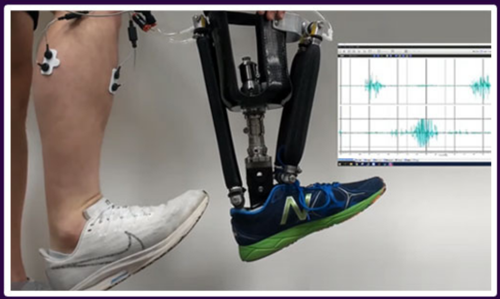
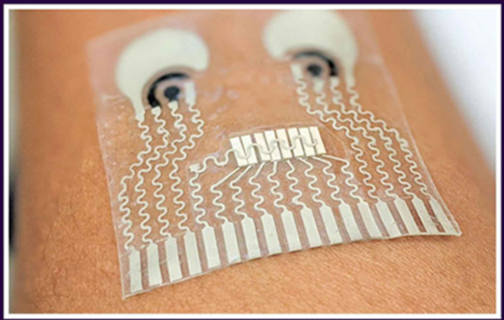
National Institute of Biomedical Imaging and Bioengineering





CONGRESSIONAL JUSTIFICATION
FY 2023

Department of Health and Human Services
National Institutes of Health

NIH National Institute of Biomedical Imaging and Bioengineering

Engineering the Future of Health

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DEPARTMENT OF HEALTH AND HUMAN SERVICES

NATIONAL INSTITUTES OF HEALTH

National Institute of Biomedical Imaging and Bioengineering (NIBIB)

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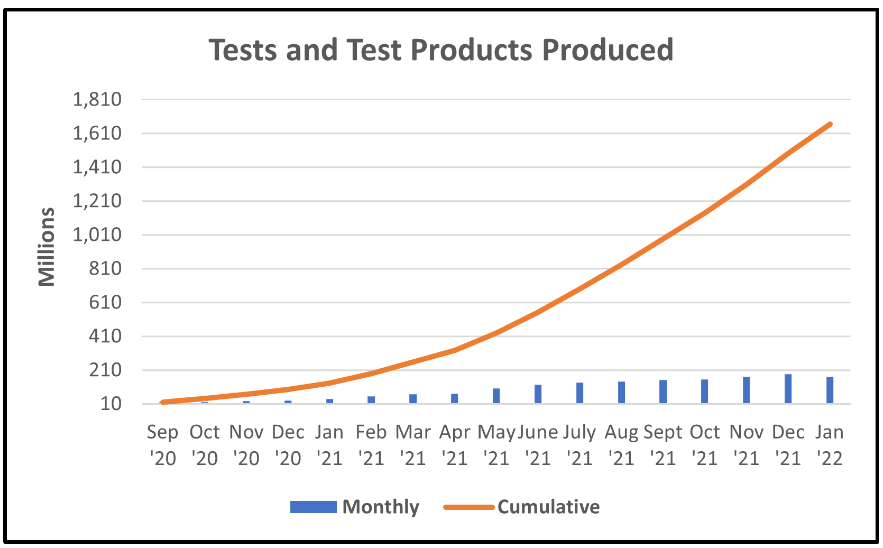
Director's Overview

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

The National Institute of Biomedical Imaging and Bioengineering (NIBIB) is engineering the future of health. We harness technology to solve healthcare problems, transforming disease diagnosis and prognosis while improving patient care. New tools and technologies increase our understanding of complex biological systems—from cells to organs to humans—and pave the way for a future of early identification and prevention of disease to greatly improve human health. We mobilized the bioengineering community to address the coronavirus disease 2019 (COVID-19) pandemic through three unprecedented approaches: innovating accessible diagnostic tests, enabling artificial intelligence (AI) analyses of medical images, and creating digital platforms to modernize pandemic surveillance.

We continue to lead the Rapid Acceleration of Diagnostics (RADx®) Tech program, part of the National Institutes of Health (NIH) RADx® initiative to speed innovation in the development and deployment of technologies for COVID-19 testing. With supplemental funding in FY 2020 and FY 2021, we leveraged and expanded an existing NIBIB network for the development of point-of-care (POC) technologies. RADx® Tech has proved enormously successful in accelerating technology development and deployment, delivering more than 1.7 billion tests and test products by January 2022. While only laboratory tests were available at the start of the pandemic, new RADx® technologies have transformed the testing landscape. Roughly 70 percent of tests conducted in the United States are now rapid, accessible POC and at-home tests. We supported more than 100 companies to develop diagnostic tests for SARS-CoV-2 and awarded 50 contracts to support the scale-up and manufacturing of home, POC, and lab tests, along with test products. With support from RADx® Tech, dozens of products are now authorized by the U.S. Food and Drug Administration (FDA) and available to consumers, including the first ever at-home over-the-counter (OTC) test for the detection of SARS-CoV-2.



NUMBER OF MANUFACTURED RADX®-SUPPORTED PRODUCTS, INCLUDING LAB-BASED, POINT OF CARE, HOME TESTS, AND LAB PRODUCTS. CREDIT: NIBIB

Throughout the pandemic, we have collaborated closely with the FDA and provided data to facilitate policy development and test authorization. In October 2021, we joined with the FDA and jointly launched the Independent Test Assessment Program (ITAP) to rapidly increase the number of at-home tests on the U.S. market. Through ITAP, NIBIB provides independent validation data to the FDA about the quality and performance of tests in foreign markets. This effort saves weeks to months in the FDA emergency authorization process while ensuring that tests sold in the United States meet rigorous regulatory standards. As of February 2022, three tests have received emergency use authorization under ITAP. This collaborative relationship could be sustained for future pandemic preparedness and, more broadly, could serve to accelerate commercialization of all novel medical devices.

RAPID POC DEVICE FOR SARS-COV-2 TESTING. CREDIT: ELLUME INC.

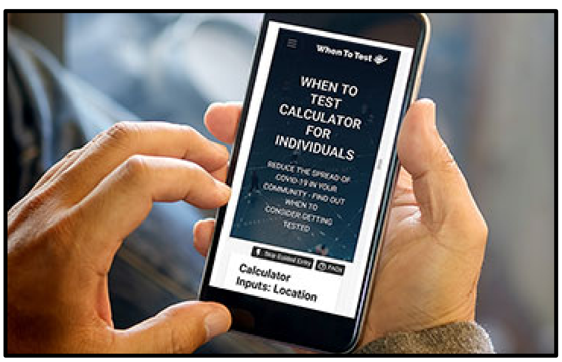
The crisis of the pandemic demanded that agencies operate differently. The mechanisms NIBIB created to accelerate test development and the partnerships we formed across the federal government, industry, and academia were essential to the success of RADx® Tech. These led to entirely new types of devices, such as rapid, POC molecular tests with accuracy equivalent to lab-based tests, and novel high-performance technologies, e.g., employing quantum dots (semiconductor particles with optical properties)[1] to detect SARS-CoV-2 at home. Enabled by efforts to fight the pandemic, the introduction of new technologies paves the way for the accessible diagnosis of many diseases, such as sexually transmitted infections, blood diseases, or other infectious diseases. RADx® Tech now is developing multiplex tests that simultaneously identify more than one illness, such as COVID-19, influenza, and other respiratory diseases. Having made new technologies available for rapid point-of-care and home diagnostics, NIBIB is poised to make a major impact on how healthcare is practiced in the United States. Expansion of these technologies can enable more accessible, lower cost, and more personalized telemedicine and improve healthcare access for rural and underserved populations.

The second pillar of NIBIB's response to the pandemic focuses on optimizing the impact of medical imaging in COVID-19 disease management and prognosis through artificial intelligence. It is widely recognized that the promise of AI in biomedical applications is limited by the lack of high-quality datasets from which to build reliable diagnostic tools and algorithms. NIBIB created a large public data resource, unprecedented in any medical field, that provides curated medical images and associated clinical data from COVID-19 patients. This collaborative initiative, called the Medical Imaging and Data Resource Center (MIDRC), collected and analyzed thousands of chest X-ray, computed tomography (CT), and other images from patients with COVID-19. These datasets are supporting the development of algorithms for detection, prognosis, and optimization of therapy in COVID-19 patients and have the potential to contribute to the understanding of Post-Acute Sequelae of SARS-CoV-2 infection (PASC, otherwise known as "Long COVID"). The AI research supported by this resource will create new tools that can be applied to imaging for other medical conditions, such as cancer, liver disease, and other infectious diseases, among

[1] Wagner AM, Knipe JM, Orive G, Peppas NA. Quantum dots in biomedical applications. Acta Biomater. 2019 Aug;94:44-63.

others. Importantly, the MIDRC imaging dataset strives to accurately represent the U.S. population, with diversity in age, racial/ethnic background, geographic location, and socioeconomic status. This focus on broad representation aims to reduce bias in AI, which is essential for building optimally predictive tools and for building and maintaining scientific and public trust in these approaches.

The third arm of our pandemic response is the development of digital tools, such as apps, to help guide in-home rapid COVID-19 testing and reporting of test results to public health authorities. We invested in the standardization of test result data so that future efforts to collect and report in-home test results are better harmonized. We also invested in studies to better understand the real-world use of at-home tests to optimize deployment of rapid diagnostics. Data from these studies will help to inform features of mobile apps to guide usage and reporting of results to health officials. Reporting of real-time results is critical in helping public health officials manage the pandemic and make decisions based on current data. While lab test results are required to be reported, test results of newer at-home and POC tests are not required to be reported, and technology platforms to capture and report test results to state and federal health systems did not exist nationwide. Working with the Association of Public Health Laboratories and the Centers for Disease Control and Prevention (CDC), we developed communication standards for at-home test reporting like the standards and workflow of laboratory tests and implemented these standards into a mobile application developed under the RADx® Tech program. Test result reporting from the mobile application to state health systems was successfully tested in six states. When made available, most participants who used the smart phone application reported their test results to their public health agency.



