



National Heart, Lung, and Blood Institute

CONGRESSIONAL JUSTIFICATION
FY 2025

Department of Health and Human Services
National Institutes of Health



National Heart, Lung,
and Blood Institute

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DEPARTMENT OF HEALTH AND HUMAN SERVICES

NATIONAL INSTITUTES OF HEALTH

National Heart, Lung, and Blood Institute (NHLBI)

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General Notes

1. FY 2024 enacted levels cited in this document are based on the Continuing Resolution in effect at the time of budget preparation (Public Law 118-35) and do not include HIV/AIDS transfers.
2. Detail in this document may not sum to the subtotals and totals due to rounding.

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Director's Overview

The National Heart, Lung, and Blood Institute (NHLBI) supports research to prevent and treat heart, lung, blood, and sleep (HLBS) disorders, which continue to be the leading causes of death and disability in the United States. NHLBI's portfolio has had a longstanding commitment to basic science, epidemiological (population) studies, clinical trials, implementation science, and health education and dissemination efforts. In recent years, the Institute's portfolio has grown to include initiatives in emergent fields such as artificial intelligence/machine learning, precision medicine, and data science in order to translate fundamental science findings into new treatments for common and rare diseases and conditions within NHLBI's purview. It is evident, now more than ever, that factors such as social determinants of health and environmental influences greatly impact HLBS health. Moving forward, NHLBI will continue to deepen and expand its focus on regional and rural HLBS health disparities using a community-based approach to engage underserved populations in the research endeavor in order to improve public health, health equity and healthier, more resilient communities. In FY 2025, NHLBI will support a robust spectrum of research and technology to spur the development of innovative, effective ways to prevent, diagnose, treat, and ultimately cure HLBS diseases and disorders.

Partnering with Under-Resourced Communities through Community-Engaged Research Initiatives

Working directly with communities and populations that have a high prevalence of HLBS conditions necessitates partnering with trusted local community members and organizations. Every community has its own needs, priorities, and processes that researchers must understand in order to create positive change. NHLBI has a long history of outreach to rural, tribal, and other under-resourced communities with high rates of HLBS conditions to study the reasons for these disparities and develop health interventions specifically for their community or region.

Maternal morbidity and mortality have risen to crisis levels, an extremely troubling indicator of health in the United States. In 2021, the most recent year for which complete data are available, more than 1,200 women died of causes related to pregnancy in the United States.¹ These numbers have steadily increased in the last few years, with 754 and 861 deaths in 2019 and 2020, respectively.² Adverse pregnancy outcomes, including death, for Black women continue to be significantly higher than rates for other racial and ethnic groups. American Indian, Alaska Native, Native Hawaiian, and other Pacific Islander populations also experience increased risk.³ NHLBI supports multiple programs in under-resourced communities designed to help people before, during, and after pregnancy. The **Maternal Health Community Implementation Project (MH-CIP)**⁴ is a community-driven initiative that uses evidence-based interventions, such as regular blood pressure readings, to help lower cardiac risk factors before and during pregnancy. Through this program, NHLBI supports four community coalitions, comprised of research organizations and community partners, to engage communities and pilot-test the

¹ [www.cdc.gov/nchs/data/hestat/maternal-mortality/2021/maternal-mortality-rates-2021.htm#:~:text=In%202021%2C%20the%20maternal%20mortality,\(Figure%201%20and%20Table\).](https://www.cdc.gov/nchs/data/hestat/maternal-mortality/2021/maternal-mortality-rates-2021.htm#:~:text=In%202021%2C%20the%20maternal%20mortality,(Figure%201%20and%20Table).)

² www.cdc.gov/nchs/data/hestat/maternal-mortality/2021/maternal-mortality-rates-2021.htm#ref2

³ jamanetwork.com/journals/jama/article-abstract/2806661

⁴ maternalhealthcip.org/

implementation of proven interventions in vulnerable populations. In addition to community coalitions, MH-CIP includes patient advocacy groups and subject matter experts in both governance and guidance roles.

Another initiative, **Early Intervention to Promote the Cardiovascular Health of Mothers and Children (ENRICH)**,⁵ is a partnership with other federal agencies (Health Resources and Services Administration, Administration for Children and Families), and certified local home visiting programs. The initiative promotes cardiovascular health in mothers and children up to five years old. Launched in 2022, ENRICH researchers work directly with communities that have a high burden of cardiovascular disease; these include communities of lower socioeconomic status, tribal nations, and those who live and work in low-resource areas. The initiative includes seven clinical centers around the country that are investigating ways to lower the incidence of cardiovascular risk factors, including examining social determinants of health, obesity, hypertension, diabetes, and those at risk of developing pre-eclampsia or gestational diabetes.

Additionally, adverse pregnancy outcomes can continue to impact future health. NHLBI supports research that examines how to prevent or manage cardiovascular risk factors and disease in women across their lifespan. The **nuMoM2b Heart Health Study**, co-funded by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development, is studying the effects of pregnancy complications on future cardiovascular health, including social factors that correlate with the future heart health of new parents, especially in communities of color.⁶

The **Community Engagement Alliance (CEAL)**⁷ initiative was developed during the COVID-19 pandemic to reach out to communities across the country that bore disproportionate burdens of COVID-19 infection. The goal was to create meaningful engagement within the community that would raise awareness of the risks of COVID-19 and the value of mitigation strategies, including vaccination. NHLBI learned valuable lessons about the important role that community-based health models play in addressing public health information gaps and developing interventions that lead to significant, sustainable change. CEAL created spaces for all—patients, advocates, community leaders, scientific partners, and others—to leverage the power of community involvement to enhance the public’s health. As a testament to its success, during the COVID-19 pandemic, CEAL teams recruited over 1,000 partners who worked to vaccinate over 300,000 people, host over 3,300 community events, and recruit more than 675 participants to NIH clinical trials.

Because of this success, CEAL funding has been sustained in order to leverage it as a comprehensive research platform to address health disparities. Additional scientific initiatives have already been incorporated, and other NIH Institutes are also leveraging it to address other major issues of public health. Some examples include MH-CIP (mentioned above), the **Implementing a Maternal Health and Pregnancy Outcomes Vision for Everyone (IMPROVE)** initiative,⁸ and the **Climate Change and Health** initiative.⁹ CEAL has become a powerful, strategic research resource that enables NHLBI and other NIH Institutes to work alongside and within communities to meet their missions.

⁵ www.nhlbi.nih.gov/grants-and-training/funding-opportunities/foa-ENRICH-FAQ

⁶ numom2b.org/

⁷ covid19community.nih.gov/

⁸ www.nichd.nih.gov/research/supported/IMPROVE

⁹ www.nih.gov/climateandhealth

Research to Reduce High Rates of Health Disparities

NHLBI is committed to reaching out to communities with the highest rates of chronic HLBS diseases in the United States, which is often a function of social determinants and locality. Some communities encounter barriers to accessing services, lack familiarity with the health care delivery system, or face a shortage of readily available providers.^{10,11}

Rural Health

According to the U.S. Census Bureau, approximately 60 million people, or one in five Americans, live in rural areas.¹² It is well established that there is no higher burden of disease and disparities than in rural America. A recent study conducted by the HHS Healthy People initiative found that health care quality and access was the top priority for health in rural America.¹³ This is especially true for heart health. NHLBI researchers have found that rural participants have an increased risk of heart failure compared with urban participants¹⁴ and appear to pass down that risk generationally because of health behaviors related to diet and smoking status.¹⁵ NHLBI strongly supports finding ways to bring care to where people are, which includes funding research to address disparities experienced by rural populations. A recent NHLBI-funded study showed that home blood pressure monitoring could not only prevent heart attacks, but also save people money spent on clinic visits. Another NHLBI researcher developed low-field magnetic resonance imaging (MRI) technology, which provides access to valuable high-quality imaging capabilities in communities with limited health care facilities.¹⁶

Blood Safety

A pivotal part of the country's public health is ensuring that the nation's blood supply is safe. The goal of NHLBI's **Recipient Epidemiology and Donor Evaluation Study (REDS)** program,¹⁷ founded in 1989, is to improve the safety and effectiveness of blood transfusion therapies. Now in its fourth phase, the program also has a new focus on previously understudied populations, such as children, newborns, and pregnant women. Additionally, this phase also extends the Brazilian sickle cell disease cohort that was established in the previous phase to evaluate transfusion practices and associated clinical outcomes in sickle cell disease. Importantly, the Brazilian transfusion program continues its monitoring and surveillance efforts for Zika, chikungunya, dengue, and other emerging viral threats to the blood supply.

