# National Institute of Biomedical Imaging and Bioengineering

CONGRESSIONAL JUSTIFICATION
FY 2024

Department of Health and Human Services
National Institutes of Health

National Institute of Biomedical Imaging and Bioengineering
*Engineering the Future of Health*

[THIS PAGE INTENTIONALLY LEFT BLANK]

DEPARTMENT OF HEALTH AND HUMAN SERVICES

NATIONAL INSTITUTES OF HEALTH

NATIONAL INSTITUTE OF BIOMEDICAL IMAGING AND BIOENGINEERING (NIBIB)

FY 2024 Budget Table of Contents



**General Notes**

1. FY 2023 Enacted levels cited in this document include the effects of the FY 2023 HIV/AIDS transfer, as shown in the Amounts Available for Obligation table.
2. Detail in this document may not sum to the subtotals and totals due to rounding.

[THIS PAGE INTENTIONALLY LEFT BLANK]

## Director's Overview

**BRUCE J. TROMBERG, PH.D., NIBIB DIRECTOR**

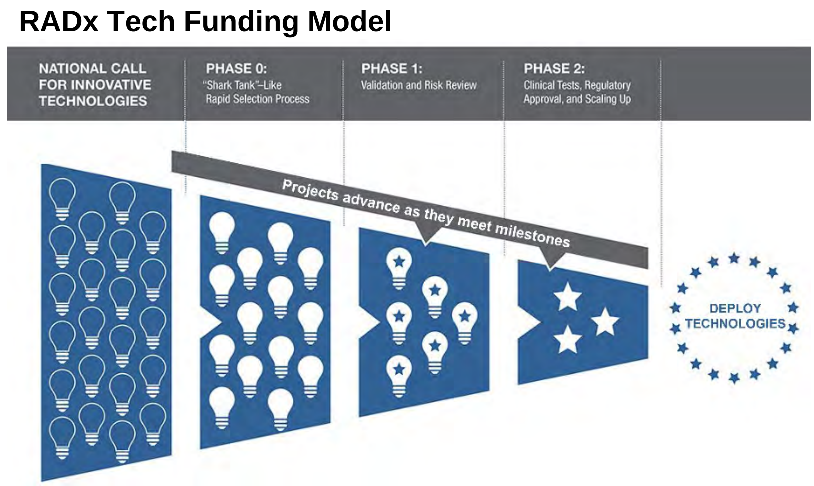
As the central hub for biomedical engineering at the National Institutes of Health (NIH), the National Institute of Biomedical Imaging and Bioengineering (NIBIB) catalyzes research in disease prevention, diagnosis, and treatment. NIBIB-funded researchers are engineering the future of health by innovating groundbreaking technologies to improve health outcomes and better understand complex biological systems. Combining the power of science and engineering provides an immense benefit to society, including improved imaging systems for rapid disease diagnosis and targeted treatments, advanced sensors to continuously monitor your health, biodevices that enhance prosthetics, and new data science approaches to improve medical decision-making. These successes are dependent on a diverse and strong biomedical engineering workforce. NIBIB will continue to support and optimize programs to overcome barriers throughout the career path and sustain the many talented individuals and organizations contributing to better health for all.

**Creating a new approach to technology development**

NIBIB used coronavirus disease 2019 (COVID-19) supplemental funding to mount a highly successful diagnostic development program in response to the COVID-19 pandemic. At the forefront of NIBIB's pandemic response is the Rapid Acceleration of Diagnostics (RADx®) Tech program, which developed and deployed innovative COVID-19 testing technologies at an unprecedented speed and scale. Through RADx Tech and other efforts, NIBIB mobilized the bioengineering community to bring Americans billions of at-home, point-of-care (POC), and lab-based COVID-19 diagnostics and test products; digital health platforms to guide at-home testing and reporting; and technologies for COVID-19 detection and treatment management through imaging and artificial intelligence.

The impetus to fight COVID-19 led us to approach technology development in a novel large-scale collaborative manner and create a nimble and rapid milestone-driven funding structure. In RADx Tech, over 900 stakeholders from government, academia, and private industry partnered to produce over five billion tests and test products by securing 46 emergency use authorizations (EUAs) from the U.S. Food and Drug Administration (FDA). With supplemental appropriations, NIBIB leveraged and expanded its well-established Point-of-Care Technologies Research Network (POCTRN) to design and manage the RADx Tech program. This unique approach included project evaluation, test validation, clinical studies, regulatory guidance, and test manufacturing. The RADx model creatively applies principles of acceleration, provides companies with expertise and support to facilitate commercialization and FDA authorization, and enables rapid manufacturing. This infrastructure maximizes efficiency and shortens the technology commercialization and dissemination process from years to months.

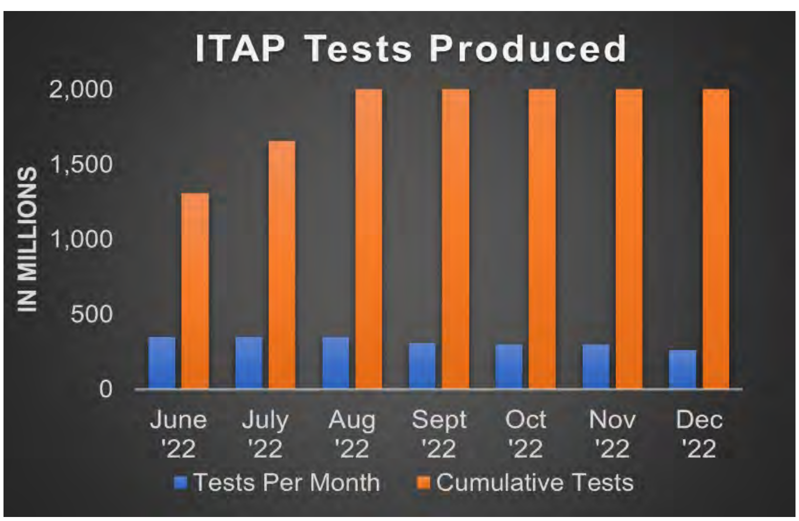
The RADx framework facilitated significant productivity from the entrepreneurial-minded bioengineering community that NIBIB supports.  Based on this success, NIBIB is partnering with other NIH Institutes and Centers to apply the RADx funding model to accelerate solutions to other urgent biomedical problems.




For example, to develop technologies that treat nervous system disorders, NIBIB partnered with the NIH Blueprint for Neuroscience consortium of institutes to launch the Blueprint MedTech program.  This program is designed to overcome barriers to the commercialization of groundbreaking neurotherapuetic devices.

As another example, to address the U.S. maternal health crisis, NIBIB has partnered with the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development to launch the RADx Maternal Health challenge.  The challenge aims to extend care and improve health outcomes during the postpartum period by developing home-based or POC diagnostic devices, wearables, and other life-saving remote sensing technologies.  NIBIB is also engaged in a collaboration with the NIH Office of AIDS Research to address the lack of POC platforms to detect HIV viral load during treatment.  Monitoring treatment response is key to enhancing the quality of life in people living with HIV and virtually eliminates the risk of HIV transmission.  Leveraging the effective RADx model that helped supply the United States with COVID-19 tests, NIBIB plans to continue expanding and optimizing this strategy to benefit the public.  Through partnerships, the RADx infrastructure can accelerate solutions to a wide range of health care problems.

**<u>Accelerating commercialization of health care solutions</u>**

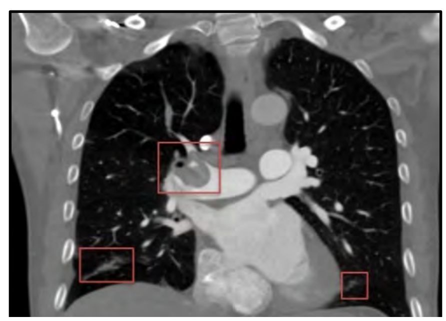



During the height of the COVID-19 pandemic, the U.S. test production capacity was insufficient to meet the public's needs.  Building on the existing NIBIB and FDA partnership, the RADx Independent Test Assessment Program (ITAP) was created to help high-volume national and international manufacturers meet U.S. regulatory performance standards.  ITAP established laboratory and clinical testing protocols, conducted independent evaluation of tests, and rapidly gathered data to streamline FDA EUA for COVID-19 over-the-counter tests. This effort produced new EUAs in as little as 2 months, resulted in over two billion additional tests for the U.S. market, and helped facilitate large-scale free test distribution by the government. In response to the mpox public health emergency, NIBIB is leveraging the ITAP infrastructure to speed the development of POC tests and home collection kits for evaluation by the FDA for EUA. Efforts are underway to expand the program to hepatitis C and multiplex tests for respiratory viruses including flu and respiratory syncytial virus (RSV). Similar to the RADx Tech program, the ITAP process can be used to streamline regulatory authorization for a wide range of diagnostics, allowing both domestic and international manufacturers to bring high-quality tests to market.

**Investment in equitable tools and technologies**

**COVID-19 Test Accessibility Program –** Improving equity and accessibility to health care technologies is a priority for NIBIB. Incidence and death rates throughout the COVID-19 pandemic have demonstrated yet another example of the stark health disparities that exist in our nation. Investments to create tools that are accessible to everyone is crucial. With supplemental funding for COVID-19 activities, NIBIB has introduced the COVID-19 Test Accessibility program. The program aims to modify existing at-home COVID-19 tests and develop novel tests to make them more accessible by people with low vision, blindness, motor disability, and/or cognitive disabilities. A key element of the program engages engineers, reviewers, and users who are blind and have other disabilities to ensure technologies meet the needs of these populations. Best-practice guidelines for accessible at-home technologies for manufacturers were developed and will be made public through partnership with the U.S. Access Board. This effort will build a foundation to help companies create more accessible over-the-counter products for other health applications.

**Medical Imaging and Data Resource Center (MIDRC) –** Additional COVID-19 supplemental funding congressional funds enabled NIBIB to establish the MIDRC imaging repository which aimed to develop methods to reliably diagnose COVID-19 from medical images. This library provides researchers with high-quality images to develop reliable artificial intelligence (AI) and machine learning (ML) methods that identify disease. Prior to the pandemic, the lack of large, high-quality imaging datasets was identified as a high priority need for the successful application of AI and ML to biomedical problems. The MIDRC image repository has addressed this need by ingesting over 150,000 demographically diverse imaging datasets and releasing more than 75,000 images into the open commons for research use. The need for high-quality imaging datasets in AI and ML research extends to all diseases, so MIDRC plans to expand its repository to include other organs and diseases.