WHEN TO TEST CALCULATOR TOOL HELPS GUIDE ORGANIZATIONS AND INDIVIDUALS TO PLAN A TESTING STRATEGY. CREDIT: ISTOCK MODIFIED BY L. SMITH

While developing and manufacturing new diagnostic tests in record time was challenging, so too was disseminating, and matching the testing needs of different communities. We supported the development of When To Test, an online calculator to assist organizations, schools, and individuals in defining testing needs based on several factors, such as vaccination status, mask wearing, and transmission rates in the local region. As of October 2021, the site had more than 68 million users. The When To Test software tools provide powerful features that extend expert guidance to individuals and organizations, allowing them to create testing programs based on their unique needs.

Central to these efforts—and efforts to combat future pandemics—is the priority that new diagnostics and tools are available and accessible to underserved populations and address long-standing health inequities. Activities targeted to underserved and vulnerable communities helped inform how to overcome the challenges of distribution and usage so that testing could be more accessible. The NIH and the CDC led the Say Yes! COVID Test initiative, which provided NIBIB-supported at-home rapid tests to households in targeted areas along with access to an app for guidance in using the test and reporting the results. NIH also is investigating the development of at-home tests that can be used independently by people with disabilities. These efforts can serve as a guide for deploying future health technologies, bridging the gap between research findings and the unique public health needs of different communities.

As we emerge from the COVID-19 pandemic, we will build on investments and discoveries made during this period, chart a path for future technology development, and continue to strive to enhance human health. We will leverage recent advancements to optimize public health surveillance in the future. Many challenges remain, including the need to improve and modernize the infrastructure for reporting test results and the ability to quickly identify disease outbreaks or hotspots. These and other challenges can be overcome with continued efforts to improve test technology and infrastructure for preparedness and surveillance. Assuring technologies reach those who could benefit is also a challenge that going forward can be addressed within the technology development pipeline. This includes better integration of public health in development and deployment of technologies and continued support to engage underserved populations in training the next generation of researchers.

National Institute of Biomedical Imaging and Bioengineering

Engineering the Future of Health

NIBIB improves health by leading the development of biomedical technologies and accelerating their application. NIBIB invests in projects that harness engineering to expand the understanding of disease prevention, detection, diagnosis and treatment to fulfill its mission.

Data as of February 2022

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

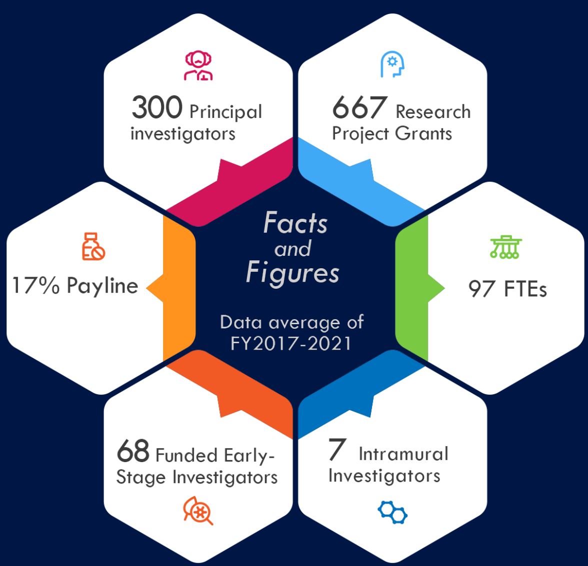
As the hub at NIH for expanding technologies across diseases and disorders, NIBIB support is driving research to benefit patients and healthcare professionals and promote further biomedical discovery. NIBIB invests in five major areas of research: technologies to sense and image health and disease, engineered biosystems, advanced diagnostics and therapies, data science and computation, and training of a diverse workforce.

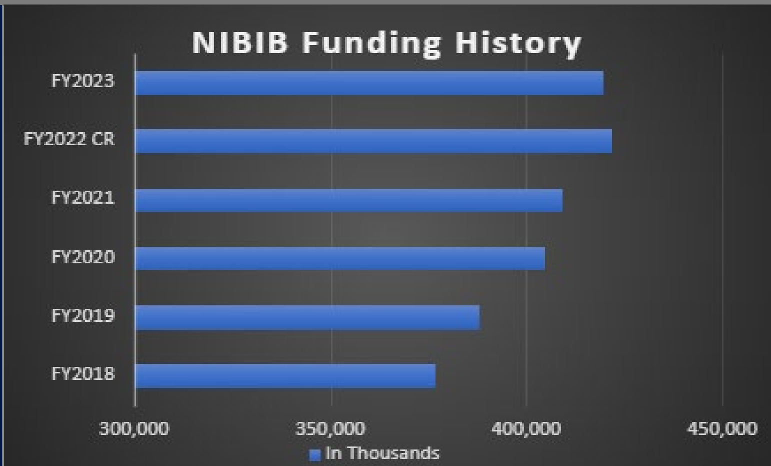
Credit: Quidel Corp., Thermo Fisher Scientific and Meridian Bioscience

1.8 billion COVID-19 tests and products produced

RADx® Tech continues to speed the development, validation and commercialization of innovative point-of-care and home-based tests for nationwide COVID-19 testing. To the left and above are examples of RADx® -supported point-of-care devices for diagnosing SARS-CoV-2 infection.

40 FDA emergency use authorizations





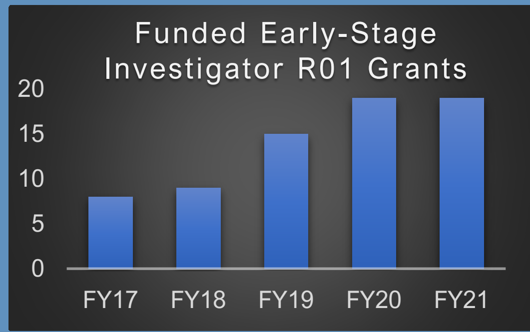
FY 2023 President's Budget is $419,493,000.
Note: In addition to the base budget, NIBIB received supplemental appropriations of $658 million in FY 2020, $651 million in FY 2021, and $640 million in FY 2022.

NIBIB Investment Priorities

Diverse Workforce

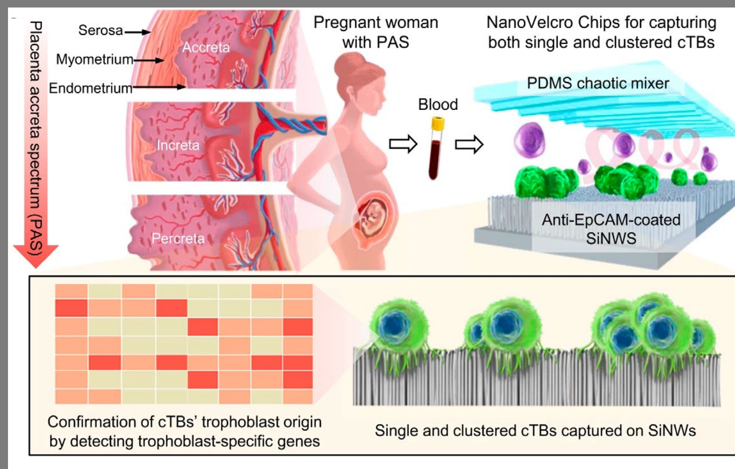
NIBIB is committed to supporting diversity, equity, and inclusion across the entire career spectrum from students to established investigators. One NIBIB-supported project is the Enhancing Science, Technology, EnginEering, and Math Educational Diversity (ESTEEMED) program to enhance the diversity of the biomedical research workforce through early preparation for undergraduate students in STEM fields.

Early Career Researchers

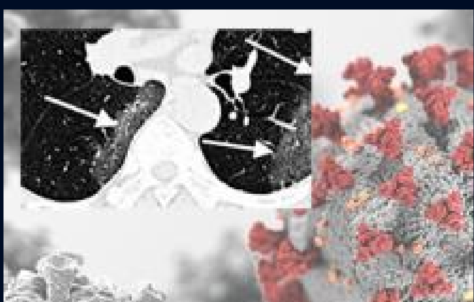


Women's Health Research Update

Placenta accreta spectrum (PAS) disorder occurs when the placenta remains anchored to the uterus after childbirth and results in life-threatening blood loss. Researchers have developed a blood test for rapid identification of this condition, enabling timely intervention by high-risk pregnancy specialists. A chip originally used for cancer detection was adapted so that it could detect placenta cells in a maternal blood sample. The chip detects a specific cell type associated with the onset of PAS known as circulating trophoblasts. The test is relatively simple and was designed to be easily done within the normal workflow of healthcare facilities providing prenatal care. The test only requires a small amount of blood and results are determined within 24 hours.