Lung Disease Treatment

Distinctions between populations for assessing normal lung function or indicators of disease can have broad implications for health equity. Consequently, researchers have been studying how to optimize race-neutral equations for pulmonary functioning. For example, patients who are

¹⁰ www.hhs.gov/guidance/sites/default/files/hhs-guidance-documents/006_Serving_Vulnerable_and_Underserved_Populations.pdf

¹¹ toolkit.ncats.nih.gov/glossary/underserved-group/

¹² www.census.gov/library/stories/2017/08/rural-america.html#:~:text=About%2060%20million%20people%2C%20or,the%20official%20Census%20Bureau%20classification.

¹³ www.ncbi.nlm.nih.gov/pmc/articles/PMC10060738/

¹⁴ jamanetwork.com/journals/jamacardiology/article-abstract/2800877?resultClick=1

¹⁵ www.ahajournals.org/doi/10.1161/JAHA.122.027881?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%20pubmed#d1e3398

¹⁶ www.nhlbi.nih.gov/science/mri-technology

¹⁷ www.nhlbi.nih.gov/science/recipient-epidemiology-and-donor-evaluation-study-reds-program

recategorized as having elevated risks for lung disease may receive a diagnosis and be treated earlier for conditions such as chronic obstructive pulmonary disease (COPD). In other cases, they may meet criteria for or be more likely to be considered for receiving a lung transplant. However, overestimating impaired lung function could prevent people from receiving medical clearance to participate in physical activities. After comparing equations for pulmonary function tests, which assess lung function, researchers found that race-neutral equations were more likely to identify Black adults as showing early indicators of disease than when a race-specific equation was used.¹⁸ Conversely, the race-neutral equation identified fewer white adults as having signs of respiratory problems.

Continuing COVID-19 Research

The effects of COVID-19 will be felt around the world for decades to come. NHLBI is dedicated to researching long-term effects of the disease, including multisystem inflammatory disease in children (MIS-C), a rare condition associated with the virus that causes COVID-19 and causes different internal and external body parts to become inflamed.¹⁹ A 2021 study conducted by the Centers for Disease Control and Prevention found that non-Hispanic Black and Hispanic children were 83 percent and 39 percent more likely to experience MIS-C, respectively, even after controlling for COVID-19 disparities and geographic variations.²⁰ Most children recover from the condition, but researchers did not know if the children were able to be vaccinated against the virus that causes COVID-19 without increased risk of adverse reactions. In 2023, researchers with NHLBI's **Long-Term Outcomes after the Multisystem Inflammatory Syndrome In Children (MUSIC)** study found that patients with a history of MIS-C were at no increased risk of adverse events following COVID-19 vaccination.²¹ NHLBI also continues to be a leader of NIH's **Researching COVID to Enhance Recovery (RECOVER)** initiative, which studies the long-term effects of infection with the virus that causes COVID-19.

Leveraging Cutting-edge Technologies and Data to Tackle Chronic Conditions

In addition to these population-based approaches, NHLBI also leverages innovative technology and data collection techniques to understand, diagnose, treat, and prevent complex health issues. The goal is to deeply explore the underlying biomolecular mechanisms of HLBS conditions and the complex interaction with individual biology, genetic inheritance, environment, and lifestyle. NHLBI is prioritizing advancing data science, including enabling integration of multi-dimensional datasets across multiple research studies and health-care systems (the latter of which provides a rich resource of electronic health record data), as well as the development and use of novel analytic tools and machine-ready technologies in developing predictive models and embedded diagnostics and clinical decision support. Additionally, researchers use a cloud-based ecosystem that offers researchers data, analytic tools, applications, and workflows in secure workspaces—all toward ensuring that people across the lifespan are able to access the right treatment at the right time.

¹⁸ jamanetwork.com/journals/jamanetworkopen/fullarticle/2805470

¹⁹ www.cdc.gov/mis/misc.html#:~:text=MIS%2DC%20causes%20different%20internal,get%20better%20with%20medical%20care.

²⁰ www.ncbi.nlm.nih.gov/pmc/articles/PMC8505134/

²¹ jamanetwork.com/journals/jamanetworkopen/fullarticle/2799939

At the heart of these efforts are NHLBI's vast data science and sharing capabilities. The **Trans-Omics for Precision Medicine (TOPMed) Program**²² generates scientific resources that improve the understanding of HLBS disorders and advance precision medicine. The TOPMed program integrates whole-genome sequencing and other -omics data (e.g., metabolic profiles, epigenomics, protein and RNA expression patterns) with molecular, behavioral, imaging, environmental, and clinical data. TOPMed data are available in **BioData Catalyst**,²³ a cloud-based ecosystem that allows researchers to share scientific data from NHLBI-funded research so they and others can reproduce findings and reuse data. By increasing access to data and innovative analytic capabilities, the NHLBI is accelerating the reproducibility of biomedical research to drive scientific advances.

A detailed and comprehensive understanding of organs and tissues is critical to identifying novel treatment strategies tailored to each individual. NHLBI's **Molecular Atlas of Lung Development Program (LungMAP)** uses cutting-edge technology and precision medicine to create an open-source molecular atlas of the lung that consists of both molecular and cellular maps of the organ. This flagship program enables better understanding of human lung development and will lead to novel therapeutic targets for lung diseases.

Another key to preventing disease progression is using biomarkers to detect people who are at increased risk for a number of diseases and disorders. By sequencing the DNA of blood samples from individuals who were in remission from a specific type of leukemia, NHLBI researchers recently found that the detection of unique gene variants in the blood could predict which patients were more likely to relapse and have worse survival outcomes.²⁴ This minimally invasive technology to detect trace levels of residual disease has great potential as a precision diagnostic tool to prevent and treat non-malignant chronic conditions, such as sickle cell disease.

NHLBI believes that a comprehensive, multifaceted approach is required to prevent disease and improve health outcomes in the United States. The Institute's proactive approach empowers communities by making health care easier to access, promoting resilience, and utilizing the latest data to promote health. Despite the many advances NHLBI-supported research has made, we continue to strive toward the betterment of health for everyone in the United States.

²² topmed.nhlbi.nih.gov/

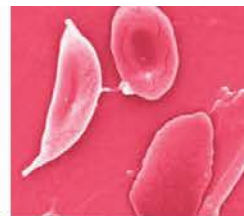
²³ biodatacatalyst.nhlbi.nih.gov/

²⁴ jamanetwork.com/journals/jama/fullarticle/2802059?guestAccessKey=9e9d4fbc-d6f8-4dfa-993c-f1ca98c07380&utm_source=For_The_Media&utm_medium=referral&utm_campaign=ftm_links&utm_content=tf1&utm_term=030723

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National Heart, Lung,
and Blood Institute



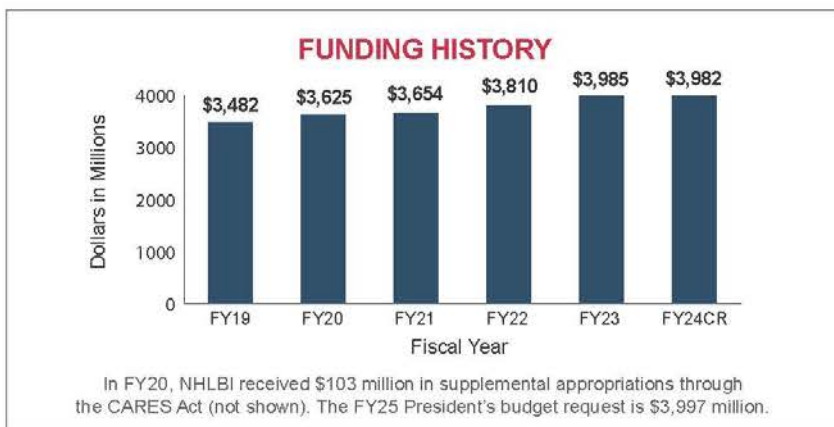
December 2023

ABOUT NHLBI

- NHLBI is the nation's leader in supporting research on the prevention and treatment of heart, lung, blood, and sleep (HLBS) disorders.
- We were established in 1948 to address rising rates of cardiovascular disease (CVD), the nation's leading cause of death.
- Our mission has expanded to lead NIH research efforts in lung diseases, including asthma and chronic obstructive pulmonary disease (COPD).
- We lead research on blood transfusion and blood diseases, such as sickle cell disease.
- In 1993, we became the home for the National Center on Sleep Disorders Research (NCSDR), which coordinates NIH programs related to sleep biology.
- NHLBI's research advances scientific knowledge, improves public health, and saves lives.