*A CT scan of a patient's chest with mild COVID-19. Red squares show vascular clots. Credit: MIDRC*

MIDRC has prioritized representing a broad and diverse demographic in their imaging library. A recent study supported by MIDRC suggests that race information could be unknowingly incorporated into image analysis models, which could potentially exacerbate racial disparities in the medical setting.[1] The NIBIB-supported researchers found that AI models could accurately predict self-reported race in several different types of radiographic images, even when expert clinicians cannot. This study highlights the need to reliably ensure equity in AI and ML research and in medicine. NIBIB will continue to support research that identifies the promise and limits of AI and ML tools and develop methods that are equitable for all.

**Technology Highlight –** Pulse oximeters are a universal health care tool used by clinicians to estimate oxygen levels in the blood. These have been a critical tool in managing COVID-19 care in hospitals. When blood oxygen levels drop too low, a patient may need to move to the intensive care unit or staff may need to administer supplemental oxygen. A study by NIBIB-funded researchers found that pulse oximeter performance varied among minority patient groups and may lead to reduced delivery of supplemental oxygen in hospitals.[2] This study offers just one example of a disparity affecting minority populations that occurs within the U.S. health care system. Improving and redesigning medical devices so they are equitable to all patient populations is paramount to **–** and is being addressed by **–** NIBIB.

**Building a diverse biomedical engineering workforce**

NIBIB is committed to fostering diversity, equity, inclusion, and accessibility (DEIA) throughout the bioengineering research community. Underrepresented populations in biomedical research bring a wealth of expertise, unique experiences, and creativity that NIBIB values and that will invigorate bioengineering research. NIBIB has developed key programs and a new center to help improve DEIA in the biomedical research community.

**Biomedical Engineering and Technology Acceleration (BETA) Center –** NIBIB has established the BETA Center, a NIH-wide resource that will serve as a new model for technology-driven, interdisciplinary, and translational research. The Center, housed in NIBIB's Intramural Research Program, will partner with Institutes and Centers across NIH to bring the power of biomedical engineering to the entire NIH enterprise. Workforce diversity and health disparities will be key to the Center, as its director will have dual responsibility as NIBIB's Associate Director for Scientific Diversity, Equity, and Inclusion. The BETA Center aims to accelerate the development, validation, and implementation of high-impact biomedical technologies to address national and global health problems. The Center will play a pivotal role addressing major public health challenges and delivering practical solutions to health care problems through a close partnership with the NIH Clinical Center. The Center will plan and champion new training opportunities at NIH for biomedical imaging and bioengineering students and fellows at all levels and serve as a model for recruiting diverse biomedical engineering talent to NIH.

---

[1] Gichoya, Judy Wawira et al. AI recognition of patient race in medical imaging: a modelling study. *The Lancet Digital Health,* 2022; 4(6): 406-414. doi: 10.1016/S2589-7500(22)00063-2

[2] Eric R. Gottlieb et al. Assessment of Racial and Ethnic Differences in Oxygen Supplementation Among Patients in the Intensive Care Unit. *JAMA Internal Medicine,* **2022**; published online July 11, 2022.

**Programs to Promote Workforce Diversity** – NIBIB has launched two important programs to promote workforce diversity.  One funding opportunity solicits applications for independent research projects to support Early-Stage Investigators and New Investigators from diverse backgrounds, including underrepresented populations in biomedical research.  The second opportunity emphasizes smaller projects that can be completed in a short period of time to facilitate transition to research independence.  Both efforts aim to increase the recruitment of the most talented researchers from all backgrounds; to broaden and enhance workforce expertise and research priorities; and to facilitate the recruitment of underrepresented populations into clinical trials.

[THIS PAGE INTENTIONALLY LEFT BLANK]

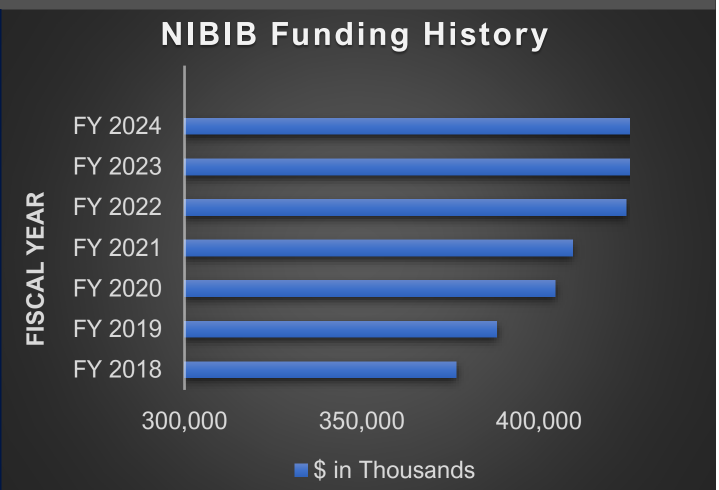
# National Institute of Biomedical Imaging and Bioengineering

*Engineering the Future of Health*

NIBIB is engineering the future of health by catalyzing research in disease prevention, diagnosis, and treatment. Combining the power of science and engineering provides an immense benefit to society by creating technologies for all. NIBIB is investing in building a diverse biomedical engineering workforce to develop, translate, and implement these technologies for all.


Bruce J. Tromberg, Ph.D., NIBIB Director

As the hub at NIH for engineering and expanding technologies across all diseases and disorders, NIBIB is redefining the approach to technology development. Leveraging lessons learned from COVID-19 and the Rapid Acceleration of Diagnostics (RADx®) Tech model, NIBIB has created a novel, collaborative milestone-driven funding structure to speed technology development at NIH. The RADx-like model will provide expertise and support to facilitate commercialization, regulatory authorization, and enable rapid manufacturing. The framework maximizes efficiency and is well suited for the entrepreneurial-minded community that NIBIB supports. NIBIB and other NIH Institutes and Offices have already begun adopting attributes of this new infrastructure to catalyze the translation of biomedical research. NIBIB has established multiple RADx-like models that address challenging health problems.

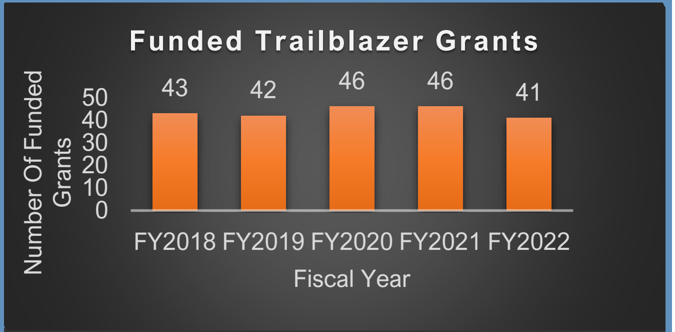

FY 2024 President's Budget is $440,625,000. Note: In addition to the base budget, NIBIB received supplemental and Inter-departmental delegation of authority funds of $658 million in FY 2020, $651 million in FY 2021, $640 million in FY 2022, and $0 million in FY2023.

## Diversity, Equity, Inclusion, and Accessibility at NIBIB

NIBIB is strongly committed to increasing and supporting diversity, equity, inclusion, and accessibility at NIBIB and throughout the biomedical research community. It is critical that we assure the participation and success of racially and ethnically underrepresented and other underrepresented populations in the biomedical imaging and bioengineering communities. Concurrently, NIBIB is dedicated to supporting technologies that address health disparities and are accessible to everyone.

## Early Career Researchers

NIBIB's Trailblazer R21 program supports early-career investigators and fosters the growth and diversity of the bioengineering workforce.

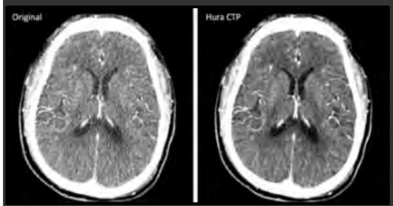



- 97% funded grants resulted in peer-review publication
- ~ 50% funded grants (FY2018-FY2020) receive subsequent NIH funding

## NIBIB Commercialized Technologies

RADx® Tech continues to speed commercialization of innovative point-of-care and home-based tests for nationwide COVID-19 testing.

New photon-counting detector-computed tomography (PCD-CT) system which outperforms current CT technology is the first FDA approval for CT in a decade.




Clinicians can now use FDA-approved software that uses artificial intelligence to reconstruct and improve brain CT scans.

## RADx Updates


## New NIBIB Centers and Initiatives

The Center for Biomedical Engineering and Technology Acceleration (BETA Center) is a NIH-wide center within NIBIB's Intramural Research Program (IRP) that will aim to accelerate the development and implementation of high-impact biomedical technologies. Central to BETA's mission will be employing evidence-driven approaches to expand diversity, equity, and inclusion within the IRP and serving as a model for recruiting diverse biomedical engineering talent to NIH.

NIH's RADx® initiative has established the Independent Test Assessment Program (ITAP) to accelerate regulatory review and availability of high-quality, accurate, and reliable over-the-counter COVID-19 tests to the public. ITAP will be utilized for other infectious diseases like Ebola and hepatitis C.

NIH National Institute of Biomedical Imaging and Bioengineering

*Engineering the Future of Health*

## Major Changes in the Budget Request

Major changes by budget mechanism and/or budget activity detail are briefly described below. Note that there may be overlap between budget mechanism and activity detail and these highlights will not sum to the total change for the FY 2024 President's Budget for NIBIB. The FY 2024 President's Budget request for NIBIB is $440.6 million, the same as the FY 2023 Enacted level.

Research Project Grants (RPGs) (-$7.2 million; total $304.0 million):
NIBIB will fund 729 RPG awards in FY 2024, an decrease of 4 awards from the FY 2023 Enacted level. This includes 515 noncompeting awards (a total increase of 11 awards and a decrease of $0.7 million from the FY 2023 Enacted level); 180 competing RPGs (a decrease of 17 awards and $6.8 million from the FY 2023 Enacted level); and 34 SBIR/STTR awards (an increase of 2 award and $0.3 million from the FY 2023 Enacted level). Noncompeting awards will be funded at the FY 2023 committed level. The average cost of competing RPGs will decrease by 1.8 percent in FY 2024 versus the FY 2023 Enacted level.

Research Centers ($0.0 million; total of $33.0 million):
NIBIB will fund 30 Center awards in FY 2024, equal to the FY 2023 Enacted level.

Other Research ($0.0 million; total of $11.8 million):
NIBIB will fund 98 Other Research awards in FY 2024, equal to the FY 2023 Enacted level.

Research Training Awards ($0.0 million; total $11.2 million):
NIBIB will fund 220 Full-Time Training Positions (FTTPs) in FY 2024, equal to the FY 2023 Enacted level.