MIDRC
MEDICAL IMAGING AND DATA RESOURCE CENTER

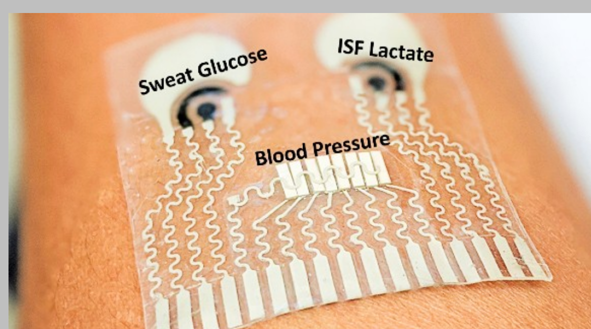


COVID-19 Imaging and Data Resource

The Medical Imaging and Data Resource Center (MIDRC) is a collaboration of leading medical imaging organizations supported by NIBIB that have launched a repository of imaging data to facilitate medical imaging research on COVID-19. In response to the urgent need for access to imaging data from patients with COVID-19, MIDRC published an initial set of images of COVID-19-positive chest computed tomography (CT) scans. The eventual repository—to include CT scans and x-rays—is planned to be the largest open database of anonymized COVID-19 medical images, along with associated clinical data, in the world. The imaging data are a free resource for research and education communities worldwide to use in development of artificial intelligence and deep learning tools and will serve as a reference to enhance clinical recognition of COVID-19. MIDRC imaging data strive to be representative of the U.S. population, with diversity in age, racial/ethnic backgrounds, geographic location, and socioeconomic status.

Technologies in the Pipeline

Researchers have developed a flexible, all-in-one skin patch that can simultaneously and continuously monitor cardiac output and metabolic levels of glucose, lactate, caffeine, or alcohol. The patch is a major step towards continuous noninvasive health monitoring of chronic conditions as well as monitoring of early signs of disease development. The small patch with printed electronic circuits looks akin to the face of a cartoon character. The "left eye" is a chemical sensor that detects substances in sweat that can increase during exercise or with caffeine and alcohol use. The "right eye" senses substances in the fluid between cells in the body like blood glucose. The "mustache" is a row of ultrasound transducers that pulse sound waves into blood vessels and pick up the returning sound waves. Those returning signals measure blood pressure and heart rate.



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 2023 President's Budget for NIBIB. The FY 2023 President's Budget request for NIBIB is $419.5 million, an increase of $8.8 million or 2.1 percent compared with the FY 2022 Continuing Resolution (CR) level.

<u>Research Project Grants (RPGs) ($1.7 million; total $290.2 million)</u>:

NIBIB will fund 651 RPG awards in FY 2023, an increase of 4 awards from the FY 2022 CR level. This includes 454 noncompeting awards (a total increase of 8 awards and $3.6 million from the FY 2022 CR level); 159 competing RPGs (a decrease of 5 awards and $2.4 million from the FY 2022 CR level); and 38 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) awards (an increase of 1 award and $0.4 million from the FY 2022 CR level). Noncompeting awards will be funded at the FY 2022 committed level. The average cost of competing RPGs will increase by 1 percent in FY 2023 versus the FY 2022 CR level.

<u>Research Centers ($0.7 million; total $36.3 million)</u>:

NIBIB will fund 28 Center awards in FY 2023, unchanged from the FY 2022 CR level.

<u>Other Research ($0.2 million; total $11.4 million)</u>:

NIBIB will fund 100 Other Research awards in FY 2023, an increase of 2 from the FY 2022 CR level.

<u>Research Training Awards ($0.2 million; total $11.1 million)</u>:

NIBIB will fund 219 Full-Time Training Positions (FTTPs) in FY 2023, an increase of 1.8 percent from the FY 2022 CR level.

<u>Research and Development (R&D) Contracts ($0.3 million; total $17.6 million)</u>:

NIBIB will fund 9 R&D Contracts in FY 2023, equal to the FY 2022 CR level.

<u>Intramural Research ($2.2 million; total $22.7 million)</u>:

Intramural Research will be increased by 10.8 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.

<u>Research Management & Support ($3.6 million; total $30.3 million)</u>:

Research Management & Support will increase by 13.3 percent from the FY 2022 CR 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.

Budget Mechanism Table

NATIONAL INSTITUTES OF HEALTH
National Institute of Biomedical Imaging and Bioengineering

Budget Mechanism – Total*
(Dollars in Thousands)

Mechanism	FY 2021 Final		FY 2022 CR		FY 2023 President's Budget		FY 2023 +/- FY 2022	
	No.	Amount	No.	Amount	No.	Amount	No.	Amount
Research Projects:								
Noncompeting	419	$173,494	446	$190,763	454	$194,388	8	$3,624
Administrative Supplements	*(25)*	$2,456	*(24)*	$2,420	*(0)*	$2,466	*(-24)*	$46
Competing:								
Renewal	16	$9,975	4	$2,172	4	$2,000	0	-$172
New	201	$95,663	160	$77,806	155	$75,589	-5	-$2,216
Supplements	0	$0	0	$0	0	$0	0	0
Subtotal, Competing	**217**	**$105,638**	**164**	**$79,978**	**159**	**$77,589**	**-5**	**-$2,388**
Subtotal, RPGs	636	$281,588	610	$273,161	613	$274,443	3	$1,282
SBIR/STTR	31	$12,785	37	15,356	38	15,731	1	$375
Research Project Grants	667	$294,374	647	$288,517	651	$290,174	4	$1,657
Research Centers:								
Specialized/Comprehensive	4	$4,043	3	$3,744	3	$3,815	0	$71
Clinical Research	0	$0	0	$0	0	$0	0	$0
Biotechnology	22	$25,616	25	$31,840	25	$32,445	0	$605
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	**26**	**$29,659**	**28**	**$35,584**	**28**	**$36,260**	**0**	**$676**
Other Research:								
Research Careers	25	$3,479	27	$3,383	28	$3,447	1	$64
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	53	$7,538	71	$7,795	72	$7,943	1	$148
Other Research	**78**	**$11,017**	**98**	**$11,178**	**100**	**$11,390**	**2**	**$212**
Total Research Grants	771	$335,050	773	$335,279	779	$337,824	6	$2,546
Ruth L Kirschstein Training Awards:	FTTPs		FTTPs		FTTPs		FTTPs	
Individual Awards	10	$553	15	$686	15	$699	0	$13
Institutional Awards	199	10,192	200	10,225	204	10,412	4	187
Total Research Training	**209**	**$10,745**	**215**	**$10,911**	**219**	**$11,111**	**4**	**$200**
Research & Develop. Contracts	9	$17,157	9	$17,328	9	$17,578	0	$250
(SBIR/STTR) (non-add)	*(3)*	*($137)*	*(3)*	*($142)*	*(3)*	*($146)*	*(0)*	*($4)*
Intramural Research	25	$20,314	37	$20,503	37	$22,712	0	$2,209
Res. Management & Support	72	$26,228	87	$26,707	92	$30,267	5	$3,560
SBIR Admin. (non-add)	*(0)*	*($230)*	*(0)*	*($239)*	*(0)*	*($245)*	*(0)*	*($7)*
Construction		$0		$0		$0		$0
Buildings and Facilities		$0		$0		$0		$0
Total, NIBIB	**97**	**$409,493**	**124**	**$410,728**	**129**	**$419,493**	**5**	**$8,765**

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

Appropriations Language

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, $419,493,000.

Summary of Changes

NATIONAL INSTITUTES OF HEALTH
National Institute of Biomedical Imaging and Bioengineering

Summary of Changes
(Dollars in Thousands)

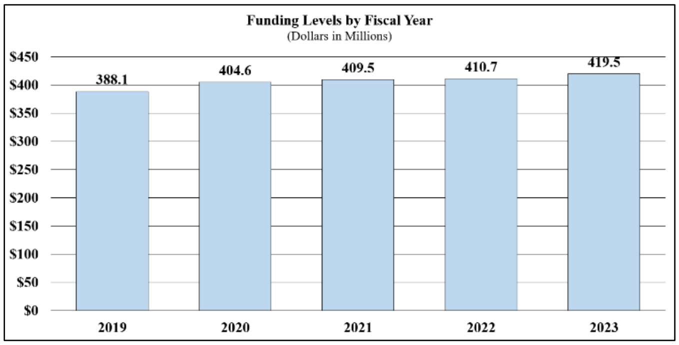
FY 2022 CR	$410,728
FY 2023 President's Budget	$419,493
Net change	$8,765

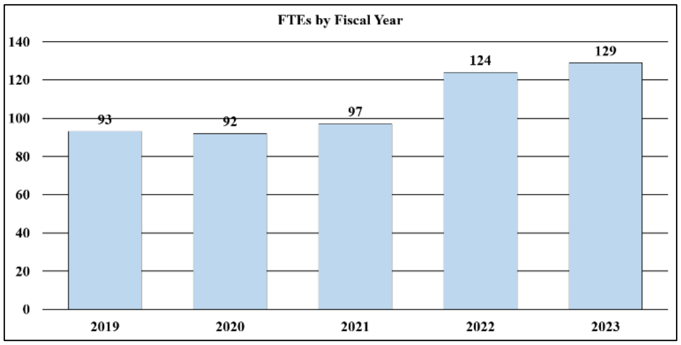
CHANGES	FY 2022 CR FTEs	FY 2022 CR Budget Authority	FY 2023 President's Budget FTEs	FY 2023 President's Budget Budget Authority	Built-In Change from FY 2022 CR FTEs	Built-In Change from FY 2022 CR Budget Authority
A. Built-in:						
1. Intramural Research:						
a. Annualization of January 2022 pay increase & benefits		$6,688		$8,600		$44
b. January FY 2023 pay increase & benefits		$6,688		$8,600		$226
c. Paid days adjustment		$6,688		$8,600		-$25
d. Differences attributable to change in FTE		$6,688		$8,600		$0
e. Payment for centrally furnished services		$3,097		$3,159		$62
f. Cost of laboratory supplies, materials, other expenses, and non-recurring costs		$10,718		$10,953		$235
Subtotal						$543
2. Research Management and Support:						
a. Annualization of January 2022 pay increase & benefits		$13,507		$16,778		$89
b. January FY 2023 pay increase & benefits		$13,507		$16,778		$456
c. Paid days adjustment		$13,507		$16,778		-$51
d. Differences attributable to change in FTE		$13,507		$16,778		$795
e. Payment for centrally furnished services		$624		$636		$12
f. Cost of laboratory supplies, materials, other expenses, and non-recurring costs		$12,576		$12,852		$276
Subtotal						$1,578
Subtotal, Built-in						$2,120