Director Profile: Gary H. Gibbons, M.D., is director of the National Heart, Lung, and Blood Institute (NHLBI). He received his M.D. from Harvard University Medical School and has served on the faculty at Harvard, Stanford University, and Morehouse School of Medicine in Atlanta.



Facts and Figures	
Full-Time Staff	943
RPG Awards	1,031
Principal Investigators	1,393
ESI Success Rates	31.4%
K Award Success Rates	49.1%

Major NHLBI Initiatives

NHLBI continues to be dedicated to understanding and addressing the long-term effects of the COVID-19 pandemic. Along with the National Institute of Neurological Disorders and Stroke and the National Institute of Allergy and Infectious Diseases, we lead NIH's Researching COVID to Enhance Recovery (RECOVER) Initiative. In 2023, the RECOVER Initiative launched and opened enrollment for Phase 2 clinical trials to evaluate at least four potential treatments for Long COVID, with clinical trials to test at least seven more treatments expected in the coming months.

We support research toward preventing or managing cardiovascular risk

factors and CVD across a woman's lifespan, especially during pregnancy. NHLBI is focused on moving evidence-based interventions proven to support maternal health into broader practice. Our Maternal Health Community Implementation Project (MH-CIP) is a community-driven initiative that studies how specific interventions, such as regular blood pressure readings, improve women's heart health and reduce maternal mortality.

NHLBI leverages innovative technology and data collection techniques to understand, diagnose, treat, and prevent complex health issues. We explore the underlying

biomolecular mechanisms of HLBS conditions and the complex interactions among individual biology, genetic inheritance, environment, and lifestyle. By leveraging cutting-edge technologies to understand the intersection of these influences, NHLBI continues to advance the transformative power of precision medicine — providing the right treatment or prevention approach to the right individual at the right time.

Moving into the future, we plan to expand both our community-engaged research into rural communities and our use of data science approaches for precision health.



National Heart, Lung,
and Blood Institute



Accomplishments in...

Heart Health

Among a large cohort of predominantly low-income Black and White participants, heart failure incidence was 21% higher among adults living in rural areas.

Compared with usual care, adopting home blood pressure monitoring was estimated to reduce myocardial infarction cases and stroke cases. Home monitoring averted more cardiovascular events in women, non-Hispanic Black people, and rural residents.

A new approach was developed to reduce the circumference of the heart's left ventricle to overcome previous surgical limitations and increase survival rates in surgery to address dilated cardiomyopathy.

Lung Health

Through the Air You Wear Challenge, NHLBI aimed to broadly stimulate the research and development of processes and technologies designed to improve the accessibility, efficacy, and usability of supplemental oxygen.

Researchers documented the first genome-wide characterization of patterns of gene expression changes in peripubertal males and females.

Sleep Health

NHLBI-funded researchers have developed a more accurate tool for diagnosing obstructive sleep apnea, which effectively assessed the severity of the condition, and predicted mortality associated with cardiovascular diseases.

A recent study conducted by NHLBI-supported researchers examined the link between the body's circadian rhythms and the development of lung diseases.

Blood Health

Researchers designed a new compound that prevented blood clots in mice, did not increase bleeding, and was well tolerated even in high doses. This finding may lead to significant changes in how doctors care for patients at risk for thrombosis, without raising the risk of bleeding.

NHLBI's Recipient Epidemiology and Donor Evaluation Study (REDS) program aims to evaluate and improve the safety and availability of the blood supply, as well as the safety and effectiveness of transfusion therapies across the lifespan, with a new focus on understudied populations, including newborns, children, and pregnant women.

NHLBI's Community Engagement Efforts

- The NIH Community Engagement Alliance (CEAL), developed during the COVID-19 pandemic, reaches out to communities across the country as a comprehensive research platform to address health disparities. We work specifically with rural, tribal, and other under-resourced communities with high rates of HLBS conditions to study the reasons for these disparities and develop health interventions specifically for those communities or regions.
- The nuMoM2b Heart Health Study, funded by NHLBI with co-funding from the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development, is studying the effects of pregnancy complications on future cardiovascular health, including social factors that correlate with the future heart health of new parents, especially in communities of color.
- We are a primary funder of NIH's Climate Change and Health Initiative, an urgent, cross-cutting NIH effort to reduce health threats from climate change across the lifespan and build health resilience in individuals, communities, and nations around the world, especially among those at highest risk.



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 mechanisms and activity detail; and these highlights may not sum exactly to the total change for the FY 2025 budget request for the National Heart, Lung, and Blood Institute (NHLBI), which is \$3,997.1 million, an \$11.9 million increase compared to the FY 2023 Final level of \$3,985.2 million. NHLBI is committed to the continuous support for key strategic priorities along with other scientific areas of the Institute's research portfolio. Within the framework of the Administration's fiscal policy goals for the Federal Government, NHLBI will continue to pursue its highest research priorities through strategic investments and careful stewardship of the appropriated funds.

Research Project Grants (RPGs) (\$9.6 million; total \$2,705.0 million):

NHLBI will slightly increase funding for RPGs in FY 2025, supporting 925 competing RPGs, 2,912 noncompeting RPG awards, and 181 awards to small businesses to stimulate research technology in key strategic areas. The total funding will provide continuous support of major initiatives and a strong focus on the investigator-initiated research submitted in response to the NIH Parent Announcements.

Research Centers (-\$0.7 million; total \$13.3 million):

NHLBI will decrease funding for Research Centers by 5.0 percent, which is a \$0.7 million decrease compared to the FY 2023 Final level of \$14.0 million. These funds requested will support several specialized centers that conduct large-scale analysis that leads to prevention, diagnosis, and treatment of heart, lung, blood, and sleep diseases and disorders.

Other Research (-\$19.2 million; total \$333.6 million):

NHLBI will decrease funding for Other Research by 5.4 percent, which is a \$19.2 million decrease compared to the FY 2023 Final level of \$352.8 million. These funds requested will support many of important NHLBI initiatives that have high impact cutting-edge research fostering scientific creativity that leads to prevention, diagnosis, and treatment of heart, lung, blood, and sleep diseases and disorders.

Research Training (\$3.4 million; total \$119.8 million):

NHLBI will increase funding for Research Training by 2.9 percent, which is a \$3.4 million increase compared to the FY 2023 Final level of \$116.4 million. These increases are to support general annual adjustments for trainees, and to continue stimulating research training focused on strategic priorities and programmatic goals.

Intramural Research (IR) (\$12.6 million; total \$266.8 million):

NHLBI will increase funding for Intramural Research by 4.9 percent, which is a \$12.6 million increase compared to the FY 2023 Final level of \$254.3 million. These increases accommodate proposed pay increases for IR staff, changes in NIH-wide assessments on the IR program, and other inflationary costs.

Research Management and Support (RMS) (\$6.6 million; total \$164.1 million):

NHLBI will increase funding for Research Management Support by 4.2 percent, which is a \$6.6 million increase compared to the FY 2023 Final level of \$157.4 million. These increases accommodate proposed pay increases for RMS staff, changes in NIH-wide assessments on the RMS program, and other inflationary costs.

BUDGET MECHANISM TABLE

NATIONAL INSTITUTES OF HEALTH
NATIONAL HEART, LUNGS, AND BLOOD INSTITUTE

BUDGET MECHANISM*

(Dollars in Thousands)