Research and Development Contracts ($0.0 million; total $21.5 million):
NIBIB will fund 10 R&D Contracts in FY 2024, equal to the FY 2023 Enacted level.

Intramural Research ($3.2 million; total $25.3 million):
Intramural Research will be increased by 14.5 percent, due to NIBIB organizing a trans-NIH Center for Biomedical Engineering and Technology Acceleration (BETA) that will accelerate the development, validation, and dissemination of high-impact biomedical technologies to address urgent national and global health needs.

Research Management & Support ($4.1 million; total $33.8 million):
Research Management & Support will increase by 13.8 percent from the FY 2023 Enacted level. NIBIB has continued to expand its communication, information technology, budget and administrative efforts and website presence to provide timely information to researchers, Congress, and the public about its activities related to addressing the COVID-19 pandemic.

## NATIONAL INSTITUTES OF HEALTH

## National Institute of Biomedical Imaging and Bioengineering

### Budget Mechanism *

(Dollars in Thousands)

| Mechanism | FY 2022 Final | | FY 2023 Enacted | | FY 2024 President's Budget | | FY 2024 +/- FY 2023 | |
|---|---|---|---|---|---|---|---|---|
| | **Number** | **Amount** | **Number** | **Amount** | **Number** | **Amount** | **Number** | **Amount** |
| Research Projects: | | | | | | | | |
| Noncompeting | 436 | $185,787 | 504 | $212,201 | 515 | $211,488 | 11 | -$713 |
| Administrative Supplements | *(28)* | $1,966 | *(35)* | $2,370 | *(35)* | $2,370 | *(0)* | $0 |
| Competing: | | | | | | | | |
| Renewal | 16 | $8,231 | 0 | $0 | 0 | $0 | 0 | $0 |
| New | 223 | $89,389 | 197 | $82,691 | 180 | $75,935 | -17 | -$6,756 |
| Supplements | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 |
| **Subtotal, Competing** | **239** | **$97,619** | **197** | **$82,691** | **180** | **$75,935** | **-17** | **-$6,756** |
| Subtotal, RPGs | 675 | $285,372 | 701 | $297,262 | 695 | $289,793 | -6 | -$7,469 |
| SBIR/STTR | 26 | $13,991 | 32 | $13,820 | 34 | $14,100 | 2 | $280 |
| Research Project Grants | 701 | $299,364 | 733 | $311,082 | 729 | $303,893 | -4 | -$7,189 |
| Research Centers | | | | | | | | |
| Specialized/Comprehensive | 4 | $4,317 | 5 | $4,714 | 5 | $4,714 | 0 | $0 |
| Clinical Research | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 |
| Biotechnology | 24 | $30,190 | 25 | $28,311 | 25 | $28,311 | 0 | $0 |
| Comparative Medicine | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 |
| Research Centers in Minority Institutions | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 |
| **Research Centers** | **28** | **$34,508** | **30** | **$33,025** | **30** | **$33,025** | **0** | **$0** |
| Other Research: | | | | | | | | |
| Research Careers | 27 | $3,859 | 28 | $3,882 | 28 | $3,882 | 0 | $0 |
| Cancer Education | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 |
| Cooperative Clinical Research | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 |
| Biomedical Research Support | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 |
| Minority Biomedical Research Support | 0 | $0 | 0 | $0 | 0 | $0 | 0 | $0 |
| Other | 67 | $6,945 | 70 | $7,928 | 70 | $7,928 | 0 | $0 |
| **Other Research** | **94** | **$10,804** | **98** | **$11,810** | **98** | **$11,810** | **0** | **$0** |
| Total Research Grants | 823 | $344,675 | 861 | $355,917 | 857 | $348,728 | -4 | -$7,189 |
| Ruth L Kirschstein Training Awards: | FTTPs | | FTTPs | | FTTPs | | FTTPs | |
| Individual Awards | 8 | $363 | 11 | $619 | 11 | $619 | 0 | $0 |
| Institutional Awards | 209 | $10,520 | 209 | $10,605 | 209 | $10,605 | 0 | $0 |
| **Total Research Training** | **217** | **$10,883** | **220** | **$11,224** | **220** | **$11,224** | **0** | **$0** |
| Research & Develop. Contracts | 10 | $19,245 | 10 | $21,641 | 10 | $21,547 | 0 | -$94 |
| *SBIR/STTR (non-add)* | *(1)* | *($141)* | *(0)* | *($0)* | *(0)* | *($0)* | *(0)* | *($0)* |
| Intramural Research | 30 | $19,578 | 37 | $22,112 | 52 | $25,277 | 15 | $3,165 |
| Res. Management & Support | 76 | $30,207 | 92 | $29,731 | 108 | $33,849 | 16 | $4,118 |
| *SBIR Admin. (non-add)* | | *($239)* | | *($0)* | | *($0)* | | *($0)* |
| Construction | | $0 | | $0 | | $0 | | $0 |
| Buildings and Facilities | | $0 | | $0 | | $0 | | $0 |
| **Total, NIBIB** | **106** | **$424,588** | **129** | **$440,625** | **160** | **$440,625** | **31** | **$0** |

* All items in italics and brackets are non-add entries.

## NATIONAL INSTITUTES OF HEALTH

## NATIONAL INSTITUTE OF BIOMEDICAL IMAGING AND BIOENGINEERING

For carrying out section 301 and title IV of the PHS Act with respect to biomedical imaging and bioengineering research, [$440,627,000] *$440,625,000*.

**NATIONAL INSTITUTES OF HEALTH**
**National Institute of Biomedical Imaging and Bioengineering**

## Summary of Changes

(Dollars in Thousands)

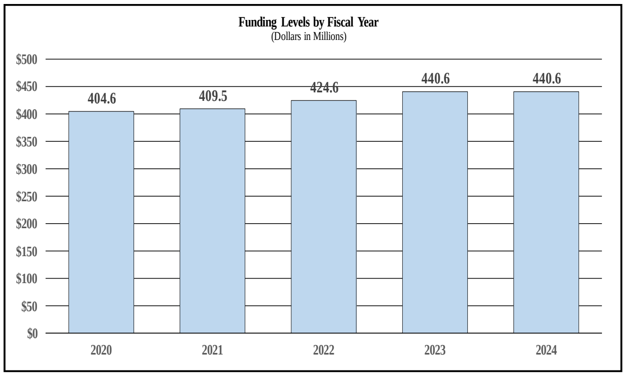
| | |
|---|---|
| **FY 2023 Enacted** | $440,625 |
| **FY 2024 President's Budget** | $440,625 |
| **Net change** | $0 |

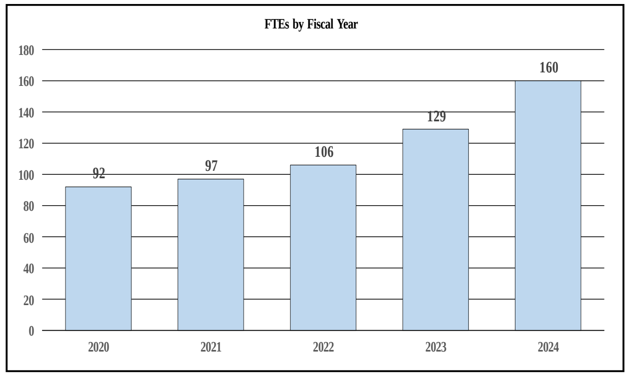
| CHANGES | FY 2023 Enacted | | FY 2024 President's Budget | | Built-In Change from FY 2023 Enacted | |
|---|---|---|---|---|---|---|
| | FTEs | Budget Authority | FTEs | Budget Authority | FTEs | Budget Authority |
| A. Built-in: | | | | | | |
| 1. Intramural Research: | | | | | | |
| a. Annualization of FY 2023 pay and benefits increase | | $6,228 | | $9,277 | | $69 |
| b. FY 2024 pay and benefits increase | | $6,228 | | $9,277 | | $239 |
| c. Paid days adjustment | | $6,228 | | $9,277 | | $24 |
| d. Differences attributable to change in FTE | | $6,228 | | $9,277 | | $3,593 |
| e. Payment for centrally furnished services | | $3,433 | | $3,487 | | $55 |
| f. Cost of laboratory supplies, materials, other expenses, and non-recurring costs | | $12,451 | | $12,513 | | $299 |
| Subtotal | | | | | | $4,279 |
| 2. Research Management and Support: | | | | | | |
| a. Annualization of FY 2023 pay and benefits increase | | $16,702 | | $20,486 | | $184 |
| b. FY 2024 pay and benefits increase | | $16,702 | | $20,486 | | $639 |
| c. Paid days adjustment | | $16,702 | | $20,486 | | $64 |
| d. Differences attributable to change in FTE | | $16,702 | | $20,486 | | $3,003 |
| e. Payment for centrally furnished services | | $0 | | $0 | | $0 |
| f. Cost of laboratory supplies, materials, other expenses, and non-recurring costs | | $13,029 | | $13,363 | | $313 |
| Subtotal | | | | | | $4,203 |
| Subtotal, Built-in | | | | | | $8,482 |

| CHANGES | FY 2023 Enacted | | FY 2024 President's Budget | | Program Change from FY 2023 Enacted | |
|---|---|---|---|---|---|---|
| | No. | Amount | No. | Amount | No. | Amount |
| B. Program: | | | | | | |
| 1. Research Project Grants: | | | | | | |
| a. Noncompeting | 504 | $214,571 | 515 | $213,858 | 11 | -$713 |
| b. Competing | 197 | $82,691 | 180 | $75,935 | -17 | -$6,756 |
| c. SBIR/STTR | 32 | $13,820 | 34 | $14,100 | 2 | $280 |
| Subtotal, RPGs | 733 | $311,082 | 729 | $303,893 | -4 | -$7,189 |
| 2. Research Centers | 30 | $33,025 | 30 | $33,025 | 0 | $0 |
| 3. Other Research | 98 | $11,810 | 98 | $11,810 | 0 | $0 |
| 4. Research Training | 220 | $11,224 | 220 | $11,224 | 0 | $0 |
| 5. Research and development contracts | 10 | $21,641 | 10 | $21,547 | 0 | -$94 |
| Subtotal, Extramural | | $388,782 | | $381,499 | | -$7,283 |
| 6. Intramural Research | 37 | $22,112 | 52 | $25,277 | 15 | -$1,114 |
| 7. Research Management and Support | 92 | $29,731 | 108 | $33,849 | 16 | -$85 |
| 8. Construction | | $0 | | $0 | | $0 |
| 9. Buildings and Facilities | | $0 | | $0 | | $0 |
| Subtotal, Program | 129 | $440,625 | 160 | $440,625 | 31 | -$8,482 |
| Total built-in and program changes | | | | | | $0 |