CHANGES	FY 2022 CR No.	FY 2022 CR Amount	FY 2023 President's Budget No.	FY 2023 President's Budget Amount	Program Change from FY 2022 CR No.	Program Change from FY 2022 CR Amount
B. Program:						
1. Research Project Grants:						
a. Noncompeting	446	$193,183	454	$196,854	8	$3,670
b. Competing	164	$79,978	159	$77,589	-5	-$2,388
c. SBIR/STTR	37	$15,356	38	$15,731	1	$375
Subtotal, RPGs	647	$288,517	651	$290,174	4	$1,657
2. Research Centers	28	$35,584	28	$36,260	0	$676
3. Other Research	98	$11,178	100	$11,390	2	$212
4. Research Training	215	$10,911	219	$11,111	4	$200
5. Research and development contracts	9	$17,328	9	$17,578	0	$250
Subtotal, Extramural		$363,518		$366,514		$2,996
6. Intramural Research	37	$20,503	37	$22,712	0	$1,666
7. Research Management and Support	87	$26,707	92	$30,267	5	$1,982
8. Construction		$0		$0		$0
9. Buildings and Facilities		$0		$0		$0
Subtotal, Program	124	$410,728	129	$419,493	5	$6,645
Total built-in and program changes						$8,765

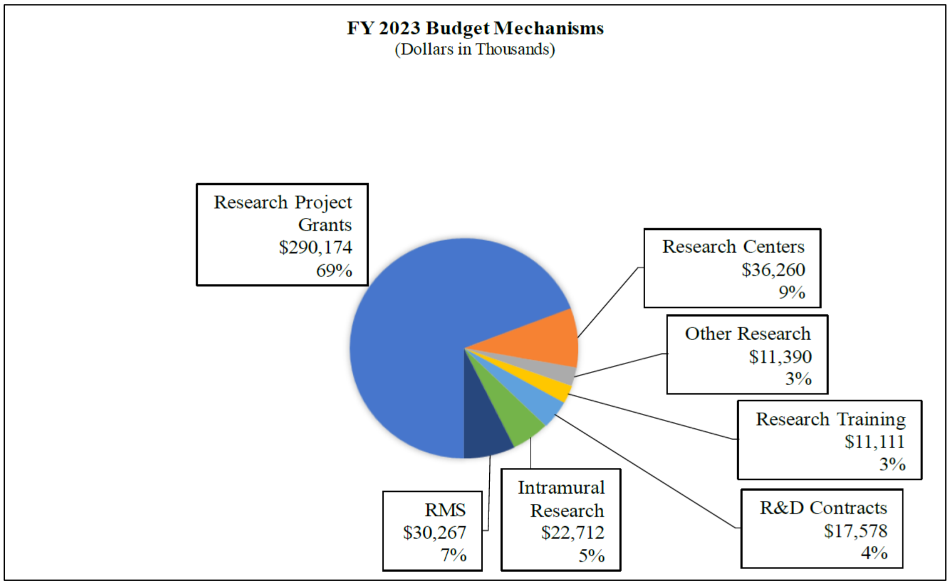
Budget Graphs

History of Budget Authority and FTEs:

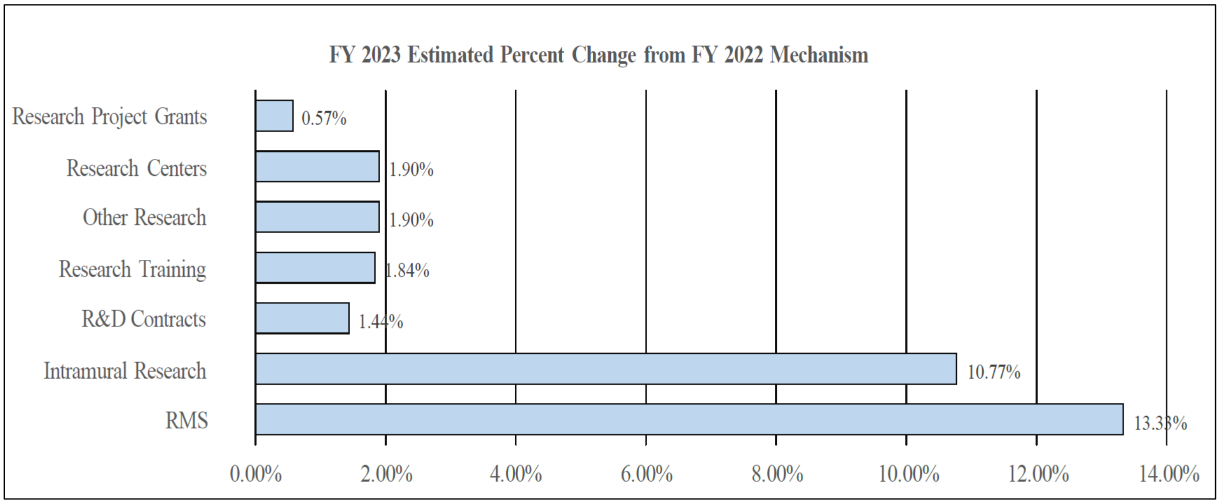




Distribution by Mechanism:



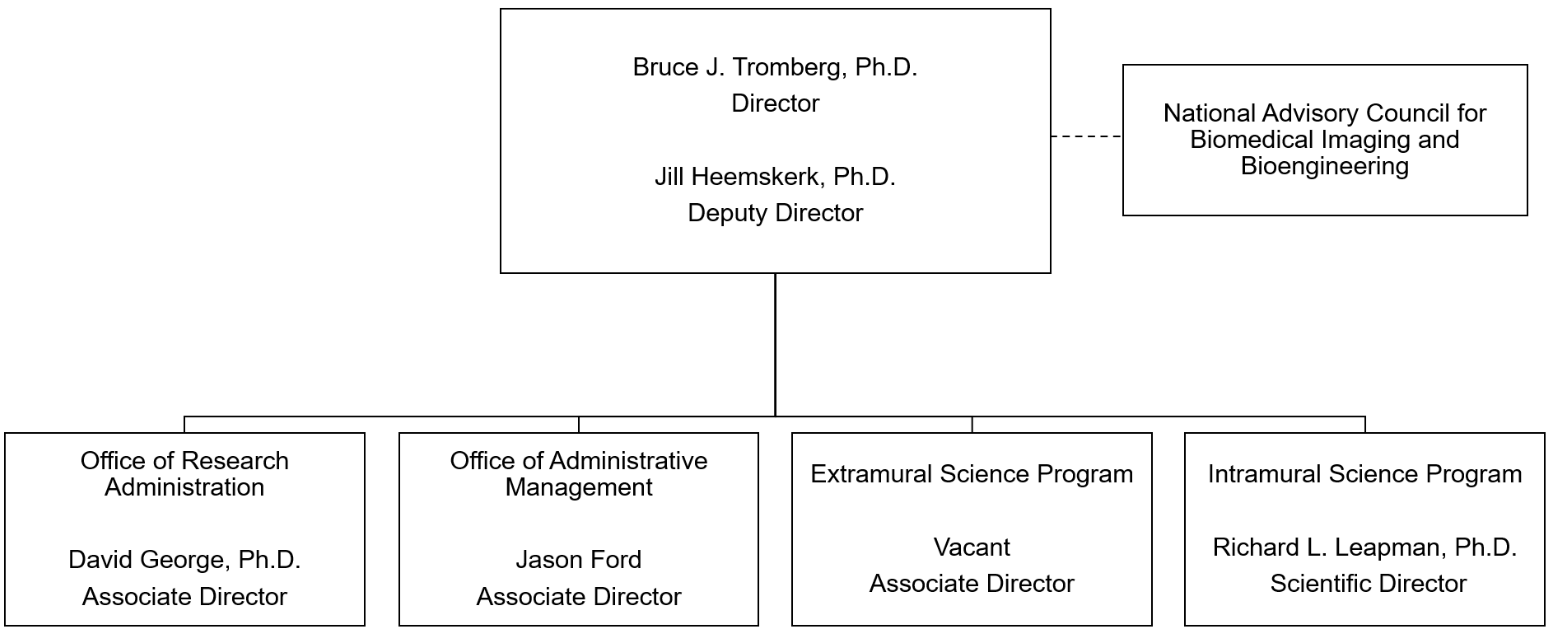
Change by Selected Mechanisms:



