease (NIAID), and the National Heart, Lung, and Blood Institute (NHLBI). These institutes rank (13, 8, and 7, respectively) as sources of research funding in RI. Furthermore, per capita in terms of population, Rhode Island's funding from NCI is less than one-half the national average, whereas funding from NHLBI and NIAID are roughly comparable to the rest of the nation.

Rhode Island ranks 25th among states in terms of total overall NIH funding. Over ten percent of NIH funding has been dedicated to INBRE and COBRE centers, which are multidisciplinary research centers designated by the NIH to support research in specific topics and to develop the biomedical research workforce. As of 2016, there are nine active COBREs, and the areas of interest explored by these COBRE centers include cancer biology, stem cell development, tissue repair, perinatal biology, immunotherapy, and CNS biology, as detailed in **Figure 2**. In addition, in 2016, the NIGMS has provides an additional $19.6 million to fund a clinical

Figure 4. NIH research funding in Rhode Island from 2007 to 2016. American Recovery and Reinvestment Act was passed in February 2009. The funding cut resulting from the federal budget sequestration crisis occurred during the 2013 fiscal year.



and translational research center (Advance-CTR) dedicated to serve as a funding source and a provider of research services to junior investigators.

Despite the additional funding from the NIGMS, the overall NIH funding to Rhode Island declined during the federal budget sequestration crises of 2014 and 2015. During the past year, NIH funding has recovered, although current total funding to Rhode Island remains at comparable levels to what they were a decade ago, or if adjusting for inflation, has declined by about 10%. The stagnation in NIH funding is a nationwide issue, given that overall NIH appropriations have been relatively constant over the past decade, and when adjusted for inflation, has declined by around 12%. The recent establishment of the RI-CCTS, allowing for more local decision-making over the use of NIH resources, should in theory, stretch each NIH dollar through more efficient allocation of funds as a result of local geographical oversight.

CONCLUSION

While Rhode Island ranks 25th in the nation in terms of NIH biomedical research funding, much of that funding is not evenly distributed across disciplines. While fields such as mental health, behavioral sciences and addiction medicine receive special research attention, other fields, most notably cancer, still lag behind the rest of the nation in terms of per capita funding. A significant percentage of research dollars has been geared to improve research efficiency, shore up and develop new research capabilities in Rhode Island, most notably in cancer and in translational research; however, the actual impact of the research investment will not be immediately apparent in the short term. Given that cardiovascular diseases and cancer remains the number one and number two top causes of mortality in Rhode Island, these two domains should become the focus of future funding.

References

1. US Department of Health and Human Services. "Fiscal Year 2016 Budget in Brief": 2016. Accessed 2/16/2017, at "https://www.hhs.gov/sites/default/files/budget/fy2016/fy-2016-budget-in-brief.pdf"
2. Department of Defense United States Army Medical Research Materiel Command Congressionally Directed Medical Research Programs. "CDMRP Research Funding for 2016": 2016. Accessed 2/16/2017.
3. NIH RePORTER: Research Portfolio Online Reporting Tools. National Institutes of Health. Accessed 2/16/2017, at https://projectreporter.nih.gov/reporter.cfm
4. Agency for Healthcare Research and Quality (AHRQ) Grants On-Line Database. Accessed 2/16/2017, at "https://gold.ahrq.gov/projectsearch"
5. US Department of Defense CDMRP Search Awards. Accessed 2/16/2017, at "http://cdmrp.army.mil/search.aspx"
6. National Institute of General Medical Sciences. "COBRE Directory of Active Awards by State" Accessed 2/16/2017, at "https://www.nigms.nih.gov/Research/CRCB/IDeA/Documents/2015COBRE-Directory.pdf"
7. Orenstein D. "$19.5M grant to bridge gaps between medical research, health care in Rhode Island" 2016. News from Brown, accessed 2/16/2017, at "https://news.brown.edu/articles/2016/07/ri-ccts"
8. National Institute of General Medical Sciences. "IDeA-CTR Principal Investigator Directory 2016" Accessed 2/16/2017, at "https://www.nigms.nih.gov/Research/CRCB/IDeA/documents/2016IDeA-CTR_Directory.pdf"

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