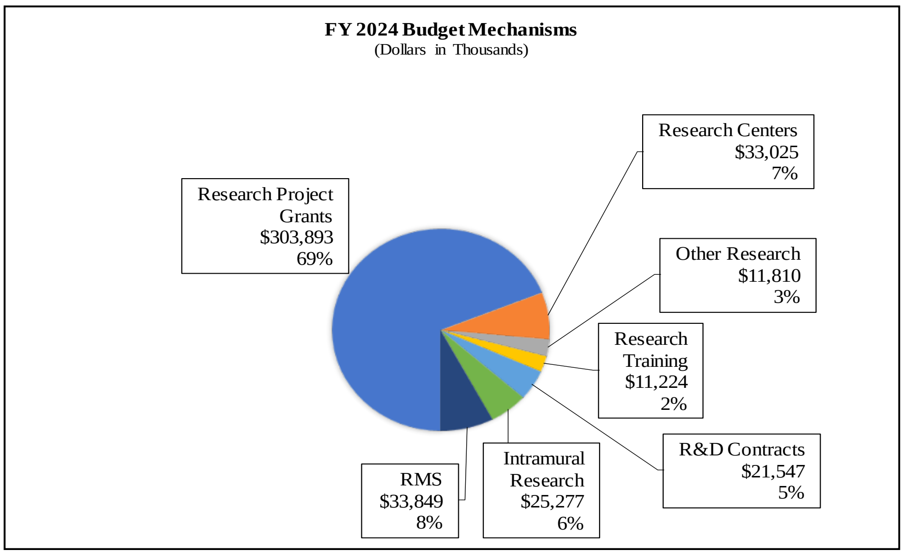
# Budget Graphs

## History of Budget Authority and FTEs:

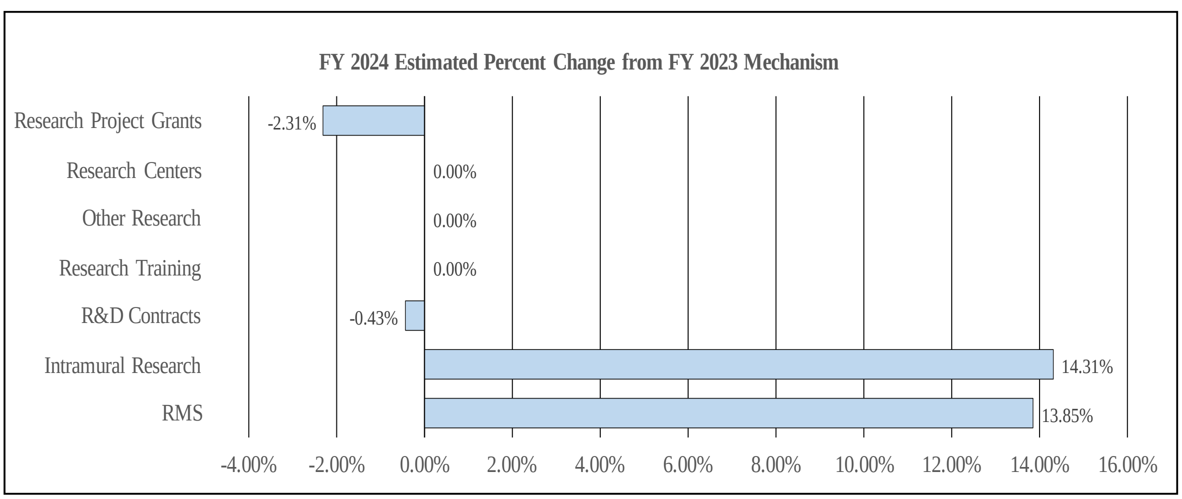


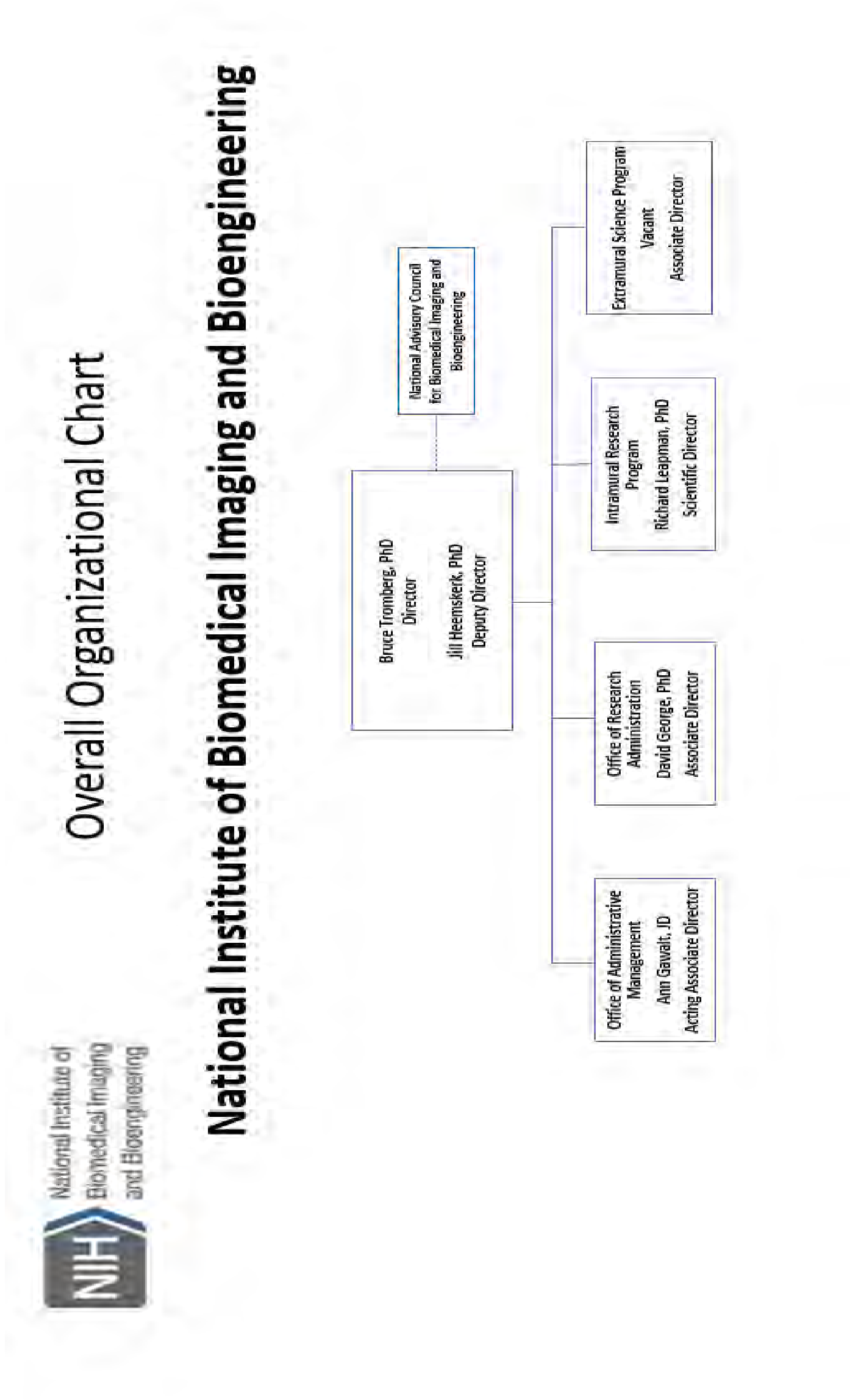

## Distribution by Mechanism:




## Change by Selected Mechanisms:



## Organizational Chart



# Budget Authority by Activity Table

## NATIONAL INSTITUTES OF HEALTH
## National Institute of Biomedical Imaging and Bioengineering

### Budget Authority by Activity *
(Dollars in Thousands)

| | FY 2022 Final | | FY 2023 Enacted | | FY 2024 President's Budget | | FY 2024 +/- FY 2023 Enacted | |
|---|---|---|---|---|---|---|---|---|
| **Extramural Research** | **FTE** | **Amount** | **FTE** | **Amount** | **FTE** | **Amount** | **FTE** | **Amount** |
| Detail | | | | | | | | |
| Discovery Science and Technology | | $121,859 | | $126,405 | | $124,037 | | -$2,368 |
| Applied Science and Technology | | $187,271 | | $194,256 | | $190,617 | | -$3,639 |
| Interdisciplinary Training | | $25,001 | | $25,934 | | $25,448 | | -$486 |
| Health Informatics Technology | | $40,671 | | $42,188 | | $41,397 | | -$790 |
| **Subtotal, Extramural** | | **$374,803** | | **$388,782** | | **$381,499** | | **-$7,283** |
| **TOTAL** | **106** | **$424,588** | **129** | **$440,625** | **160** | **$440,625** | **31** | **$0** |
| **Intramural Research** | **30** | **$19,578** | **37** | **$22,112** | **52** | **$25,277** | **15** | **$3,165** |
| **Research Management & Support** | **76** | **$30,207** | **92** | **$29,731** | **108** | **$33,849** | **16** | **$4,118** |

* Includes FTEs whose payroll obligations are supported by the NIH Common Fund.

## National Institute of Biomedical Imaging and Bioengineering

Authorizing Legislation: Section 301 and Title IV of the Public Health Service Act, as amended.

Budget Authority (BA):

| | FY 2022 Final | FY 2023 Enacted | FY 2024 President's Budget | FY 2024 +/- FY 2023 |
|---|---|---|---|---|
| BA | $410,728,000 | $440,625,000 | $440,625,000 | $0 |
| FTE | 124 | 129 | 160 | 31 |

Program funds are allocated as follows: Competitive Grants/Cooperative Agreements; Contracts; Direct Federal/Intramural and Other.

Overall Budget Policy: The FY 2024 President's Budget request for NIBIB is $440.6 million, the same as the FY 2023 Enacted level.

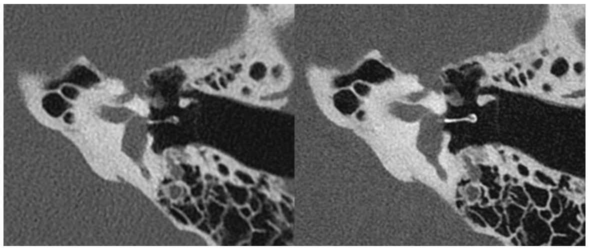
## Program Descriptions and Accomplishments

The National Institute of Biomedical Imaging and Bioengineering (NIBIB) supports research and training to fulfill its mission through its Extramural and Intramural Research Programs at national and international sites. Core research areas drive the development and application of bioengineering health care solutions to improve disease prevention, detection, diagnosis, and treatment. Key investment areas for NIBIB include sensing and imaging health and disease, engineered biosystems, advanced diagnostics and therapies, data science and computation, and training a diverse bioengineering workforce.