Organizational Chart

National Institute of Biomedical Imaging and Bioengineering

NIBIB 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 2021 Final		FY 2022 CR		FY 2023 President's Budget		FY 2023 +/- FY 2022 CR	
Extramural Research	**FTE**	**Amount**	**FTE**	**Amount**	**FTE**	**Amount**	**FTE**	**Amount**
Detail								
Discovery Science and Technology		$100,495		$100,652		$101,482		$830
Applied Science and Technology		$183,743		$184,030		$185,547		$1,517
Interdisciplinary Training		$17,781		$17,809		$17,956		$147
Health Informatics Technology		$60,931		$61,027		$61,529		$503
Subtotal, Extramural		**$362,952**		**$363,518**		**$366,514**		**$2,996**
Intramural Research	**25**	**$20,314**	**37**	**$20,503**	**37**	**$22,712**	**0**	**$2,209**
Research Management & Support	**72**	**$26,228**	**87**	**$26,707**	**92**	**$30,267**	**5**	**$3,560**
TOTAL	**97**	**$409,493**	**124**	**$410,728**	**129**	**$419,493**	**5**	**$8,765**

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

Justification of Budget Request

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 2021 Final	FY 2022 Continuing Resolution	FY 2023 President's Budget	FY 2023 +/- FY 2022
BA	$409,493,000	$410,728,000	$419,493,000	$8,765,000
FTE	97	124	129	5

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

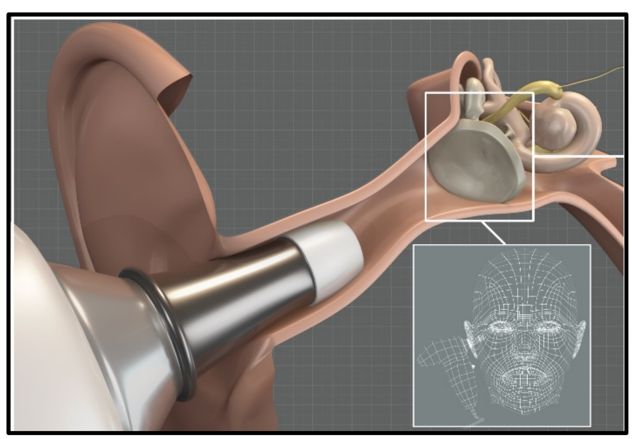
Overall Budget Policy: The FY 2023 President's Budget request for NIBIB is $419.5 million, an increase of $8.8 million or 2.1 percent compared with the FY 2022 CR level.

Program Descriptions

The National Institute of Biomedical Imaging and Bioengineering's core areas of research to engineer the future of health are housed in extramural research divisions and the intramural research program. Research areas of interest include sensing and imaging, engineered biosystems, advanced diagnostics and therapies, data science and computation, and the training of a diverse bioengineering workforce. In all these areas, NIBIB supports technology development from basic research that seeks to answer fundamental problems to the commercialization of products that solve a defined clinical need. Throughout this research spectrum, an engineering approach provides a unique lens to solve a range of healthcare problems and to connect the resulting solutions to improve public health.

Applied Science and Technology

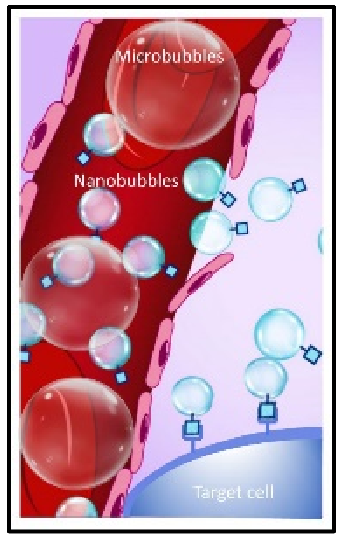
NIBIB-supported research develops innovative biomedical imaging and sensing technologies that advance our understanding of biological and disease processes to improve the effectiveness and accessibility of diagnostics, image-guided therapies, and monitoring of human health. Additionally, the program is harnessing data science approaches such as AI to create new tools for early detection of disease and personalized therapies.



Optical coherence tomography device for diagnosing middle ear infection. Credit: Boppart laboratory at University of Illinois Urbana-Champaign

An example of this type of research is improving the diagnosis of pediatric ear infections, a very common disease in children throughout the world. If diagnosed accurately, appropriate treatment can be delivered, and the overuse of antibiotics can be prevented. To do this, a physician uses a standard otoscope to look for fluid in the middle ear, which is often difficult to see. If an infection is not detected, it can lead to the formation of a biofilm, or a community of microorganisms including bacteria, which protects the bacteria from antibiotic treatments, making the infection harder to treat. If not properly treated or managed, these infections can lead to the need for expensive surgeries. Researchers are investigating the use of optical coherence tomography (OCT), a noninvasive imaging technique that uses near-infrared light, to visualize the middle ear and detect the presence of fluid or a biofilm. Recent advances include making the technology portable and utilizing a machine learning algorithm to help improve clinicians' ability to diagnose ear infections and provide the most effective treatment right away.

Improved imaging can help clinicians plan biopsies and surgeries, which may lead to better detection of high-grade tumors and tumor staging. Ultrasound imaging can be enhanced with the use of contrast agents, which are tiny bubbles filled with gas that enhance the reflection of ultrasound waves and improve the quality of ultrasound images. While useful for some imaging purposes, contrast agents used today are limited by the fact that they only stay in the bloodstream for up to 10 minutes, and, due to their relatively large size, their use is limited to larger vasculature areas. To address these limitations, researchers are developing customizable contrast agents using nanobubbles, so named because their size is measured in nanometers. Compared with current agents that use microbubbles, nanobubbles are much smaller, allowing them to fit into tiny capillaries and seep out of leaky blood vessels that often surround tumors, providing greater detail on images. Researchers also are working to alter how the ultrasound waves are reflected by manipulating the shell of the nanobubble to make it more stiff or more elastic. By controlling the elasticity, and potentially other characteristics of the nanobubble shell, the researchers may be able to develop customized bubbles for specific clinical applications, including nanobubbles that can target specific types of cells.



SMALLER NANOBUBBLES CAN FLOW OUT OF LEAKY BLOOD VESSELS, WHILE MICROBUBBLES ARE CONFINED TO THE VASCULATURE. SCHEMATIC ADAPTED, ORIGINAL BY ERIKA WOODRUM

ADVANCES IN FOCUSED ULTRASOUND FOR TREATMENT

NIBIB support for recent advances related to focused ultrasound is helping to improve treatment for a range of neurological diseases. Current neuromodulation techniques to treat disorders such as Alzheimer's, Parkinson's, epilepsy, and others are invasive and, while somewhat effective, come with many risks. NIBIB's focused ultrasound program for treating neurological diseases and disorders is finding ways to provide or deliver treatment that is noninvasive and targeted to a specific area of concern. These methods do not require surgery and are, therefore, lower risk.

In one example, researchers used a specialized nanodroplet called a cavitation agent along with focused ultrasound as a drug delivery method to stimulate or suppress neurons in the brain. Stimulating or suppressing neurons is a known way to help alleviate symptoms of several diseases and disorders, yet current neuromodulation strategies face the challenge of having to safely cross the blood-brain barrier to effectively deliver therapies to the central nervous system. However, with this novel method tested in a rat model, neurostimulation and neurosuppression were achieved without disturbing the blood-brain barrier and allowed for the delivery of a lower drug dose. This method represents a more precise and less invasive approach to treatments such as deep brain and spinal cord stimulation.

Low-intensity focused ultrasound is also a way to modulate neurons directly to treat Parkinson's disease, epilepsy, or insomnia. One study found that excitatory neurons showed high sensitivity to ultrasound parameters, while inhibitory neurons did not. This research could lead to precise select targeting of both inhibitory and excitatory neurons, leading to the development of improved treatments for neurological disorders such as Parkinson's disease.

Another example of NIBIB-supported research in this area includes an imaging technique to help treat epilepsy. Epilepsy affects about 3 million Americans, yet anti-seizure drugs are not effective for nearly one-third of diagnosed individuals. For patients who do not respond to drugs, surgery—where a small section of the brain that is responsible for causing the trauma is removed—is the next best treatment. A main barrier to this procedure is the complexity of mapping the brain to determine precisely where the seizure onset zone is located. Current options to map the brain for surgery are not always clear enough to proceed with the surgery or are expensive and invasive. Researchers have been developing a new real-time mapping system that is noninvasive and achieves a higher resolution map using acoustoelectric brain imaging. This approach uses an ultrasound beam to quickly generate a real-time image of the brain and reveal with greater clarity the area of interest. As such, the technique overcomes limitations in conventional methods and could help guide surgeons while they remove the seizure onset zone. This new mapping technique could allow surgery to be an option for patients where, previously, a surgical option was limited due to poor mapping. This is one example illustrating how medical imaging can facilitate the visualization of tissues deep inside the body in the least invasive way possible.

An imaging modality on its own can be extremely beneficial for surgeons. Combining two common methods to produce medical images—light and sound—can enhance their applications and be even more useful. Up to 500,000 people in the United States have a chronic venous problem, such as diabetic ulcers, where blood flow to the wound is interrupted.[2] Surgical procedures can repair the damage, but it is difficult to see if proper blood flow returns after surgery. Current imaging

[2] Cleveland Clinic Health Library. my.clevelandclinic.org/health/diseases/17169-foot-and-toe-ulcers

technologies such as magnetic resonance imaging (MRI) and X-ray imaging are limited, as these techniques can visualize only small blood vessels at the wound site. Using a technique called photoacoustic tomography (PAT), researchers have developed a new way to image blood flow surrounding chronic leg ulcers following surgery. The PAT technique directs near-infrared light into the surgical area, which expands blood cells and generates sound waves. These sound waves are captured by an ultrasound machine and translated into an image of blood flow at the site of interest. Doctors then can compare PAT images before and after surgery to see if blood flow has been restored to the wound area. Researchers hope that PAT will be able to provide this important feedback in 2 weeks or less, as compared with the current feedback time of several months.