Mechanism	FY 2023 Final		FY 2024 CR		FY 2025 President's Budget		FY 2025 +/- FY 2023	
	Number	Amount	Number	Amount	Number	Amount	Number	Amount
Research Projects:	-	-	-	-	-	-	-	-
Noncompeting	2,905	\$1,940,568	2,908	\$1,944,269	2,912	\$1,947,645	7	\$7,076
Administrative Supplements	(233)	\$33,502	(165)	\$23,669	(166)	\$23,802	-(67)	-\$9,700
Competing:	-	-	-	-	-	-	-	-
Renewal	110	\$83,314	113	\$85,679	114	\$86,459	4	\$3,146
New	798	\$514,275	802	\$518,347	811	\$524,557	13	\$10,282
Supplements	0	\$0	0	\$0	0	\$0	0	\$0
Subtotal, Competing	908	\$597,588	915	\$604,027	925	\$611,016	17	\$13,428
Subtotal, RPGs	3,813	\$2,571,658	3,823	\$2,571,964	3,837	\$2,582,463	24	\$10,805
SBIR/STTR	183	\$123,789	182	\$123,361	181	\$122,535	-2	-\$1,255
Research Project Grants	3,996	\$2,695,447	4,005	\$2,695,326	4,018	\$2,704,998	22	\$9,550
Research Centers	-	-	-	-	-	-	-	-
Specialized/Comprehensive	5	\$13,527	5	\$12,837	5	\$12,828	0	-\$699
Clinical Research	0	\$0	0	\$0	0	\$0	0	\$0
Biotechnology	0	\$0	0	\$0	0	\$0	0	\$0
Comparative Medicine	0	\$450	0	\$450	0	\$450	0	\$0
Research Centers in Minority Institutions	0	\$0	0	\$0	0	\$0	0	\$0
Research Centers	5	\$13,977	5	\$13,287	5	\$13,278	0	-\$699
Other Research:	-	-	-	-	-	-	-	-
Research Careers	807	\$130,304	805	\$130,504	804	\$131,219	-3	\$915
Cancer Education	0	\$0	0	\$0	0	\$0	0	\$0
Cooperative Clinical Research	26	\$6,389	15	\$3,700	15	\$3,690	-11	-\$2,699
Biomedical Research Support	0	\$0	0	\$0	0	\$0	0	\$0
Minority Biomedical Research Support	0	\$1,471	0	\$1,433	0	\$1,422	0	-\$49
Other	69	\$214,604	157	\$198,903	156	\$197,233	-13	-\$17,371
Other Research	1,002	\$352,769	977	\$334,540	975	\$333,564	-27	-\$19,205
Total Research Grants	5,003	\$3,062,193	4,987	\$3,043,153	4,998	\$3,051,840	-5	-\$10,353
Ruth L Kirschstein Training Awards:	FTTPs	-	FTTPs	-	FTTPs	-	FTTPs	-
Individual Awards	493	\$23,660	495	\$24,089	493	\$24,317	0	\$657
Institutional Awards	1,344	\$92,773	1,345	\$94,142	1,342	\$95,466	-2	\$2,693
Total Research Training	1,837	\$116,434	1,840	\$118,231	1,835	\$119,784	-2	\$3,350
Research & Develop. Contracts	898	\$394,844	883	\$393,501	866	\$394,580	-32	-\$264
SBIR/STTR (non-add)	(10)	(\$12,208)	(4)	(\$5,985)	(6)	(\$8,500)	-(4)	-\$3,708
Intramural Research	463	\$254,255	473	\$264,706	473	\$266,812	10	\$12,557
Res. Management & Support	480	\$157,433	493	\$162,755	493	\$164,071	13	\$6,638
SBIR Admin. (non-add)	-	(\$193)	-	(\$198)	-	(\$258)	-	(\$65)
Construction	-	\$0	-	\$0	-	\$0	-	\$0
Buildings and Facilities	-	\$0	-	\$0	-	\$0	-	\$0
Total, NHLBI	899	\$3,985,158	966	\$3,982,345	966	\$3,997,086	23	\$11,928

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

**NATIONAL INSTITUTES OF HEALTH
NATIONAL HEART, LUNG, AND BLOOD INSTITUTE**

For carrying out section 301 and title IV of the PHS Act with respect to cardiovascular, lung, and blood diseases, and blood and blood products, \$3,997,086,000.

SUMMARY OF CHANGES

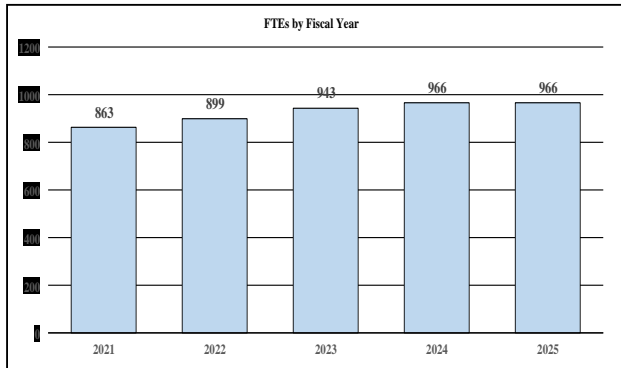
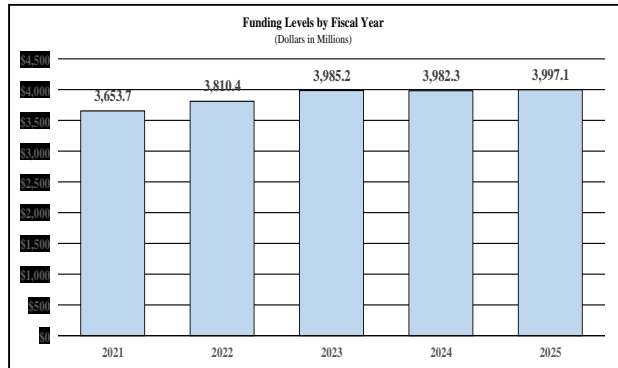
NATIONAL INSTITUTES OF HEALTH
NATIONAL HEART, LUNGS, AND BLOOD INSTITUTE

SUMMARY OF CHANGES

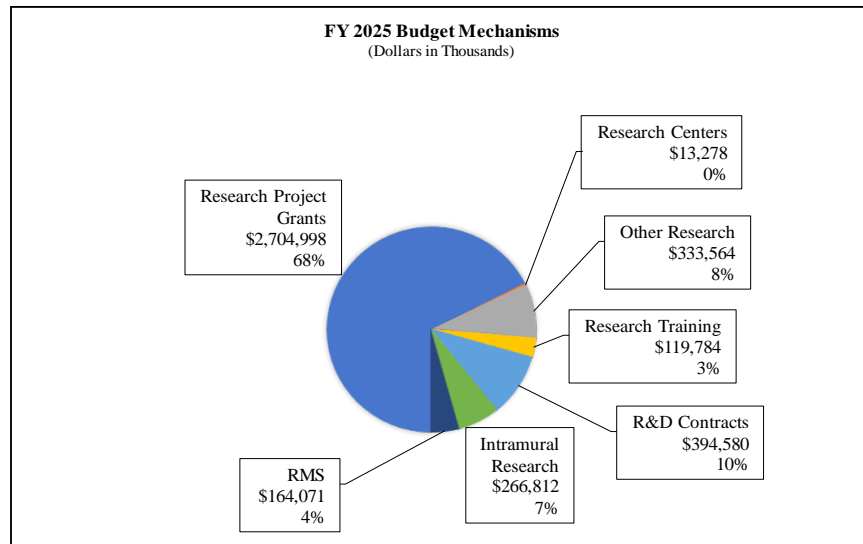
(Dollars in Thousands)

CHANGES	FY 2023 Final		FY 2025 President's Budget		Built-In Change from FY 2023 Final	
	FTEs	Budget Authority	FTEs	Budget Authority	FTEs	Budget Authority
<i>1. Intramural Research:</i>	-	-	-	-	-	-
<i>A. Built-in cost changes:</i>	-	-	-	-	-	-
a. FY 2024 effect of FY 2023 pay and benefits increase	-	\$107,454	-	\$116,708	-	\$1,267
b. FY 2024 effect of FY 2024 pay and benefits increase	-	\$107,454	-	\$116,708	-	\$4,181
c. FY 2024 paid days adjustment	-	\$107,454	-	\$116,708	-	\$414
d. Differences attributable to FY 2024 change in FTE	-	\$107,454	-	\$116,708	-	\$2,415
e. FY 2025 effect of FY 2024 pay and benefits increase	-	\$107,454	-	\$116,708	-	\$1,419
f. FY 2025 effect of FY 2025 pay and benefits increase	-	\$107,454	-	\$116,708	-	\$1,952
g. FY 2025 paid days adjustment	-	\$107,454	-	\$116,708	-	\$0
h. Differences attributable to FY 2025 change in FTE	-	\$107,454	-	\$116,708	-	\$0
i. Payment for centrally furnished services	-	\$26,524	-	\$28,441	-	\$1,916
j. Cost of laboratory supplies, materials, other expenses, and non-recurring costs	-	\$120,277	-	\$121,663	-	\$7,933
Subtotal, IR built-in cost changes	-	-	-	-	-	\$21,497
<i>2. Research Management and Support:</i>	-	-	-	-	-	-
<i>A. Built-in cost changes:</i>	-	-	-	-	-	-
a. FY 2024 effect of FY 2023 pay and benefits increase	-	\$85,053	-	\$92,364	-	\$1,006
b. FY 2024 effect of FY 2024 pay and benefits increase	-	\$85,053	-	\$92,364	-	\$3,309
c. FY 2024 paid days adjustment	-	\$85,053	-	\$92,364	-	\$327
d. Differences attributable to FY 2024 change in FTE	-	\$85,053	-	\$92,364	-	\$2,304
e. FY 2025 effect of FY 2024 pay and benefits increase	-	\$85,053	-	\$92,364	-	\$1,118
f. FY 2025 effect of FY 2025 pay and benefits increase	-	\$85,053	-	\$92,364	-	\$1,533
g. FY 2025 paid days adjustment	-	\$85,053	-	\$92,364	-	\$0
h. Differences attributable to FY 2025 change in FTE	-	\$85,053	-	\$92,364	-	\$0
i. Payment for centrally furnished services	-	\$2,215	-	\$2,375	-	\$160
j. Cost of laboratory supplies, materials, other expenses, and non-recurring costs	-	\$70,165	-	\$69,332	-	\$3,607
Subtotal, RMS built-in cost changes	-	-	-	-	-	\$13,365
CHANGES	No.	Amount	No.	Amount	No.	Amount
<i>B. Program:</i>	-	-	-	-	-	-
1. Research Project Grants:	-	-	-	-	-	-
a. Noncompeting	2,905	\$1,974,070	2,912	\$1,971,447	7	-\$2,623
b. Competing	908	\$597,588	925	\$611,016	17	\$13,428
c. SBIR/STTR	183	\$123,789	181	\$122,535	-2	-\$1,255
Subtotal, RPGs	3,996	\$2,695,447	4,018	\$2,704,998	22	\$9,550
2. Research Centers	5	\$13,977	5	\$13,278	0	-\$699
3. Other Research	1,002	\$352,769	975	\$333,564	-27	-\$19,205
4. Research Training	1,837	\$116,434	1,835	\$119,784	-2	\$3,350
5. Research and development contracts	898	\$394,844	866	\$394,580	-32	-\$264
Subtotal, Extramural	-	\$3,573,470	-	\$3,566,203	-	-\$7,267
6. Intramural Research	463	\$254,255	473	\$266,812	10	-\$8,940
7. Research Management and Support	480	\$157,433	493	\$164,071	13	-\$6,727
8. Construction	-	\$0	-	\$0	-	\$0
9. Buildings and Facilities	-	\$0	-	\$0	-	\$0
Subtotal, Program	943	\$3,985,158	966	\$3,997,086	23	-\$22,934
Total built-in and program changes	-	-	-	-	-	\$11,928