**Division of Applied Science and Technology (DAST)**

Biomedical imaging and sensing technologies are important tools for examining the body and its function at multiple levels — from cells to organs to the whole body. Advances in these tools will improve health equity and accessibility, enable rapid diagnoses, inform best therapy decisions, and accurately guide and monitor treatments. NIBIB catalyzes growth in biomedical imaging and sensing technologies through DAST programs which primarily support research in basic and medical imaging and bioanalytical sensors. DAST programs also integrate data science and imaging to improve and generate new tools and methods that support treatment management. The division drives the utility of imaging and sensing to monitor individual changes in health and disease, optimize clinical outcomes, and improve quality of life.

### First FDA approval for new CT system in a decade



*Conventional CT (left side) image of an inner ear prosthesis compared to PCD-CT system (right side). The structures of the inner ear are composed of tiny bones that are difficult to visualize. Clinicians can get much clearer inner ear images with PCD-CT, which helps with cochlear implants for children. Credit: Cynthia McCollough, Mayo Clinic, Rochester, Minnesota.*

NIBIB-supported researchers engineered the first photon-counting detector-computed tomography (PCD-CT) system which outperforms current CT technology. Over 80 million CT images are generated each year to help clinicians diagnose disease and injury.[3] Standard CT detectors use a two-step process to turn x-rays that have passed through a patient into an electrical signal transmitted to a computer for further processing. With the PCD-CT system, researchers can gather more information in just one step and produce clearer images. The system also produces detailed images of tissues at a lower patient radiation dose.[4] This new system is the first CT advance cleared by the FDA in a decade for use in clinical settings.

### Engineered materials and sensors improve MRI applications

To improve the clarity of magnetic resonance imaging (MRI), NIBIB-supported researchers have been working to make improvements with a new type of metamaterial that fits around a person's head much like a safety helmet. These engineered materials are composed of several individual units that combine to enhance the image. For MRI applications, copper-wrapped plastic tubes improved image resolution and clarity by fourfold.[5] Metamaterials have the potential to make MRI scans cheaper, faster, and more accessible to many people around the world.

In another study, NIBIB-funded researchers are using genetically engineered sensors and MRI for noninvasive, clinical management of cancer in the brain.[6] The sensor targets a protein biomarker that indicates the location of a tumor in the brain via MRI. New sensors like this one can guide treatment without invasive procedures. To date, the sensor has had success in rat and non-human primate models.

### Probes light up breast cancer tissue during surgery

Other types of probes and imaging methods can help surgeons identify cancerous cells during surgery. One potential area where a new probe could make a high impact is for treatment of early-stage breast cancer. Treatment normally includes breast-conserving surgery, where the tumor and some surrounding healthy tissues are removed. In about 20 percent of these surgeries,

---

[3] Harvard Health Publishing https://www.health.harvard.edu/cancer/radiation-risk-from-medical-imaging.

[4] Kishore Rajendran, et al. First Clinical Photon-counting Detector CT System: Technical Evaluation Radiology 2022 303:1, 130-138.

[5] Wu, K. et al., Auxetics-Inspired Tunable Metamaterials for Magnetic Resonance Imaging. *Adv. Mater.* 2022, 34, 2109032. https://doi.org/10.1002/adma.202109032

[6] Mitul Desai et al. (2021) Hemodynamic molecular imaging of tumor-associated enzyme activity in the living brain eLife 10:e70237 https://doi.org/10.7554/eLife.70237

a second operation is needed because some cancer cells were left behind.[7] Probes that glow under near-infrared light can help surgeons visualize cancer cells in real time. The few currently FDA-approved probes are not specific to breast cancer and do not stay in the bloodstream very long, limiting their usefulness. NIBIB-funded researchers have combined a probe that is already FDA-approved with a peptide that is specific to breast cancer cells. So far, the new probe has displayed improved outcomes in a preclinical mouse study.

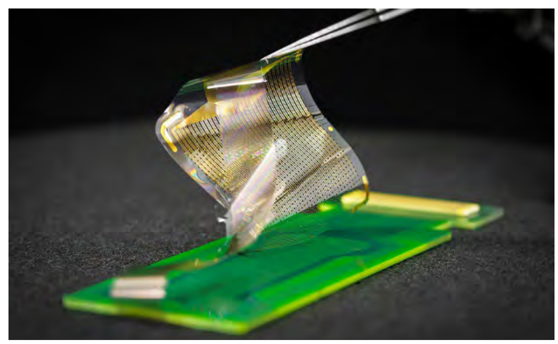
Budget policy: The FY 2024 President's Budget request for Division of Applied Science and Technology is $190.6 million, a decrease of $3.6 million or 1.9 percent compared with the FY 2023 Enacted level.

**Division of Discovery Science and Technology (DDST)**

Engineered biology is the manipulation of complex biological materials, processes, and systems to develop technologies that improve human health. DDST leverages engineering to drive technology development in biology-based technologies and biomedical devices. The division focuses on supporting biomedical technologies, methods, and models that apply broadly to disease and are well positioned to deliver significant research and medical breakthroughs. Key investment areas for NIBIB include biodevices, mathematical modeling and simulation, robotics, synthetic biology, and biomaterials.

**Tiny biodevices and biomaterials map the brain and stimulate cartilage growth**

One example of NIBIB-supported research is the development of a new "nano-sensor" that can create precise maps of the human brain. Improving brain sensing technologies helps surgeons perform complex procedures and enables researchers to map and learn more about the brain's functional networks that control feeling, movement, and thought. To create these more precise maps, a team harnessed nanotechnology to build densely packed grids with thousands of sensors that can be placed on a muscle near the brain. Sensors on these grids are only one millimeter apart, a tenfold improvement on older grids. In a clinical study in a patient with epilepsy, the postage stamp-sized sensor identified the precise location in the brain – with millimeter accuracy – that was discharging epileptic waves. This outperforms current technology which only achieves centimeter accuracy.[8] This precise localization could allow a surgeon to remove diseased tissue more exactly, thus sparing healthy brain tissue and preserving function for the patient.



*A new array of brain sensors can record electrical signals directly from the surface of the human brain in record-breaking detail. Credit: David Baillot/UC San Diego Jacobs School of Engineering.*

---

[7] Masahide Goto, et al. Image-guided surgery with a new tumour-targeting probe improves the identification of positive margins. eBioMedicine 2022; 76:103850. DOI: https://doi.org/10.1016/j.ebiom.2022.103850

[8] Tchoe Y, et al. Human brain mapping with multithousand-channel PtNRGrids resolves spatiotemporal dynamics. Sci Transl Med. 2022 Jan 19;14(628):eabj1441. doi: 10.1126/scitranslmed.abj1441. Epub 2022 Jan 19.

Another NIBIB-funded preclinical study addressed the problem of osteoarthritis, a challenging problem in aging adults. As we age, cartilage in our joints deteriorates, causing pain. Regenerating native cartilage has proven to be difficult, and surgical treatment options can be costly, time-consuming, and unreliable. NIBIB-supported researchers developed a small, biodegradable film with piezoelectric properties which generates electrical signals from pressure or vibrations to stimulate new cartilage growth. Researchers evaluated their film in a model of osteoarthritis by implanting the film in rabbits at sites of damaged knee joints.[9] Rabbits that were treated with the piezoelectric film followed by exercise to activate the piezoelectric properties of the film developed a new layer of cartilage that looked like native tissue. This was not seen in rabbits that were treated but did not exercise or were untreated. This biomaterial is easy to scale and manufacture and next steps will be to test in larger animal models and humans.

*The piezoelectric film. Credit: Thanh lab at the University of Connecticut.*

**Models: alternatives to animal studies in drug evaluation and predictors of clinical tests**

Scientists strive to develop alternatives to animal models to evaluate drugs. The goal is to engineer organs outside the body that are an accurate representation of human physiology. Using these tissue chips, researchers could determine if a drug was toxic before costly and time-consuming clinical trials and learn more about disease progression. A major limitation of the technology has been mimicking tissue interactions. For example, if a researcher was testing a drug for heart disease how would the liver respond?

*The multi-organ tissue chip system. Types of tissues, from left to right: liver, heart, skin, and bone. Credit: Ronaldson-Bouchard and Vunjak-Novakovic at Columbia University*

To address this challenge, NIBIB-supported bioengineers have made a multi-organ tissue chip system where each organ is in its own semi-permeable chamber. This barrier allows each tissue to grow in their optimal environment while allowing communication between the different organs.[10] The team was able to demonstrate that organs were able to communicate with each other in the multi-organ model as intended. When they injured the heart tissue in the model, they found cardiac-specific markers in the other three chambers. They also modeled testing of a common chemotherapeutic drug for cancer treatment and found it behaved similarly in patients and in the tissue chip model.

[9] Yang Liu, et al. Exercise-induced piezoelectric stimulation for cartilage regeneration in rabbits. Science Translational Medicine, 2022; 14 (627).
[10] Ronaldson-Bouchard K, et al. A multi-organ chip with matured tissue niches linked by vascular flow. Nat Biomed Eng. 2022;6(4):351-371. doi:10.1038/s41551-022-00882-6

A different type of modeling – mathematical modeling – has the potential to predict when early warning signs of disease are present based on data from wearable sensors. Wearable sensors like smartwatches and fitness trackers measure a person's vital signs including heart rate, skin temperature, step count, and the conductance of the skin (electrodermal activity). Over roughly 3 years, NIBIB-funded researchers followed 54 participants in a clinical study that analyzed data collected by a smartwatch in comparison to measurements taken in a clinical setting. Researchers found that heart rate was more consistent on the smartwatch than clinical measures, most likely because it was measured continuously throughout the day.[11] Researchers also wanted to determine if they could predict clinical laboratory results based on over 150 different features collected by the wearable and interpreted through machine learning models. The models found four common blood tests that were best predicted by wearable sensors.

Budget policy: The FY 2024 President's Budget request for Division of Discovery Science and Technology is $124.0 million, a decrease of $2.4 million or 1.9 percent compared with the FY 2023 Enacted level.

**Centers To Drive State-Of-The-Art Technologies**

NIBIB will continue to invest in its network of 30 National Centers for Biomedical Imaging and Bioengineering (NCBIB). At the forefront of their respective fields, NCBIBs are poised to develop state-of-the-art technologies and advanced methods for biomedical research to improve human health. The NCBIB network supports basic, translational, and early-stage clinical research projects that address a wide range of health care problems. NCBIBs bring together diverse teams of investigators on over 500 collaborative and service projects. To achieve maximum impact on biomedical research, technologies and knowledge developed through support from the NCBIBs are disseminated throughout the entire nation.