Budget Policy: The FY 2023 President's Budget request for Applied Science and Technology is $185.5 million, an increase of $1.5 million or 0.8 percent compared with the FY 2022 CR level.

Discovery Science and Technology

This Division supports development and demonstration of research in three key bioengineering domains: biomaterials, with applications in drug delivery, regenerative medicine, and tissue engineering to model disease and test treatments; synthetic biological systems, with applications such as programming of cells for immunotherapies and gut microbiome health; and bioelectronics, with applications in devices such as robotic prostheses and technologies for rehabilitation.

Much of this research shares the common element of a multidisciplinary bioengineering approach. An example involves the collaboration of bioengineers and physicians who are trying to gain a better understanding of the interaction between the surface proteins on platelets (cells that form clots to stop bleeding) and a cancerous tumor. With this understanding, new drug strategies that interrupt the spread of cancer throughout the body via blood cells could be developed. One new approach that researchers are undertaking is a multimodal tissue chip that models the properties of tumors and recreates what happens as platelets come near a tumor. They identified a protein on the surface of platelets that enabled interaction with the tumor and then tested a drug to inhibit this interaction. By inhibiting the interaction, the researchers were able to limit the potential for the tumor to metastasize. Researchers continue to make advances in organ-on-a-chip microdevices that enable discoveries in disease pathology and to test and identify optimal treatments, thus avoiding a trial-and-error approach for patients.

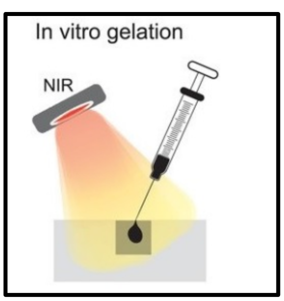


ILLUSTRATION OF A TYPE OF HYDROGEL THAT IS CONTROLLED BY NEAR-INFRARED LIGHT. ILLUSTRATION CREDIT: TEXAS A&M ENGINEERING

Hydrogels are used commonly in everyday products, such as contact lenses, and have been used in medicine for wound coverings that promote faster healing. Using these materials for drug delivery is of great interest but has been limited due to challenges in toxicity and the ability to activate them deep inside the body for targeted drug delivery. Researchers have developed a new type of hydrogel that uses near-infrared light to overcome these drawbacks. This new class of hydrogels absorb near-infrared light and convert this energy to heat. The heat can be used to trigger any number of processes. For example, drugs encased in the hydrogels can be released at specific amounts and precise locations in the body. Hydrogels like these also could be used to design tissues for repair and growth or coat implantable biomedical devices so they can be operated "on-demand" when needed.

NIBIB supports research that spans the technology development pipeline from basic, early-stage research to innovation and technology advances that are ripe for the next level of commercialization. This is exemplified in recent advances in prosthetics, which are developed to assist the more than 2 million people in the United States with an amputation.[3] NIBIB's support is moving these advances closer to the commercialization of an advanced prosthetic with a sense of touch. Building on prior research, investigators conducted a small clinical trial of an upper limb prosthetic that overcomes the lack of control seen in existing technologies. These new prosthetics connect to nerves in the remaining limbs above the site of amputation. A stimulator is placed in the limb and is connected to the prosthetics. When the stimulator activates the working nerves in the limb, it creates a sense of sense of touch, allowing for better control and use of the prosthetic. Another advance builds on similar research to use residual muscles and electrical signals for better control of an ankle prosthetic. In this example, individuals train residual muscles to operate a powered prosthetic for continuous control of their posture and balance. Improvements in robotics can improve the quality of life for those with an amputation and provide greater independence for the user.

The potential for wearables such as smartwatches to play a significant role in diagnosing and monitoring health and disease continues to expand, especially when combined with machine learning. For example, researchers performed a study in which data from smartwatches were collected from 54 participants over a 5-year period and analyzed using machine learning algorithms. Data collected through the smartwatch included heart rate, activity level, body temperature, and perspiration. Clinical results, including white blood cell count, were collected from the participants over the same 5-year period. When researchers compared the readings obtained by the smartwatch to the clinical tests, they found that irregular temperature and movement were symptomatic of diseases, which was confirmed by white blood count measurements. Many people may ignore these types of symptoms or not notice them at all. These preliminary results demonstrate how data from wearables could be a noninvasive, early indicator and alert the wearer of the need for clinical tests to identify illness promptly, perhaps before symptoms start.

Budget Policy: The FY 2023 President's Budget request for Discovery Science and Technology is $101.5 million, an increase of $0.8 million or 0.8 percent compared with the FY 2022 CR level.

Health Informatics and Technology

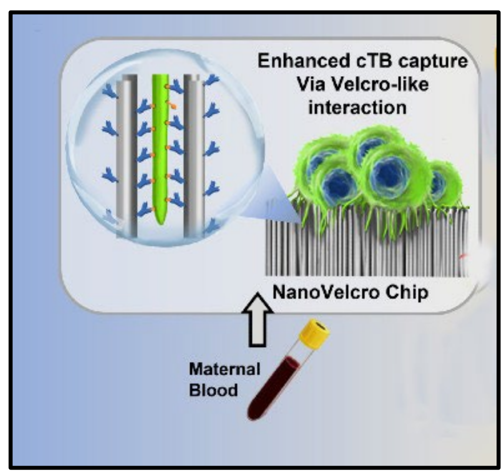
This Division supports the development of data science, information technology, and point-of-care technology for processing and evaluating complex biomedical information and developing solutions to real-world healthcare problems. Research in this area includes the development of practical, patient-centered applications for clinical decision-making support systems; POC or in-home diagnostics for treatment monitoring; improvements in medical imaging through advanced methodologies; next-generation intelligent image and data analysis tools, including artificial intelligence, and mobile health and telemedicine solutions.

[3] Ziegler-Graham K, MacKenzie EJ, Ephraim PL, Travison TG, Brookmeyer R. Estimating the prevalence of limb loss in the United States: 2005 to 2050. Arch Phys Med Rehabil. 2008;89(3):422-9.

One type of AI, called deep learning (DL), uses many layers of computation to form what is described as a deep neural network. This network is capable of learning from large amounts of complex, unstructured data. Examples of deep neural networks include voice-controlled virtual assistants and self-driving vehicles, which learn to recognize traffic signs. In medical imaging, advanced biomedical technologies such as MRI have produced an enormous volume of data about the human body. DL is proving to be particularly valuable for extracting useful information from large sets of MRI brain images and for combining this information with large arrays of additional clinical data to provide superior characterizations of the human brain. For example, the use of DL could help reveal potential biomarkers for diagnosing Alzheimer's disease or other neurological disorders or could shed light on changes in brain network connectivity that may lead to diseases such as schizophrenia. Researchers envision that DL models will provide unique information for a better understanding of how the human brain functions.

As the complexity and diversity of medical imaging technologies accelerate, optimizing new imaging innovations ideally would be achieved through clinical trials. However, such trials are often not feasible due to ethical limitations, expense, time requirements, or difficulty in recruiting enough subjects. The Center for Virtual Imaging Trials supported by NIBIB will assess the impact of medical imaging innovations on patient care. Virtual imaging trials (VITs) offer an alternative to evaluate and optimize medical imaging concepts and technologies more efficiently and economically. VIT simulates the patients in a clinical trial with digital human phantoms and the imaging systems being studied with a virtual scanner, thus emulating the clinical process without an actual clinical trial. Initial emphasis of the trials includes studies on cancer, cardiac problems, neurological diseases, and lung conditions using CT. Longer term efforts will focus on other imaging modalities, diverse clinical applications, and biochemical models and interventions.

This Division also supports the development of innovative POC diagnostic tests that are rapid, easy to use, portable, and affordable. One example is development of a blood test to diagnose placenta accreta spectrum (PAS), a life-threatening condition that occurs when the placenta remains attached to the uterus after childbirth. The condition can result in serious complications or, more tragically, the death of the mother. Currently, one-half to two-thirds of cases of PAS disorders remain undiagnosed before delivery. This new diagnostic test provides results within 24 hours. If PAS is detected early in pregnancy, patients can be referred to a high-risk pregnancy specialist. This test for detecting PAS does not rely on expensive imaging instruments or expertise, making it accessible for a range of POC settings, including in low-resource areas.



A DIAGNOSTIC BLOOD TEST USES A VELCRO CHIP TO CAPTURE A SPECIFIC CELL TYPE ASSOCIATED WITH THE ONSET OF PAS. CREDIT: UCLA

NIBIB's broad research support also includes NIH-wide initiatives and programs such as the NIH Common Fund's Harnessing Data Science for Health Discovery and Innovation in Africa (DS-I Africa) program. This program will leverage data science to help provide local solutions to

African countries' most immediate biomedical and public health problems. With a focus on community engagement, various research hubs will focus on specific priorities. One research hub will develop data science techniques to identify solutions for helping serve patients with multiple diseases, which significantly adds to the health burden in Africa. Another research hub will apply novel approaches to data assimilation and advanced AI and machine learning-based methods to improve both health outcomes for at-risk mothers and children and mental health outcomes for at-risk adolescents and young adults. The research training program pairs universities in Africa and the United States to develop the next generation of researchers working on fundamental data science, computational "omics," and imaging data science. This program will target graduate students and faculty from African institutions to build critical capacity in data science and drive the development of innovative solutions to identified health challenges. This collaborative effort has the potential to transform research throughout Africa and through its training programs to support data science leaders for the future.