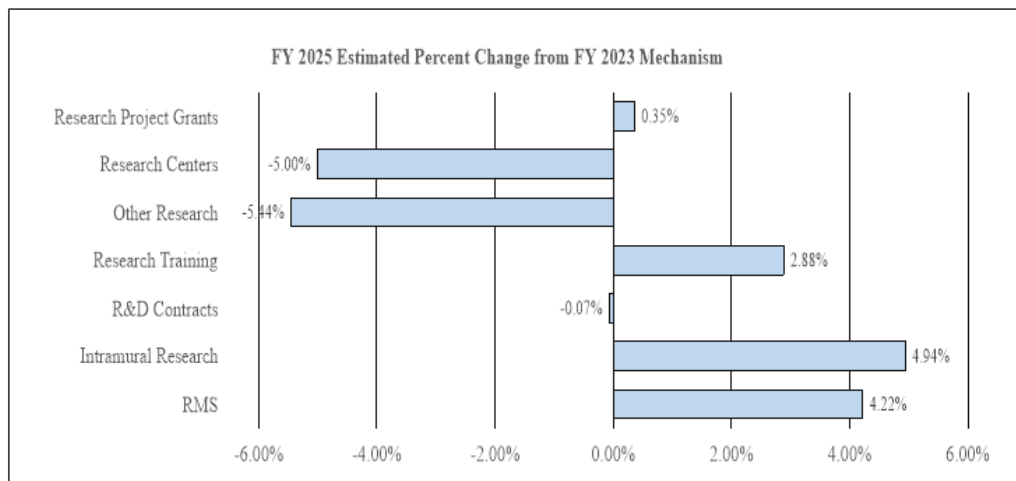
History of Budget Authority and FTEs:



Distribution by Mechanism:

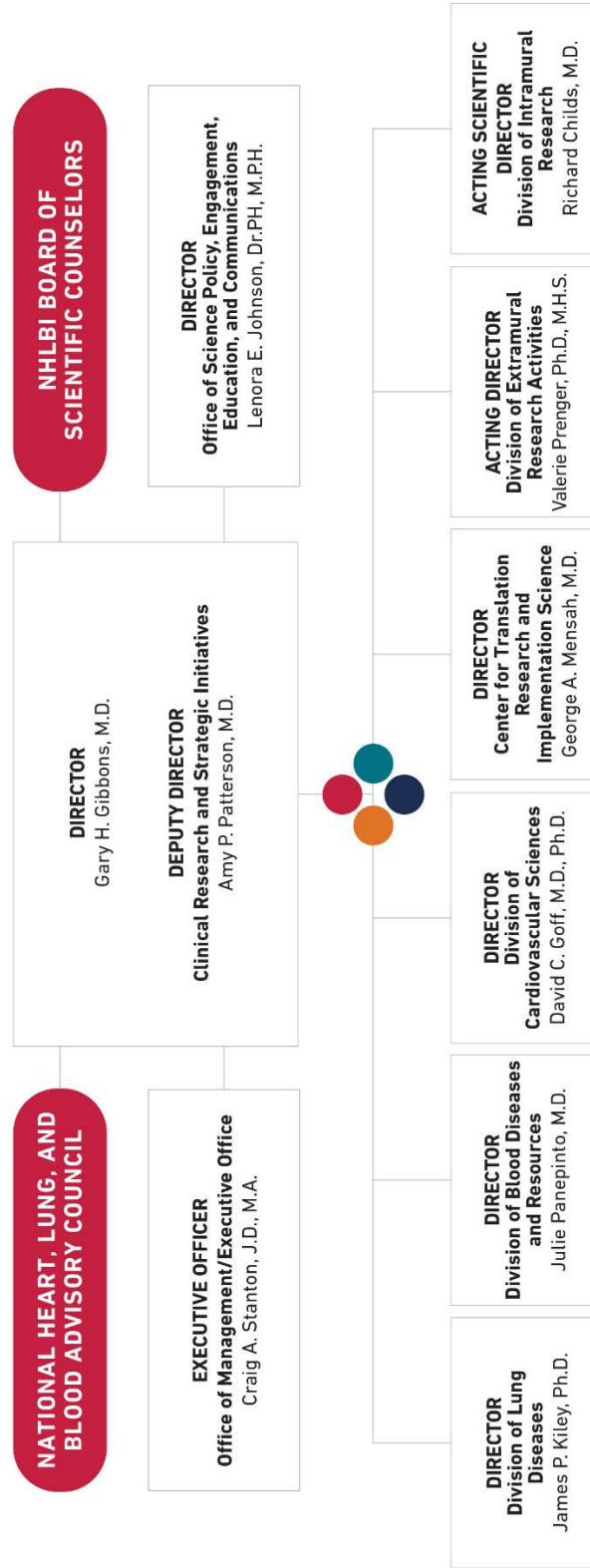


Change by Selected Mechanisms:



NATIONAL INSTITUTES OF HEALTH NATIONAL HEART, LUNG, AND BLOOD INSTITUTE

ORGANIZATIONAL CHART



BUDGET AUTHORITY BY ACTIVITY TABLE

**NATIONAL INSTITUTES OF HEALTH
NATIONAL HEART, LUNGS, AND BLOOD INSTITUTE**

BUDGET AUTHORITY BY ACTIVITY*

(Dollars in Thousands)

Activity	FY 2023 Final		FY 2024 CR		FY 2025 President's Budget		FY 2025 +/- FY 2023 Final	
	<u>FTE</u>	<u>Amount</u>	<u>FTE</u>	<u>Amount</u>	<u>FTE</u>	<u>Amount</u>	<u>FTE</u>	<u>Amount</u>
<u>Extramural Research</u>	<u>FTE</u>	<u>Amount</u>	<u>FTE</u>	<u>Amount</u>	<u>FTE</u>	<u>Amount</u>	<u>FTE</u>	<u>Amount</u>
<u>Detail</u>	NA	NA	NA	NA	NA	NA	NA	NA
Center for Translation Research and Implementation Science	NA	\$126,856	NA	\$126,177	NA	\$126,586	NA	-\$270
Heart and Vascular Diseases	NA	\$2,137,727	NA	\$2,126,771	NA	\$2,133,478	NA	-\$4,249
Lung and Sleep Health	NA	\$815,926	NA	\$811,565	NA	\$814,193	NA	-\$1,733
Blood Diseases and Resources	NA	\$492,962	NA	\$490,370	NA	\$491,947	NA	-\$1,015
Subtotal, Extramural	NA	\$3,573,470	NA	\$3,554,884	NA	\$3,566,203	NA	-\$7,267
Intramural Research	463	\$254,255	473	\$264,706	473	\$266,812	10	\$12,557
Research Management & Support	480	\$157,433	493	\$162,755	493	\$164,071	13	\$6,638
TOTAL	943	\$3,985,158	966	\$3,982,345	966	\$3,997,086	23	\$11,928