In one example, NIBIB-supported researchers performed and evaluated outcomes from a phase II study of image-guided focal therapy to treat intermediate-risk prostate cancer. Men diagnosed with intermediate-risk prostate cancer typically undergo whole gland ablation treatment regardless of tumor size and risk of metastasis. Whole gland ablation treatment is often associated with erectile dysfunction and urinary incontinence. Localizing the treatment to affected regions of the prostate gland could potentially preserve function and improve quality of life after treatment. In this clinical study with 101 patients, clinicians used focal therapy in combination with a magnetic resonance imaging (MRI)-guided ultrasound device and compared outcomes to the standard whole focal therapy. The treatment was found to be effective and safe, with no patient reporting urinary incontinence 24 months after the procedure.

## Division of Health Informatics and Technologies (DHIT)

Data science and point-of-care (POC) technologies are changing the way people's health is managed through disease diagnosis, prognosis, and treatment. DHIT supports the advancement of these technologies to create more practical, patient-centered health care solutions, aid experts in clinical decision making and prediction, and help advance biomedical research. Research in this division focuses on developing practical and intelligent methods and systems to process, analyze, and store complex biomedical health data like medical images and clinical data; advancing POC technologies to speed treatments and enable disease prevention; and expanding mobile health research to allow for

[11] Dunn, J., Kidzinski, et al. Wearable sensors enable personalized predictions of clinical laboratory measurements. Nat Med 27, 1105–1112 (2021).

continuous health monitoring and feedback to improve daily living and wellness.

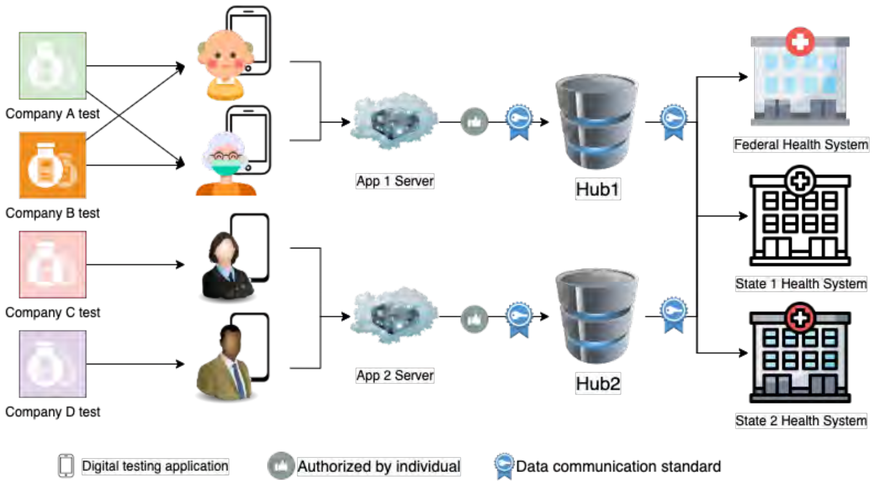
**NIH Technology Accelerator Challenge (NTAC) –** To stimulate the design of new diagnostic technologies that transform public and global health, NIBIB held its second NTAC in partnership with the Gates Foundation. The 2022 challenge focus was maternal health, with an emphasis on low-cost sensing and diagnostic technologies to reduce maternal morbidity and mortality. The first prize winner developed a mobile health tool intended for use by community health workers that are monitoring postpartum recovery following cesarian delivery. The home-based diagnostic screens for anemia and infections at the surgical site. The technology is designed for use in low-resource settings.

**Digital health and research platforms serve as public health tools**

NIBIB has contributed significantly to the wide availability of at-home tests in the United States to help prevent the spread of COVID-19. Unlike POC tests that would be administered at a clinic or doctor's office, at-home tests do not have a well-developed public health reporting infrastructure. With the shift away from laboratory testing, data from at-home tests can contribute significantly to disease surveillance efforts. One solution to this challenge is to enable at-home test users to self-report their results. However, to be utilized by public health agencies and personal electronic health records, reporting data needs to be standardized.

NIBIB developed Mobile Application Reporting through Standards (MARS), a digital health platform for at-home test result reporting. MARS takes COVID-19 testing information from a mobile app in the form of standardized, deidentified data elements, and routes the information to a data hub which transmits to both state and federal health databases. A pilot study showed that public health officials successfully received the data from those that self-reported their results.[12] They also found that most people reported their test result when they used the guided app for test taking. While barriers to adoption of this type of technology remain, future studies including a pilot study that combines home testing with COVID-19 treatments (i.e., test-to-treat) will help overcome some of these challenges.

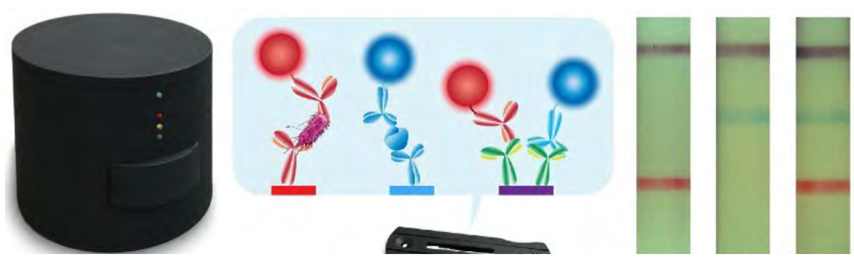
[12] Herbert C, et al. Use of a Digital Assistant to Report COVID-19 Rapid Antigen Self-test Results to Health Departments in 6 US Communities. JAMA Netw Open. 2022;5(8):e2228885.




*The diagram shows how results from a self-administered test are sent to public health systems. Results are captured in a mobile application (App) that accompanies a specific test. The App standardizes the data and sends it to a third-party hub which then relays the message to the appropriate public health system(s).*

As variants have emerged during the COVID-19 pandemic, it has been key to track their spread in real time to allow public health officials to update policies and notify the public. To identify variants, experts typically sequence the entire viral genome which is expensive and can take two to three weeks. A NIBIB-funded team of researchers developed a new method that can identify variants in one to 2 days and for a fraction of the cost of sequencing. The technique is based on genotyping and uses unique genetic reference points. This reduces the processing of a 30,000 base-pair SARS-CoV-2 genome to about 45 specific markers. The genotyping process can accurately characterize all major subvariants in circulation.[13] As this platform is adopted by more public health and private testing labs, tracking infectious disease will be more easily managed.

**Multiplex POC test for typhoid and malaria**



*Duplex lateral flow assay for typhoid and malaria with reader. A red line indicates a positive typhoid infection and the blue line indicates a malaria infection. The purple line indicates the test worked properly. Credit: Reprinted with permission from Cao, et al. ACS, Sept 1, 2021. Copyright 2021 ACS.*

Diagnosing infectious disease was a significant problem well before the COVID-19 pandemic began. In low-resource, tropical regions where access to diagnostics can be limited, malaria and typhoid fever are common infectious diseases that have overlapping and nonspecific symptoms. Current diagnostic tests in these regions are not widely available and require expensive equipment and trained professionals. It is also important to differentiate between disease types for precision therapies, as treating with

[13] Eric Lai, et al. A Method for Variant Agnostic Detection of SARS-CoV-2, Rapid Monitoring of Circulating Variants, and Early Detection of Emergent Variants Such as Omicron. Jour of Clin Micro. 2022; e00342-22.

broad spectrum antibiotics can lead to antibiotic resistance and leave a population defenseless to infectious diseases.

NIBIB-funded researchers developed a lateral flow POC test that is similar to at-home COVID-19 tests. A unique feature of this test is its ability to determine if you have typhoid fever, malaria, or both.[14] The reader is a small, handheld device that maximizes portability, thereby making it a more practical solution for low-resource settings. The test and reader are inexpensive and highly accurate. The team is working to upgrade the reader to transmit results to smartphones via Bluetooth so that the information can be uploaded to an individual's electronic health record and reported to public health officials for disease surveillance.

**FDA-approved CT software developed with AI to improve brain scans**
Harnessing the power of AI for use in clinical practice has been a key investment area for NIBIB. In a major milestone, the FDA approved use of software that was developed by NIBIB-funded engineers. The software uses AI to improve CT brain scans. While CT imaging is very safe, patients are exposed to small doses of radiation. Patients receiving repeat CT scans or a specialized type of CT that is used to evaluate damage from a stroke are exposed to higher doses of radiation; the higher dose of radiation helps clinicians obtain a higher quality image to inform treatment decisions. To lower the dose, the researchers used an algorithm that helps reduce the noise in the specialized CT scan during image reconstruction. The radiation dose was lowered by 50-75 percent when compared to the conventional method.[15] The software does not disrupt the standard clinical workflow and does not require expensive upgrades to CT hardware making the technology readily translatable.

<u>Budget policy</u>: The FY 2024 President's Budget request for Division of Health Informatics and Technology is $41.4 million, a decrease of $0.8 million or 1.9 percent compared with the FY 2023 Enacted level.

---

[14] Cao XE, Kim J, Mehta S, Erickson D., Two-Color Duplex Platform for Point-of-Care Differential Detection of Malaria and Typhoid Fever.. Anal Chem. 2021 Sep 14;93(36):12175-12180. doi: 10.1021/acs.analchem.1c03298.

[15] Zhao C, Martin T, Shao X, Alger JR, Duddalwar V, Wang DJJ. Low Dose CT Perfusion With K-Space Weighted Image Average (KWIA). IEEE Trans Med Imaging. 2020 Dec;39(12):3879-3890. doi: 10.1109/TMI.2020.3006461. Epub 2020 Nov 30. PMID: 32746131; PMCID: PMC7704693.

## Division of Interdisciplinary Training (DIDT)

NIBIB invests in training the next generation of bioengineering and bioimaging researchers to ensure the Institute can uphold its mission and drive innovation in science. DIDT supports a broad range of training programs across the pipeline from undergraduates to early-stage career investigators. Diverse skill sets and life experiences generate creativity and provide unique ways of solving challenging scientific problems. Signature programs focus on enhancing diversity and fostering mentorship of underrepresented groups in biomedical research. The division also supports novel, accessible technologies that reduce health disparities.