Another collaboration to address major global health issues is the NIH Technology Accelerator Challenge (NTAC). Most recently, NTAC targeted major blood diseases that dramatically affect public health on a global scale—particularly in low- and middle-income country settings. One million dollars was awarded to six winners to support the design and development of noninvasive, handheld, digital technologies to detect and diagnose sickle cell disease, malaria, and anemia. Current efforts focus on maternal health and support the design and development of low-cost, point-of-care devices for the diagnosis of pregnancy-associated infections, hypertensive disease, hemorrhage, and placental issues. The lack of diagnostics for detecting these common, life-threatening conditions before and during childbirth is a major factor in the high rates of maternal morbidity and mortality in low-resource settings.

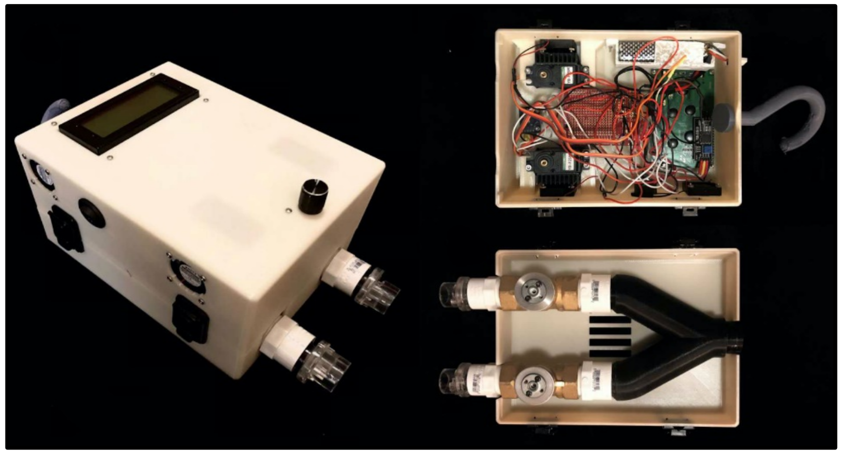
Budget Policy: The FY 2023 President's Budget request for Health Informatics and Technology is $61.5 million, an increase of $0.5 million or 0.8 percent compared with the FY 2022 CR level.

Interdisciplinary Training

This Division continues to invest in training the next generation of researchers, including investment in diversity programs and support for researchers throughout the career path. For undergraduates, NIBIB initiated the Enhancing Science, Technology, EnginEering, and Math Educational Diversity (ESTEEMED) training program. This effort supports educational activities that enhance the diversity of the biomedical research workforce through early preparation of students in STEM fields and fills a critical gap in support during the first two years of their undergraduate education. In addition to academic and research skill acquisition, the program offers career development, mentoring, and community building for participants. Through 2020, the ESTEEMED program provided support for 68 scholars at 6 different universities.

NIBIB also supports researchers from diverse backgrounds in their transition from postdoctoral research to independent investigators through the Maximizing Opportunities for Scientific and Academic Independent Careers (MOSAIC) Postdoctoral Career Transition Award to Promote Diversity. This NIH-wide program provides independent research support to scientific cohorts along with mentoring, networking, and professional development activities to help early-stage researchers achieve success.

One of NIBIB's signature programs engages undergraduate students in solving real-world healthcare problems. The Design by Biomedical Undergraduate Teams (DEBUT) Challenge in 2021 received 76 applications across 26 states and 47 universities. More than 400 students were engaged in this challenge and more than $100,000 was awarded. The top three prizes address a range of important healthcare problems. First prize was for the development of a medical device that allows multiple patients to be treated with a single ventilator but can deliver different pressures and volumes of air to each patient. This innovation addresses some of the safety concerns traditionally associated with co-ventilation. One application is supporting patients suffering from COVID-19. In addition, the device is pertinent to limited-resource scenarios such as rural areas, military settings, and natural disasters.



THE ECUOVENT DEVICE ALLOWS MULTIPLE PATIENTS TO BE SAFELY TREATED ON ONE VENTILATOR. SOURCE: UNIV. OF SOUTH FL. TEAM

The second prize was awarded to a team that designed a negative pressure pump used to treat low-pressure hydrocephalus (buildup of fluid in the brain) among patients who cannot be treated with the traditional shunt system. The third prize went to a team for their mobile phone app to monitor the progression of glaucoma. All student teams were successful in engaging the community and end users in the design and development of their innovations.

For the DEBUT Challenge, NIBIB partnered with other NIH Institutes, Centers, and Offices to recognize achievements that address solutions for HIV/AIDS; solutions that can be used in low-resource settings; and technologies for cancer prevention, diagnosis, and treatment. The Office of AIDS Research awarded a prize to a team that developed a 3D-printed point-of-care device designed for early diagnosis of HIV. The National Institute on Minority Health and Health Disparities selected a team that devised an inexpensive, POC sickle cell disease screening device designed to be implemented in low-to-middle-income healthcare settings. Finally, the National Cancer Institute prize went to an affordable colostomy bag that will benefit colon cancer patients after colon resection in low-resource settings.

The DEBUT program demonstrates real-life impact of bioengineering for undergraduate students and illustrates the breadth of talent in the future biomedical engineering workforce. Ongoing efforts are engaging and supporting researchers across the career span to maintain and improve the diversity and talent of the next generation of biomedical researchers.

Budget Policy: The FY 2023 President's Budget request for Interdisciplinary Training is $18.0 million, an increase of $0.1 million or 0.8 percent compared with the FY 2022 CR level.

Intramural Research Program

NIBIB's Intramural Research Program plays a key role in fulfilling the Institute's mission, particularly to advance knowledge in imaging and biomedical engineering using a combination of basic, translational, and clinical science, and to develop effective training programs in related fields. Some of the recent advancements have been a result of NIBIB researchers shifting part of their focus to help tackle the COVID-19 pandemic.

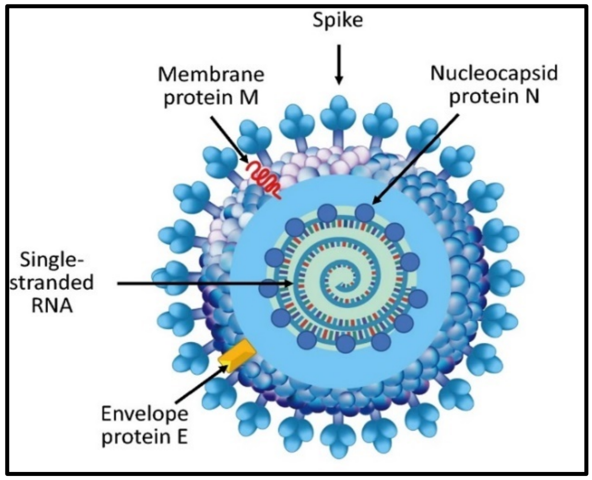


ILLUSTRATION OF COVID-19 PARTICLE AND RIBONUCLEOPROTEIN PARTICLES INCLUDING N PROTEIN INSIDE. CREDIT: WIKIMEDIA COMMONS

In one example, NIBIB researchers have sought greater knowledge of the replication process of SARS-CoV-2, the virus that causes COVID-19. The spike protein of the SARS-CoV-2 virus is now well known as the key to the virus attaching itself to cells and, thus, has been one basis for diagnosing the infection and developing vaccines. To supplement this work, NIBIB researchers also are focusing on another protein, the nucleocapsid protein, or N protein, which helps the virus replicate once it is inside a cell. Having a better understanding of the virus's lifecycle will offer clues to develop treatments that can stop the replication of the virus.

NIBIB researchers also have used their knowledge to address the pandemic by estimating the number of undiagnosed cases of COVID-19 in the country. They collaborated with scientists across and outside NIH to establish and analyze the first representative U.S. serosurvey of SARS-CoV-2. This study measured the antibody prevalence among participants who had not been diagnosed previously with a SARS-CoV-2 infection. The study estimates that by mid-July of 2020, 16.8 million people in the United States had an undiagnosed SARS-CoV-2 infection, almost five times the rate of diagnosed infections. This and ongoing studies to determine who has developed antibodies from infection and vaccination and how antibodies react to variants of the virus will help inform public health efforts to address the pandemic and to prepare for possible future pandemics.

Finally, NIBIB is 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. This NIBIB-led effort will focus on technology-driven interdisciplinary research and clinical translation in biomedical imaging, biosensing, engineered/synthetic biology, nano/biomaterials, AI, modeling, computation, and informatics. The Center will play a key role in informing the design and operation of future research programs, responding to public health challenges, and delivering tangible solutions to critical healthcare problems. The Center will create and support new education and training opportunities at NIH for biomedical imaging and bioengineering students and fellows at all levels.

Also central to BETA's mission will be evidence-driven approaches to expand diversity, equity, and inclusion within NIBIB's Intramural Research Program. This approach could serve as a model for recruiting diverse biomedical engineering talent to NIH. As such, the BETA Center

Director will serve a dual role as NIBIB's Associate Director for Scientific Diversity, Equity, and Inclusion. In this role, the BETA Center Director will be responsible for tracking, advancing, and coordinating NIBIB's efforts to increase diversity.

Budget Policy: The FY 2023 President's Budget request for the Intramural Research Program is $22.7 million, an increase of $2.2 million or 10.8 percent compared with the FY 2022 CR level.

Research Management and Support

Activities in research, management, and support contribute to achieving NIBIB's mission through efficient management and oversight of administrative operations, budget, communications, and strategic planning. 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.