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

JUSTIFICATION OF BUDGET REQUEST

National Heart, Lung, and Blood Institute

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

Budget Authority (BA):

	FY 2023 Final	FY 2024 Enacted	FY 2025 President's Budget	FY 2025 +/- FY 2023
BA	\$3,985,158,000	\$3,982,345,000	\$3,997,086,000	\$11,928,000
FTE	943	966	966	23

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

Overall Budget Policy: The FY 2025 President’s Budget request is \$3,997.1 million, an increase of \$11.9 million or 0.3 percent compared with the FY 2023 Final level. Included in this amount is funding to sustain the FY 2023 Enacted increase of \$30.0 million for continued support of the NIH Community Engagement Alliance (CEAL) Against COVID-19 Disparities program so that it can operationalize a community engagement plan to reduce research participation hesitancy, address misinformation and mistrust of science, and promote diverse inclusion in NIH clinical trials and research. The **Alliance for Community Engagement- Climate and Health**’s goal is to reduce health threats across the lifespan and build health resilience in individuals, communities, and nations around the world, especially among those at highest risk. NHLBI is also targeting sleep research to improve the negative health impacts of climate change on heart, lung, and blood health. Also included in this request is funding for the **Cardiovascular Advances in Research and Opportunities Legacy (CAROL) Act** for \$20.0 million in support of valvular heart disease to improve information on, and understanding of, causation and risk factors related to this disease. This funding will continue to advance technological imaging and other relevant methods to generate data, assessing potential risk factors for sudden cardiac arrest or sudden cardiac death from valvular heart diseases.

Program Descriptions

Valvular Heart Disease Research

Each year, approximately 25,000 people in the United States die from valvular heart disease (VHD),¹ a condition in which one or more of the heart's valves do not open or close correctly. Many of these deaths are due to underdiagnosis and under-treatment of the condition. VHD can develop congenitally (before a baby is born) or can be acquired as one ages. Risk factors include: age, family history, lifestyle habits, and sex, among others.² As part of its broader commitment to research on heart and vascular diseases, the NHLBI leads and supports research and programs on heart valve diseases in the United States and around the world.

In December 2022, Congress authorized \$100 million over five years to NIH to support more research into the causation of and risk factors for valvular heart disease via the Cardiovascular Advances in Research and Opportunities Legacy (CAROL Act).³ NHLBI is supporting expanded valvular heart disease research, including on risk factors for sudden cardiac arrest or sudden cardiac death from valvular heart disease, most commonly associated with mitral valve prolapse (MVP) and use of advanced imaging techniques. Research activities include basic science research aimed at addressing current knowledge gaps in valvular heart disease, development of artificial intelligence or machine learning techniques for comprehensive risk assessment and improved phenotypic characterization of individuals with MVP, and studies to establish ideal intervals for imaging and electrophysiological monitoring. In addition, the Institute supports studies which assess VHD treatment and interventions and on addressing disparities in equitable access, diagnosis, management, and treatment for individuals with MVP and valvular heart disease from diverse communities.

¹ <https://wonder.cdc.gov/ucd-icd10.html>

² <https://www.nhlbi.nih.gov/health/heart-valve-diseases/causes>

³ www.govinfo.gov/content/pkg/CRPT-117hrpt212/html/CRPT-117hrpt212.htm

Heart and Vascular Diseases

During pregnancy, the heart works harder to pump blood to the body and to the fetus. The extra stress to the heart may exacerbate heart health risks that existed before pregnancy but can also cause new problems to emerge during pregnancy (e.g., high blood pressure/hypertension, diabetes, or preeclampsia). Additionally, adverse pregnancy outcomes, such as hypertension during pregnancy, preterm delivery, and gestational diabetes, are associated with increased risk of future cardiovascular disease.²⁵ A recent analysis found a positive association between the number of live births and reduced heart health among women.

An additional, larger analysis in the same study found that having more live births was associated with a higher risk of developing heart failure with lower cardiac function compared to those who had never experienced a live birth. Specifically, left ventricles of women who experienced three or more live births did not function as well. Additionally, greater numbers of live births were associated with increased risk of heart failure with reduced ejection fraction (HFrEF, a type of heart failure when the heart's left ventricle does not pump blood out to the body as well as it should) as compared to those without histories of live births. Importantly, women with five live births had a nearly two-fold increased risk of future HFrEF compared with women who hadn't experienced a live birth, although risk of another form of cardiac failure called heart failure with preserved ejection fraction (HFpEF, a type of heart failure where heart output is maintained) was reduced. Further research is needed to understand better the factors that may

contribute to these conditions in order to improve the long-term care of women who have multiple children.

²⁵ www.ahajournals.org/doi/full/10.1161/JAHA.120.017216#d1e4774

Cardiovascular disease (CVD) continues to be the leading cause of death worldwide.²⁶ In 2019, more than 870,000 deaths in the United States were attributable to heart disease.²⁷ Family history of CVD is often used as a marker of future CVD risk in offspring.²⁸ This risk can be further compounded by shared environments and adverse behaviors such as smoking, sedentary lifestyle, and poor diet. Until recently, it was previously not known whether modifiable risk factors in parents (such as smoking, obesity, and diabetes) contributed to risk of CVD in their children or was simply a marker of future risk.²⁹ In 2023, a study funded by NHLBI demonstrated that parental history of obesity and smoking were associated with a higher risk of future CVD in offspring.³⁰ However, some of the other parental modifiable risk factors (such as parental history of hypertension, diabetes, and high cholesterol) were not associated with offspring CVD risk. These findings suggest that the presence of parental obesity should prompt a focus on disease prevention in offspring of parents with CVD and/or obesity. Future research should develop and test interventions before conception and during pregnancy to treat parental obesity and smoking to prevent obesity and CVD risk in the offspring.

According to the Centers for Disease Control and Prevention,³¹ nearly 1 out of 2 adults in the United States—around 108 million—have high blood pressure, and only 1 in 4 with the condition have it under control. Additionally, approximately one in five U.S. adults with high blood pressure are unaware that they have the condition.³² Left undiagnosed or uncontrolled, high blood pressure can lead to serious health problems like aneurysm, stroke, heart failure, heart attack, and vascular dementia. Home blood pressure monitoring is more convenient and effective than clinic-based monitoring in diagnosing and managing hypertension, especially in regions with reduced access to clinical care, but there is limited evidence of the health and economic impacts of home monitoring. A recent study by NHLBI-supported researchers used cardiovascular disease modeling to estimate the long-term impact of adopting home blood pressure monitoring versus usual care on myocardial infarction, stroke, and healthcare costs.³³ Compared with usual care, adopting home blood pressure monitoring was estimated to reduce myocardial infarction cases by 4.9 percent and stroke cases by 3.8 percent, as well as saving an average of \$7,794 in healthcare costs per person over 20 years. Women, non-Hispanic Black people, and rural residents had more averted cardiovascular events and greater cost savings related to home blood pressure monitoring when compared with men, non-Hispanic White people, and urban residents. The study provides compelling evidence for healthcare systems and payers to support the broader implementation of this intervention.

More than 6.2 million adults in the United States have heart failure.³⁴ Roughly half of them have HFpEF, a condition in which the heart muscle contracts normally, but the walls of the heart's lower chambers (ventricles) are thicker and stiffer than usual and cannot relax enough between

²⁶ www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death

²⁷ www.ahajournals.org/doi/10.1161/CIR.0000000000001052#d1e1489

²⁸ www.ncbi.nlm.nih.gov/pmc/articles/PMC7854782/

²⁹ www.nhlbi.nih.gov/health/heart-healthy-living/risks

³⁰ www.ahajournals.org/doi/10.1161/JAHA.122.027881?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%20pubmed%22%20%22d1e3398

³¹ www.cdc.gov/bloodpressure/facts.htm

³² www.sciencedirect.com/science/article/abs/pii/S0749379710002072?via%3Dihub

³³ [www.ajpmonline.org/article/S0749-3797\(23\)00232-5/fulltext#seccesectitle0005](http://www.ajpmonline.org/article/S0749-3797(23)00232-5/fulltext#seccesectitle0005)

³⁴ www.nhlbi.nih.gov/health/heart-failure

heart beats to adequately fill with blood.³⁵ Unfortunately, much is still unknown about this condition and no effective treatments that convincingly reduce mortality are available. To optimally pump blood, the human heart uses fatty acids as its primary energy source, but research has shown that HFpEF patients have decreased fatty acid utilization. NHLBI-funded researchers investigated which myocardial energy sources HFpEF patients with severe obesity or diabetes use, as people with these conditions tend to have elevated myocardial fatty acid use.³⁶ By evaluating metabolites (molecules which are part of metabolic reactions and are required for normal cell function) and RNA expression in blood plasma and from biopsies, researchers determined that these patients appear to have metabolic defects from both heart failure and their underlying conditions (obesity, diabetes), creating a syndrome with substantial fuel inflexibility. This inflexibility means that the heart is not effectively utilizing fuel, implying it cannot function optimally. This ineffective fuel utilization may be a factor in why HFpEF is so challenging to treat, and researchers indicate some important features worthy of future study, which may ultimately lead to therapies.