> **EARLY CAREER TRAILBLAZERS**
>
> NIBIB's unique Trailblazer Program awards are geared toward New and Early-Stage Investigators that are pursuing a broad range of biomedical research. Underrepresented groups are strongly encouraged to apply to the program. The program exemplifies NIBIB's commitment to supporting early-career investigators and fostering the growth and diversity of the bioengineering workforce. A signature element of the grant application is the lack of a requirement to include preliminary data that demonstrates project feasibility, which is often needed for other NIH grant mechanisms. Trailblazer projects should integrate advanced engineering, bioimaging, or computational technologies with life sciences to impact human health. In the last 5 years, NIBIB has supported and average of 44 Trailblazer awards each year. Nearly all funded grants (97%) resulted in peer-reviewed publications. Data from FY 2018-2020 shows that more than half of the funded grants go on to receive further NIH funding.

**Workforce development**

The NIBIB Enhancing Science, Technology, EnginEering, and Math Educational Diversity (ESTEEMED) training program was created to invest in the growth of the next generation of bioengineers. The program aims to increase diversity in the biomedical research workforce through educational activities that prepare students in STEM for undergraduate and graduate level courses. Funded programs are expected to help students gain academic and research skills, in addition to career development opportunities and mentorship.

In the past four years NIBIB has invested in 130 students at 12 different universities across the U.S. Of the selected universities, two were historically black colleges and universities (HBCU); two were Hispanic-serving institutions (HIS); and four were limited-resource institutions (LRI). Students who complete the ESTEEMED program enrolled in honors programs at their university. The goal of the programs is for students to complete their Bachelor of Science degree and move on to a graduate level degree.

The annual Design by Biomedical Undergraduate Teams (DEBUT) Challenge led by NIBIB invites undergraduate student research teams to develop technology solutions to unmet needs in health care. In FY 2022, in collaboration with NIH partners, prizes totaled $130,000. Nine teams received prizes and five more received honorable mentions. DEBUT received 73 applications from 43 universities in 19 states, with four countries represented, engaging a total of


*A photo of the FY 2022 DEBUT winning device – the EquinOx device which aims to mitigate bias in pulse oximeters.*

456 students this year. The winning prize attempts to mitigate bias that most pulse oximeters exhibit by failing to account for different skin tones in patients. The device incorporates hardware and software improvements that integrate skin tone measurements and raw pulse oximeter data. With these improvements, the device, named the EquinOx, is better able to estimate blood oxygen saturation in participants with darker skin tones than current technology. The second prize was awarded to a group that developed an easy-to-use diagnostic tool that can detect Group B Streptococcus in low-resources settings. The inexpensive test could help to decrease infant mortality rates worldwide. The third-place winners designed a technology to help monitor the risk of preterm birth. One way to monitor risk for preterm birth is to measure cervical stiffness. This team developed an instrument that can be used in low-resource clinical settings that quantifies cervical stiffness.

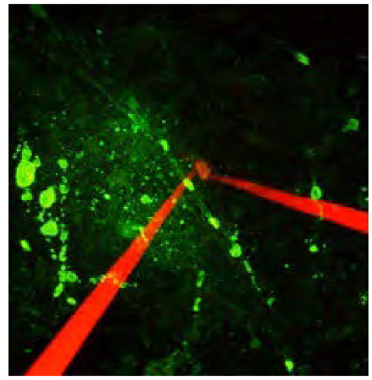
<u>Budget policy</u>: The FY 2024 President's Budget request for Division of Interdisciplinary Training is $25.4 million, a decrease of $0.5 million or 1.5 percent compared with the FY 2023 Enacted level.

**<u>Intramural Research Program (IRP)</u>**

NIBIB's IRP effectively combines basic, translational, and clinical science to fulfill NIBIB's mission to advance knowledge in imaging and bioengineering research. To actively support and maintain a diverse biomedical workforce, the IRP develops valuable training programs in related fields. NIBIB has added two key programs in the IRP to play a pivotal role in helping the Institute fulfill its mission.

The Center for Biomedical Engineering and Technology Acceleration (BETA) will support NIH-wide technology development and implementation to meet urgent national and global health needs. The Center will focus on the advancement of biomedical imaging, biosensing, engineered/synthetic biology, nano/biomaterials, artificial intelligence, modeling, computation, and informatics. Expanding diversity, equity, inclusion, and accessibility (DEIA) within NIBIB's IRP and the bioengineering community at large will be fundamental to BETA's mission, as part of NIH's UNITE initiative, whose aims are to improve the biomedical research culture and structure at NIH and throughout the entire science community. The BETA Center Director will work to eliminate barriers inhibiting professional growth for staff focusing on those from diverse backgrounds.

Another new entity in NIBIB's IRP is the Instrumentation Development and Engineering Application Solutions (IDEAS) lab at NIBIB, which performs as the principal, on-campus, engineering resource within IRP. The wealth of engineering expertise and experience provides a robust foundation to foster interdisciplinary, collaborative, cross-cutting technology incubators that adopt high-risk high-reward research projects. Examples of IDEAS projects are unique instrument design, software development, device fabrication, and laboratory and clinical validation studies.



*A single neuron cell is targeted and patch-clamped by two micromanipulator-driven micropipettes. Both micropipettes are coated in a red fluorescent dye, and one is used to inject the red fluorescent dye into the cell. This technology was created by NIBIB's IDEAS lab.*

Budget policy: The FY 2024 President's Budget request for the Intramural Research Program is $25.3 million, an increase of $3.2 million or 14.5 percent compared with the FY 2023 Enacted level. This increase includes costs to fund the planned trans-NIH Center for Biomedical Engineering and Technology Acceleration (BETA) to accelerate the development, validation, and dissemination of high-impact biomedical technologies, and also covers pay and inflation increases in the existing IR program. A fundamental objective of the BETA Center is to expand diversity, equity, inclusion and accessibility (DEIA) at NIBIB, building on the inherent interdisciplinary nature of biomedical engineering.

**Research Management and Support**

Effective research management and support heavily impact NIBIB's ability to achieve its mission. Effective management, oversight of administrative operations budget, communications, and strategic planning have been crucial to NIBIB's successes. NIBIB has prioritized timely, accurate, and transparent communications to the broader research community, the public, and Congress including information addressing the COVID-19 pandemic through an online dashboard and other communication tools. NIBIB also continues to develop and deploy DEIA-related programs and activities. These efforts and achievements will be shared with the research community and other stakeholders.

Budget Policy**:** The FY 2024 President's Budget request for Research Management and Support is $33.8 million, an increase of $4.1 million or 13.8 percent compared with the FY 2023 Enacted level. This increase will allow NIBIB to expand communication, information technology, and other efforts while covering pay raises and other inflation-related costs. The BETA Center Director works in collaboration with the Extramural Scientific Diversity Officer to ensure promotion of DEIA efforts and initiatives across NIBIB.

# NATIONAL INSTITUTES OF HEALTH
## National Institute of Biomedical Imaging and Bioengineering

## Appropriations History

| Fiscal Year | Budget Estimate to Congress | House Allowance | Senate Allowance | Appropriation |
|---|---|---|---|---|
| 2015 | $328,532,000 | | | $330,192,000 |
| Rescission | | | | $0 |
| 2016 | $337,314,000 | $338,360,000 | $344,299,000 | $346,795,000 |
| Rescission | | | | $0 |
| 2017 [1] | $343,506,000 | $356,978,000 | $361,062,000 | $357,080,000 |
| Rescission | | | | $0 |
| 2018 | $282,614,000 | $362,506,000 | $371,151,000 | $377,871,000 |
| Rescission | | | | $0 |
| 2019 | $346,550,000 | $382,384,000 | $389,672,000 | $389,464,000 |
| Rescission | | | | $0 |
| 2020 | $335,986,000 | $408,498,000 | $411,496,000 | $403,638,000 |
| Rescission | | | | $0 |
| Supplemental | | | | $60,000,000 |
| 2021 | $368,111,000 | $407,109,000 | $417,815,000 | $410,728,000 |
| Rescission | | | | $0 |
| 2022 | $422,039,000 | $431,081,000 | $421,617,000 | $424,590,000 |
| Rescission | | | | $0 |
| 2023 | $419,493,000 | $437,991,000 | $437,752,000 | $440,627,000 |
| Rescission | | | | $0 |
| 2024 | $440,625,000 | | | |

[1] Budget Estimate to Congress includes mandatory financing.

# Authorizing Legislation

## NATIONAL INSTITUTES OF HEALTH
### National Institute of Biomedical Imaging and Bioengineering

### Authorizing Legislation

| | PHS Act/ Other Citation | U.S. Code Citation | 2023 Amount Authorized | FY 2023 Enacted | 2024 Amount Authorized | FY 2024 President's Budget |
|---|---|---|---|---|---|---|
| Research and Investigation | Section 301 | 42§241 | Indefinite | $440,625,000 | Indefinite | $440,625,000 |
| National Institute of Biomedical Imaging and Bioengineering | Section 401(a) | 42§281 | Indefinite | | Indefinite | |
| Total, Budget Authority | | | | $440,625,000 | | $440,625,000 |

# NATIONAL INSTITUTES OF HEALTH

## National Institute of Biomedical Imaging and Bioengineering

### Amounts Available for Obligation [1]

(Dollars in Thousands)

| Source of Funding | FY 2022 Final | FY 2023 Enacted | FY 2024 President's Budget |
|---|---|---|---|
| Appropriation | $424,590 | $440,627 | $440,625 |
| Mandatory Appropriation: (non-add) | | | |
| *Type 1 Diabetes* | *($0)* | *($0)* | *($0)* |
| *Other Mandatory financing* | *($0)* | *($0)* | *($0)* |
| Subtotal, adjusted appropriation | $424,590 | $440,627 | $440,625 |
| OAR HIV/AIDS Transfers | -$2 | -$2 | $0 |
| Subtotal, adjusted budget authority | $424,588 | $440,625 | $440,625 |
| Unobligated balance, start of year | $0 | $0 | $0 |
| Unobligated balance, end of year (carryover) | $0 | $0 | $0 |
| **Subtotal, adjusted budget authority** | **$424,588** | **$440,625** | **$440,625** |
| Unobligated balance lapsing | -$29 | $0 | $0 |
| Total obligations | $424,559 | $440,625 | $440,625 |

[1] Excludes the following amounts (in thousands) for reimbursable activities carried out by this account:
FY 2022 - $49,541    FY 2023 - $10,200    FY 2024 - $10,200