Budget Policy: The FY 2023 President's Budget request for Research Management and Support is $30.3 million, an increase of $3.6 million or 13.3 percent compared with the FY 2022 CR level.

Appropriations History

NATIONAL INSTITUTES OF HEALTH
National Institute of Biomedical Imaging and Bioengineering

Appropriations History

Fiscal Year	Budget Estimate to Congress	House Allowance	Senate Allowance	Appropriation
2014	$338,892,000		$337,728,000	$329,172,000
Rescission				$0
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 *	$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	$410,728,000
Rescission				$0
2023	$419,493,000			

* Budget Estimate to Congress includes mandatory financing.

Authorizing Legislation

NATIONAL INSTITUTES OF HEALTH
National Institute of Biomedical Imaging and Bioengineering

Authorizing Legislation

<table>
<tr><th></th><th>PHS Act/ Other Citation</th><th>U.S. Code Citation</th><th>2022 Amount Authorized</th><th>FY 2022 CR</th><th>2023 Amount Authorized</th><th>FY 2023 President's Budget</th></tr>
<tr><td>Research and Investigation</td><td>Section 301</td><td>42§241</td><td>Indefinite</td><td rowspan="2">$410,728,000</td><td>Indefinite</td><td rowspan="2">$419,493,000</td></tr>
<tr><td>National Institute of Biomedical Imaging and Bioengineering</td><td>Section 401(a)</td><td>42§281</td><td>Indefinite</td><td>Indefinite</td></tr>
<tr><td>Total, Budget Authority</td><td></td><td></td><td></td><td>$410,728,000</td><td></td><td>$419,493,000</td></tr>
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NATIONAL INSTITUTES OF HEALTH
National Institute of Biomedical Imaging and Bioengineering

Amounts Available for Obligation*
(Dollars in Thousands)

Source of Funding	FY 2021 Final	FY 2022 CR	FY 2023 President's Budget
Appropriation	$410,728	$410,728	$419,493
Secretary's Transfer	-$1,233	$0	$0
OAR HIV/AIDS Transfers	-$2	$0	$0
Subtotal, adjusted budget authority	$409,493	$410,728	$419,493
Unobligated balance, start of year	$0	$0	$0
Unobligated balance, end of year (carryover)	$0	$0	$0
Subtotal, adjusted budget authority	**$409,493**	**$410,728**	**$419,493**
Unobligated balance lapsing	-$32	$0	$0
Total obligations	$409,461	$410,728	$419,493

* Excludes the following amounts (in thousands) for reimbursable activities carried out by this account:
FY 2021 - $2,964 FY 2022 - $5,100 FY 2023 - $5,100

Budget Authority by Object Class

NATIONAL INSTITUTES OF HEALTH
National Institute of Biomedical Imaging and Bioengineering

Budget Authority by Object Class*
(Dollars in Thousands)

		FY 2022 CR	FY 2023 President's Budget	FY 2023 +/- FY 2022
Total compensable workyears:				
	Full-time equivalent	124	129	5
	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	$136	$138	$3
	Average salary, Commissioned Corps (42 U.S.C. 207)	$0	$0	$0
	Average salary of ungraded positions	$204	$208	$4
	OBJECT CLASSES	**FY 2022 CR**	**FY 2023 President's Budget**	**FY 2023 +/- FY 2022**
	Personnel Compensation			
11.1	Full-Time Permanent	$9,047	$12,804	$3,757
11.3	Other Than Full-Time Permanent	$3,706	$3,844	$139
11.5	Other Personnel Compensation	$558	$579	$21
11.7	Military Personnel	$0	$0	$0
11.8	Special Personnel Services Payments	$1,719	$1,783	$64
11.9	**Subtotal Personnel Compensation**	**$15,030**	**$19,010**	**$3,981**
12.1	Civilian Personnel Benefits	$5,154	$6,355	$1,202
12.2	Military Personnel Benefits	$12	$12	$0
13.0	Benefits to Former Personnel	$0	$0	$0
	Subtotal Pay Costs	**$20,195**	**$25,378**	**$5,183**
21.0	Travel & Transportation of Persons	$7	$8	$0
22.0	Transportation of Things	$47	$48	$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	$49	$50	$1
24.0	Printing & Reproduction	$4	$4	$0
25.1	Consulting Services	$8,462	$8,633	$171
25.2	Other Services	$5,157	$5,270	$113
25.3	Purchase of Goods and Services from Government Accounts	$23,731	$24,201	$471
25.4	Operation & Maintenance of Facilities	$0	$0	$0
25.5	R&D Contracts	$209	$213	$5
25.6	Medical Care	$5	$5	$0
25.7	Operation & Maintenance of Equipment	$2,909	$2,973	$64
25.8	Subsistence & Support of Persons	$0	$0	$0
25.0	**Subtotal Other Contractual Services**	**$40,472**	**$41,296**	**$824**
26.0	Supplies & Materials	$842	$861	$19
31.0	Equipment	$2,403	$2,456	$53
32.0	Land and Structures	$646	$661	$14
33.0	Investments & Loans	$0	$0	$0
41.0	Grants, Subsidies, & Contributions	$346,062	$348,732	$2,670
42.0	Insurance Claims & Indemnities	$0	$0	$0
43.0	Interest & Dividends	$0	$0	$0
44.0	Refunds	$0	$0	$0
	Subtotal Non-Pay Costs	**$390,533**	**$394,115**	**$3,582**
	Total Budget Authority by Object Class	**$410,728**	**$419,493**	**$8,765**

* 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 2022 CR	FY 2023 President's Budget	FY 2023 +/- FY 2022
Personnel Compensation			
Full-Time Permanent (11.1)	$9,047	$12,804	$3,757
Other Than Full-Time Permanent (11.3)	$3,706	$3,844	$139
Other Personnel Compensation (11.5)	$558	$579	$21
Military Personnel (11.7)	$0	$0	$0
Special Personnel Services Payments (11.8)	$1,719	$1,783	$64
Subtotal, Personnel Compensation (11.9)	**$15,030**	**$19,010**	**$3,981**
Civilian Personnel Benefits (12.1)	$5,154	$6,355	$1,202
Military Personnel Benefits (12.2)	$12	$12	$0
Benefits to Former Personnel (13.0)	$0	$0	$0
Subtotal Pay Costs	**$20,195**	**$25,378**	**$5,183**
Travel & Transportation of Persons (21.0)	$7	$8	$0
Transportation of Things (22.0)	$47	$48	$1
Rental Payments to Others (23.2)	$0	$0	$0
Communications, Utilities, & Misc. Charges (23.3)	$49	$50	$1
Printing & Reproduction (24.0)	$4	$4	$0
Other Contractual Services			
Consultant Services (25.1)	$8,436	$8,608	$171
Other Services (25.2)	$5,157	$5,270	$113
Purchase of Goods and Services from Government Accounts (25.3)	$23,731	$24,201	$471
Operation & Maintenance of Facilities (25.4)	$0	$0	$0
Operation & Maintenance of Equipment (25.7)	$2,909	$2,973	$64
Subsistence & Support of Persons (25.8)	$0	$0	$0
Subtotal Other Contractual Services	**$40,233**	**$41,052**	**$819**
Supplies & Materials (26.0)	$842	$861	$19
Subtotal Non-Pay Costs	**$41,182**	**$42,022**	**$840**
Total Administrative Costs	**$61,377**	**$67,401**	**$6,023**

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/DIVISION	FY 2021 Final			FY 2022 CR			FY 2023 President's Budget		
	Civilian	Military	Total	Civilian	Military	Total	Civilian	Military	Total
Extramural Science Program									
Direct:	21	-	21	22	-	22	23	-	23
Reimbursable:	1	-	1	1	-	1	1	-	1
Total:	22	-	22	23	-	23	24	-	24
Intramural Science Program									
Direct:	25	-	25	36	-	36	37	-	37
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	25	-	25	36	-	36	37	-	37
Office of Administrative Management									
Direct:	30	-	30	43	-	43	44	-	44
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	30	-	30	43	-	43	44	-	44
Office of Research Administration									
Direct:	3	-	3	4	-	4	5	-	5
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	3	-	3	4	-	4	5	-	5
Office of the Director									
Direct:	17	-	17	18	-	18	19	-	19
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	17	-	17	18	-	18	19	-	19
Total	97	-	97	124	-	124	129	-	129
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
2019	13.1
2020	12.7
2021	13.0
2022	13.0
2023	13.0

Detail of Positions

NATIONAL INSTITUTES OF HEALTH
National Institute of Biomedical Imaging and Bioengineering

Detail of Positions *

GRADE	FY 2021 Final	FY 2022 CR	FY 2023 President's Budget
Total, ES Positions	0	0	0
Total, ES Salary	$0	$0	$0
General Schedule			
GM/GS-15	16	20	21
GM/GS-14	26	30	31
GM/GS-13	20	24	27
GS-12	4	8	10
GS-11	5	6	5
GS-10	1	2	1
GS-9	3	4	3
GS-8	0	0	0
GS-7	0	0	0
GS-6	0	0	0
GS-5	0	0	1
GS-4	1	1	1
GS-3	2	2	2
GS-2	0	0	0
GS-1	0	0	0
Subtotal	78	97	102
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	37	50	52
Total permanent positions	75	89	92
Total positions, end of year	115	147	154
Total full-time equivalent (FTE) employment, end of year	97	124	129
Average ES salary	$0	$0	$0
Average GM/GS grade	13.0	13.0	13.0
Average GM/GS salary	$131,941	$135,503	$138,010

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