Significant cardiac events can lead to lasting heart damage. Various conditions, including heart attack, hypertensive heart disease (changes in the heart resulting from chronic blood pressure elevation), diabetic hypertrophic cardiomyopathy (damage to nerves and blood vessels that control the heart), and idiopathic dilated cardiomyopathy (the thinning, stretching, and elongation of the heart muscle), can cause cardiac fibrosis, or a scarring of the heart muscles.³⁷ Researchers are interested in learning more about how the heart heals after such injuries. Cardiac fibroblasts are cells that are responsible for maintaining the cardiac microenvironment.³⁸ During an injury, these fibroblasts transition into myofibroblasts, cells that restore tissue and their surrounding structures after the damage is sustained.³⁹ However, chronic myofibroblast activity can lead to cardiac fibrosis. A recent animal study funded by NHLBI found that the increased activity of human antigen R (HuR), an RNA-binding protein that influences the expression of targeted genes, leads to the cardiac fibroblasts transitioning into myofibroblasts. Further research is needed to understand how HuR influences myofibroblast activity and may ultimately lead to a mechanism that reduces fibrosis.

Dilated cardiomyopathy is a type of heart disease in which the chambers of the heart thin and stretch, becoming enlarged.⁴⁰ The enlargement affects the ability of the heart to sufficiently pump blood to the rest of the body and can ultimately lead to heart valve problems, arrhythmias, blood clots, and heart failure. Current treatments aim to reduce symptoms and prevent further heart damage through medications or surgically implanted devices.⁴¹ Implanted myocardial remodeling devices use a tether wrapped around a ventricle to reduce the chamber size and wall

³⁵ www.nih.gov/research-training/accelerating-medicines-partnership-amp/heart-failure

³⁶ pubmed.ncbi.nlm.nih.gov/36856044/

³⁷ www.sciencedirect.com/science/article/pii/S0169409X19300614#:~:text=Fibrotic%20scars%20of%20the%20cardiac,cardiomyopathy%20%5B4%2C5%5D.

³⁸ www.ncbi.nlm.nih.gov/pmc/articles/PMC5588900/#:~:text=Typically%2C%20a%20cardiac%20fibroblast%20is,%2C%20and%20glycoproteins%2C6.

³⁹ [www.ncbi.nlm.nih.gov/pmc/articles/PMC2891362/#:~:text=In%20injured%20tissues%2C%20fibroblasts%20are,connective%20tissue%20wound%20healing%20\(Fig](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2891362/#:~:text=In%20injured%20tissues%2C%20fibroblasts%20are,connective%20tissue%20wound%20healing%20(Fig).

⁴⁰ www.nhlbi.nih.gov/health/cardiomyopathy/types#:~:text=All%20rights%20reserved%20.-,Dilated%20cardiomyopathy,makes%20your%20heart%20work%20harder.&text=Another%20type%20of%20cardiomyopathy%20%2E%2080%2094%20called,occur%20during%20or%20after%20pregnancy.

⁴¹ www.nhlbi.nih.gov/health/cardiomyopathy/treatment

stress, but these surgeries have several significant limitations. NHLBI-funded researchers have developed a new approach to reduce the circumference of the heart's left ventricle to overcome previous surgical limitations and increase survival rates, an approach known as MIRTH (Myocardial Intramural Remodeling by Transvenous Tether).⁴² The new method allows researchers to steer a guidewire through the coronary vein and uses EDEN (Electrocardiographic Radial Depth Navigation) electrocardiograms to direct the user to any location within the ventricular walls, increasing procedural accuracy and speed and allowing the user to integrate the tether within the heart's walls. MIRTH was performed on swine (some with heart muscle damage, some without), which resulted in positive measures of left ventricle performance, including increased contractility, efficiency, and reduced oxygen demand in cardiomyopathic animals. Additional research and clinical trials will be required to test this method in humans, but the technique may also have uses in the treatment of certain forms of acute myocardial infarction.

Budget Policy: The FY 2025 President's Budget request for NHLBI heart and vascular disease research is \$2,133.5 million, a decrease of \$4.2 million or 0.2 percent compared with the FY 2023 Final level.

Lung and Sleep Health

COPD affects more than 15 million U.S. adults and is a major cause of disability.⁴³ Women are slightly more likely to be diagnosed with COPD than men. However, COPD remains underdiagnosed in primary care settings, particularly amongst African American patients and current or former smokers.⁴⁴ Underdiagnosed patients experience impaired health and a greater risk of acute respiratory events and mortality. The diagnostic test for COPD is spirometry, an exam that measures the volume and speed at which someone breaths, which can detect COPD before symptoms become apparent.⁴⁵ However, disease symptoms of COPD are more complex and informative. They include airway inflammation, airflow obstruction, emphysema, shortness of breath, and exercise intolerance, among others.⁴⁶ Systematic failure to diagnose the disease may hamper understanding of disease manifestations and progression in populations more at-risk of deprivation, as well as perpetuate health disparities.⁴⁷ NHLBI-funded researchers have been working on new tools to mitigate missed COPD diagnoses.⁴⁸ A recent NHLBI-funded study found that participants with tobacco exposure and preserved spirometry (TEPS) and symptoms (symptomatic TEPS) had a similar rate of decline in lung function and similar incidence of COPD defined by spirometry as those with TEPS without symptoms (asymptomatic TEPS), but participants with symptomatic TEPS experienced significantly more respiratory exacerbations over 2 to 10 years of follow-up.⁴⁹

⁴² pubmed.ncbi.nlm.nih.gov/37014015/

⁴³ www.nhlbi.nih.gov/health/copd

⁴⁴ www.nhlbi.nih.gov/health/copd/causes

⁴⁵ www.nhlbi.nih.gov/health/copd/diagnosis#:~:text=The%20main%20test%20for%20COPD,much%20air%20you%20breathe%20out.

⁴⁶ www.nhlbi.nih.gov/health/copd/symptoms

⁴⁷ link.springer.com/article/10.1007/s11606-023-08185-5

⁴⁸ jamanetwork.com/journals/jama/article-abstract/2801317?resultClick=1

⁴⁹ jamanetwork.com/journals/jama/fullarticle/2807747

More than 1.5 million Americans use supplemental oxygen for a range of medical conditions.⁵⁰ Supplemental oxygen increases their oxygen intake and helps them feel better and be more

LungMAP

The NHLBI-supported LungMAP Consortium¹ unites teams of researchers at universities and institutions across the country that are devoted to a better understanding of human lung development. The consortium continues to build an open-access reference resource of a comprehensive, dynamic, 3-dimensional molecular atlas of the late-stage developing human lung with data and reagents available to the research community. Technological advancements, such as single-cell multi-omics have revealed novel cell types and enriched functional properties of existing cell types in the lung. Recently, members of the LungMAP Consortium, along with experts in the lung biology community, synthesized current data into a comprehensive and practical cellular census of the lung, called CellCards.² Identities of cell types in the normal lung are captured in individual CellCards with delineation of function, markers, developmental lineages, heterogeneity, regenerative potential, disease links, and key experimental tools. This is the starting point of a live, up-to-date guide for lung research, meant to evolve, integrate, and adapt to new data and emerging technologies. Researchers are already building upon the LungMAP CellCards with analyses that direct the identification of lung reference cell populations according to a dictionary of pre-compiled cell type terms and molecular markers derived from CellCards.