# Budget Authority by Object Class

**NATIONAL INSTITUTES OF HEALTH**
**National Institute of Biomedical Imaging and Bioengineering**

**Budget Authority by Object Class [1]**
(Dollars in Thousands)

| | | FY 2023 Enacted | FY 2024 President's Budget | FY 2024 +/- FY 2023 |
|---|---|---|---|---|
| **Total compensable workyears:** | | | | |
| | Full-time equivalent | 129 | 160 | 31 |
| | Full-time equivalent of overtime and holiday hours | 0 | 0 | 0 |
| | Average ES salary | $0 | $0 | $0 |
| | Average GM/GS grade | 13.0 | 13.0 | 0.0 |
| | Average GM/GS salary | $137 | $144 | $7 |
| | Average salary, Commissioned Corps (42 U.S.C. 207) | $0 | $0 | $0 |
| | Average salary of ungraded positions | $0 | $0 | $0 |
| | **OBJECT CLASSES** | **FY 2023 Enacted** | **FY 2024 President's Budget** | **FY 2024 +/- FY 2023** |
| | Personnel Compensation | | | |
| 11.1 | Full-Time Permanent | $10,975 | $13,614 | $2,639 |
| 11.3 | Other Than Full-Time Permanent | $3,706 | $5,208 | $1,502 |
| 11.5 | Other Personnel Compensation | $679 | $869 | $191 |
| 11.7 | Military Personnel | $0 | $0 | $0 |
| 11.8 | Special Personnel Services Payments | $1,710 | $2,548 | $838 |
| **11.9** | **Subtotal Personnel Compensation** | **$17,070** | **$22,240** | **$5,170** |
| 12.1 | Civilian Personnel Benefits | $5,861 | $7,523 | $1,662 |
| 12.2 | Military Personnel Benefits | $0 | $0 | $0 |
| 13.0 | Benefits to Former Personnel | $0 | $0 | $0 |
| | **Subtotal Pay Costs** | **$22,930** | **$29,762** | **$6,832** |
| 21.0 | Travel & Transportation of Persons | $129 | $131 | $2 |
| 22.0 | Transportation of Things | $56 | $57 | $1 |
| 23.1 | Rental Payments to GSA | $0 | $0 | $0 |
| 23.2 | Rental Payments to Others | $0 | $0 | $0 |
| 23.3 | Communications, Utilities & Misc. Charges | $59 | $60 | $1 |
| 24.0 | Printing & Reproduction | $3 | $4 | $0 |
| 25.1 | Consulting Services | $6,997 | $7,108 | $111 |
| 25.2 | Other Services | $11,306 | $11,281 | -$25 |
| 25.3 | Purchase of Goods and Services from Government Accounts | $27,025 | $27,399 | $375 |
| 25.4 | Operation & Maintenance of Facilities | $47 | $47 | $0 |
| 25.5 | R&D Contracts | $222 | $222 | $0 |
| 25.6 | Medical Care | $56 | $58 | $2 |
| 25.7 | Operation & Maintenance of Equipment | $1,273 | $1,301 | $28 |
| 25.8 | Subsistence & Support of Persons | $0 | $0 | $0 |
| **25.0** | **Subtotal Other Contractual Services** | **$46,926** | **$47,417** | **$491** |
| 26.0 | Supplies & Materials | $1,432 | $1,416 | -$16 |
| 31.0 | Equipment | $1,886 | $1,762 | -$124 |
| 32.0 | Land and Structures | $60 | $61 | $1 |
| 33.0 | Investments & Loans | $0 | $0 | $0 |
| 41.0 | Grants, Subsidies & Contributions | $367,141 | $359,952 | -$7,189 |
| 42.0 | Insurance Claims & Indemnities | $0 | $0 | $0 |
| 43.0 | Interest & Dividends | $3 | $3 | $0 |
| 44.0 | Refunds | $0 | $0 | $0 |
| | **Subtotal Non-Pay Costs** | **$417,695** | **$410,863** | **-$6,832** |
| | **Total Budget Authority by Object Class** | **$440,625** | **$440,625** | **$0** |

[1] Includes FTEs whose payroll obligations are supported by the NIH Common Fund.

## NATIONAL INSTITUTES OF HEALTH

## National Institute of Biomedical Imaging and Bioengineering

### Salaries and Expenses

(Dollars in Thousands)

| Object Classes | FY 2023 Enacted | FY 2024 President's Budget | FY 2024 +/- FY 2023 |
|---|---|---|---|
| Personnel Compensation | | | |
| Full-Time Permanent (11.1) | $10,975 | $13,614 | $2,639 |
| Other Than Full-Time Permanent (11.3) | $3,706 | $5,208 | $1,502 |
| Other Personnel Compensation (11.5) | $679 | $869 | $191 |
| Military Personnel (11.7) | $0 | $0 | $0 |
| Special Personnel Services Payments (11.8) | $1,710 | $2,548 | $838 |
| **Subtotal, Personnel Compensation (11.9)** | **$17,070** | **$22,240** | **$5,170** |
| Civilian Personnel Benefits (12.1) | $5,861 | $7,523 | $1,662 |
| Military Personnel Benefits (12.2) | $0 | $0 | $0 |
| Benefits to Former Personnel (13.0) | $0 | $0 | $0 |
| **Subtotal Pay Costs** | **$22,930** | **$29,762** | **$6,832** |
| Travel & Transportation of Persons (21.0) | $129 | $131 | $2 |
| Transportation of Things (22.0) | $56 | $57 | $1 |
| Rental Payments to Others (23.2) | $0 | $0 | $0 |
| Communications, Utilities & Misc. Charges (23.3) | $59 | $60 | $1 |
| Printing & Reproduction (24.0) | $3 | $4 | $0 |
| Other Contractual Services | | | |
| Consultant Services (25.1) | $6,997 | $7,108 | $111 |
| Other Services (25.2) | $11,306 | $11,281 | -$25 |
| Purchase of Goods and Services from Government Accounts (25.3) | $27,025 | $27,399 | $375 |
| Operation & Maintenance of Facilities (25.4) | $47 | $47 | $0 |
| Operation & Maintenance of Equipment (25.7) | $1,273 | $1,301 | $28 |
| Subsistence & Support of Persons (25.8) | $0 | $0 | $0 |
| **Subtotal Other Contractual Services** | **$46,647** | **$47,136** | **$489** |
| Supplies & Materials (26.0) | $1,432 | $1,416 | -$16 |
| **Subtotal Non-Pay Costs** | **$48,326** | **$48,803** | **$477** |
| **Total Administrative Costs** | **$71,257** | **$78,566** | **$7,309** |

# Detail of Full-Time Equivalent Employment (FTE)

**NATIONAL INSTITUTES OF HEALTH**
**National Institute of Biomedical Imaging and Bioengineering**

**Detail of Full-Time Equivalent Employment (FTE)**

| Office | FY 2022 Final | | | FY 2023 Enacted | | | FY 2024 President's Budget | | |
|---|---|---|---|---|---|---|---|---|---|
| | Civilian | Military | Total | Civilian | Military | Total | Civilian | Military | Total |
| Office of the Director | | | | | | | | | |
| Direct: | 5 | - | 5 | 5 | - | 5 | 5 | - | 5 |
| Total: | 5 | - | 5 | 5 | - | 5 | 5 | - | 5 |
| Extramural Science Program | | | | | | | | | |
| Direct: | 21 | - | 21 | 28 | - | 28 | 32 | - | 32 |
| Reimbursable: | 5 | - | 5 | 3 | - | 3 | 3 | - | 3 |
| Total: | 26 | - | 26 | 31 | - | 31 | 35 | - | 35 |
| Office of Reseach Administration | | | | | | | | | |
| Direct: | 3 | - | 3 | 6 | - | 6 | 8 | - | 8 |
| Total: | 3 | - | 3 | 6 | - | 6 | 8 | - | 8 |
| Office of Administrative Management | | | | | | | | | |
| Direct: | 42 | - | 42 | 50 | - | 50 | 60 | - | 60 |
| Total: | 42 | - | 42 | 50 | - | 50 | 60 | - | 60 |
| Intramural Science Program | | | | | | | | | |
| Direct: | 17 | - | 17 | 26 | - | 26 | 41 | - | 41 |
| Reimbursable: | 13 | - | 13 | 11 | - | 11 | 11 | - | 11 |
| Total: | 30 | - | 30 | 37 | - | 37 | 52 | - | 52 |
| Total | 106 | - | 106 | 129 | - | 129 | 160 | - | 160 |
| Includes FTEs whose payroll obligations are supported by the NIH Common Fund. | | | | | | | | | |
| FTEs supported by funds from Cooperative Research and Development Agreements. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| FISCAL YEAR | Average GS Grade |
|---|---|
| 2020 | 12.7 |
| 2021 | 13.0 |
| 2022 | 13.0 |
| 2023 | 13.0 |
| 2024 | 13.0 |

# Detail of Positions

**NATIONAL INSTITUTES OF HEALTH**
**National Institute of Biomedical Imaging and Bioengineering**

**Detail of Positions [1]**

| GRADE | FY 2022 Final | FY 2023 Enacted | FY 2024 President's Budget |
|---|---|---|---|
| Total, ES Positions | 0 | 0 | 0 |
| Total, ES Salary | $0 | $0 | $0 |
| General Schedule | | | |
| GM/GS-15 | 19 | 22 | 25 |
| GM/GS-14 | 24 | 28 | 32 |
| GM/GS-13 | 30 | 35 | 40 |
| GS-12 | 6 | 7 | 9 |
| GS-11 | 10 | 10 | 10 |
| GS-10 | 1 | 2 | 2 |
| GS-9 | 3 | 3 | 3 |
| GS-8 | 0 | 0 | 0 |
| GS-7 | 0 | 0 | 0 |
| GS-6 | 0 | 0 | 0 |
| GS-5 | 0 | 0 | 0 |
| GS-4 | 1 | 1 | 1 |
| GS-3 | 2 | 2 | 2 |
| GS-2 | 1 | 1 | 1 |
| GS-1 | 0 | 0 | 0 |
| Subtotal | 97 | 111 | 125 |
| Commissioned Corps (42 U.S.C. 207) | | | |
| Assistant Surgeon General | 0 | 0 | 0 |
| Director Grade | 0 | 0 | 0 |
| Senior Grade | 0 | 0 | 0 |
| Full Grade | 0 | 0 | 0 |
| Senior Assistant Grade | 0 | 0 | 0 |
| Assistant Grade | 0 | 0 | 0 |
| Subtotal | 0 | 0 | 0 |
| Ungraded | 32 | 32 | 35 |
| Total permanent positions | 93 | 106 | 131 |
| Total positions, end of year | 129 | 143 | 160 |
| Total full-time equivalent (FTE) employment, end of year | 106 | 129 | 160 |
| Average ES salary | $0 | $0 | $0 |
| Average GM/GS grade | 13.0 | 13.0 | 13.0 |
| Average GM/GS salary | $130,773 | $136,788 | $143,696 |

[1] Includes FTEs whose payroll obligations are supported by the NIH Common Fund.