¹ www.lungmap.net/

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www.sciencedirect.com/science/article/pii/S1534580721008923

active, so that these individuals live fuller lives. Yet some patients have found that portable oxygen creates challenges with daily activities, exercise, socialization, work, and travel.⁵¹ When asked, people consistently express a desire for a lighter, more portable oxygen supply that lasts longer and has flow rates that supply the necessary amounts of oxygen for their needs. Through the Air You Wear Challenge prize competition, NHLBI aimed to broadly stimulate the research and development of processes and technologies designed to improve the accessibility, efficacy, and usability of supplemental oxygen.⁵² The Air You Wear Challenge had two phases, one that focused on the concepts and feasibility of solutions, and a 30-week second phase during which teams developed working prototypes of their solutions. During the second phase, the NHLBI helped finalists engage with subject matter experts from NIH, the NHLBI Catalyze Program,⁵³ the National Science Foundation, the U.S. Food and Drug Administration (FDA), and the Centers for Medicare & Medicaid Services. In February 2023, NHLBI named three winning teams and one honorable mention.⁵⁴ Since then, two teams successfully completed the competitive National Institute of Biomedical Imaging and Bioengineering Spring 2023 Concept to Clinic Commercialization program,⁵⁵ and all three winners have submitted small business applications to help conduct pre-clinical and/or clinical feasibility studies. The Air

You Wear Challenge helped teams advance their innovations, bringing them closer to a time when they may help supplemental oxygen users live fuller lives.

⁵⁰ www.atsjournals.org/doi/full/10.1513/AnnalsATS.201809-627WS

⁵¹ www.atsjournals.org/doi/epdf/10.1513/AnnalsATS.202005-487OC

⁵² www.nhlbi.nih.gov/grants-and-training/air-you-wear-challenge

⁵³ www.nhlbi.nih.gov/grants-and-training/funding-opportunities-and-contacts/NHLBI-Catalyze-Program

⁵⁴ www.nhlbi.nih.gov/grants-and-training/air-you-wear-challenge

⁵⁵ [seed.nih.gov/aboutseed/news/concept-clinic-commercializing-innovation-c3i-education-program#:~:text=C3i\)%20E2%80%93%20Education%20Program,Concept%20to%20Clinic%3A%20Commercializing%20Innovation%20\(C3i\)%20E2%80%93%20Education%20Program,to%20the%20market%20\(clinic\).](http://seed.nih.gov/aboutseed/news/concept-clinic-commercializing-innovation-c3i-education-program#:~:text=C3i)%20E2%80%93%20Education%20Program,Concept%20to%20Clinic%3A%20Commercializing%20Innovation%20(C3i)%20E2%80%93%20Education%20Program,to%20the%20market%20(clinic).)

Puberty is a period marked by hormonal, metabolic, and immune changes that occurs between the ages of 8-13 years for girls and 9-14 years for boys, respectively.⁵⁶ It also marks a shift in sex differences in susceptibility to asthma. Males have higher asthma prevalence in childhood, but starting from young adulthood, females are more affected.⁵⁷ Sex hormones are hypothesized to play a role in this difference, but not much is known about gene expression changes in immune cells that occur during pubertal development—in particular, gene expression changes throughout puberty (peri-puberty). A recent NHLBI-funded study examined pubertal development and leukocyte gene expression in a cohort of 163 children with asthma between 10 and 17 years old who were followed annually for up to 3 years.⁵⁸ The investigators used quantitative measures of asthma symptoms⁵⁹ (chest tightness, coughing, wheezing) and severity to investigate whether changes in gene expression in immune cells during puberty were also associated with changes in disease status. The researchers observed sex-specific patterns. In males, gene expression changes associated with puberty and age were inversely correlated with those associated with asthma symptoms and positively correlated with those associated with pulmonary function. Conversely, the opposite correlations were observed with gene expression changes linked to puberty and age in females. The study is the first to document these differences and also offers the first genome-wide characterization of patterns of gene expression changes in peri-pubertal males and females, adding to the knowledge base of epigenetic reprogramming of immune cells during puberty.

Idiopathic pulmonary fibrosis (IPF) is an incurable lung disease characterized by progressive scarring that leads to air sac stiffening, reduced lung capacity, and poorer rates of gas transfer, and is eventually fatal.⁶⁰ Disease progression is highly variable, and it is not clear why some individuals have different rates of decline than others. To investigate if there is a genetic component to disease progression in IPF, NHLBI researchers examined genetic variants associated with lung function decline.⁶¹ The researchers examined more than 1,300 individuals with significant IPF symptoms, looking for genetic variants associated with disease progression. They found that certain variants in one area of the genome were associated with more rapid decline. These genetic variations likely affect PKN2, a protein that regulates various cellular processes. Additional research is needed to confirm a possible new biological role for this protein, which may ultimately lead to novel therapeutic targets for IPF.

Pulmonary fibrosis is a chronic lung disease characterized by the ongoing formation of scar tissue in the lungs accompanied by impaired lung function.⁶² Currently, nintedanib and pirfenidone are the only FDA-approved drugs for the treatment of pulmonary fibrosis.⁶³ These drugs ease symptoms and slow the progression of the disease but cannot repair lung damage. A

⁵⁶ www.nichd.nih.gov/health/topics/puberty/conditioninfo#:~:text=The%20time%20in%20one's%20life,between%20ages%209%20and%2014.

⁵⁷ www.cdc.gov/asthma/most_recent_national_asthma_data.htm

⁵⁸ www.nature.com/articles/s41467-022-35742-z

⁵⁹ www.nhlbi.nih.gov/health/asthma/symptoms

⁶⁰ www.nhlbi.nih.gov/health/idiopathic-pulmonary-fibrosis

⁶¹ www.sciencedirect.com/science/article/pii/S221326002200251X?via%3Dihub

⁶² www.nhlbi.nih.gov/health/idiopathic-pulmonary-fibrosis#:~:text=This%20condition%20develops%20when%20that,progressively%20more%20difficult%20to%20breath.

⁶³ www.nhlbi.nih.gov/news/2022/experimental-anticancer-drug-shows-promise-treatment-idiopathic-pulmonary-fibrosis

recent study conducted by NHLBI-supported researchers examined the link between the body's circadian rhythms and the development of lung diseases.⁶⁴ The study, using observations from mice and human subjects, has uncovered a new mechanism underlying the link: a circadian rhythm protein called REV-ERB α . A lack of REV-ERB α contributes to lung scarring in mouse models by increasing production of collagen, a major component of connective tissue, and the enzyme lysyl oxidase, which makes connective tissue more rigid. Thus, REV-ERB α appears to be an important molecular regulator of fibrotic progression in the lungs. The team also found low levels of REV-ERB α and large amounts of collagen and lysyl oxidase in lung samples from patients with pulmonary fibrosis. Because REV-ERB α normally fluctuates throughout the day, peaking at noon and dipping at midnight, night shift work could make lungs more vulnerable to fibrosis development, especially if workers are also exposed to lung irritants during work hours. Further research exploring the molecular mechanisms related to circadian rhythm proteins could open new possibilities for developing strategies to treatment other fibrotic diseases.

Obstructive sleep apnea (OSA) is one of the most prevalent chronic sleep disorders, estimated to affect up to 30 million people in the United States.⁶⁵ It is associated with an increased risk for cardiovascular disease and mortality.^{66,67} The primary diagnostic tool for OSA is the Apnea-Hypopnea Index (AHI),⁶⁸ which measures the average number of times per hour breathing either partially or fully stops during sleep; however, there are limitations. NHLBI-funded researchers have developed a more accurate tool for diagnosing OSA, using a metric called ventilatory burden (VB), which effectively captures breath-by-breath reductions in airflow and isolates the purely ventilatory burden of the disorder.⁶⁹ The researchers leveraged data from 4 different NIH-funded cohorts to derive the normative range of VB from analysis of more than 34 million breaths. The team then assessed the relationship between the degree of upper-airway obstruction and VB and, using a unique algorithm, the relationship between VB and mortality risks, including cardiovascular disease and hypertension. Their method effectively assessed the severity of OSA and predicted mortality associated with cardiovascular diseases, which could potentially be a more successful diagnostic tool than the AHI. The team now plans to use an artificial intelligence algorithm along with the VB measure to identify patients who will benefit from continuous positive airway pressure treatment.

Budget Policy: The FY 2025 President's Budget request for NHLBI lung disease research is \$814.2 million, a decrease of \$1.7 million or 0.2 percent compared with the FY 2023 Final level.

⁶⁴ www.nhlbi.nih.gov/health/idiopathic-pulmonary-fibrosis#:~:text=This%20condition%20develops%20when%20that,progressively%20more%20difficult%20to%20breathe.

⁶⁵ www.ncbi.nlm.nih.gov/pmc/articles/PMC4909617/

⁶⁶ www.nhlbi.nih.gov/health/sleep-apnea/living-with

⁶⁷ www.atsjournals.org/doi/10.1164/rccm.202209-1808OC

⁶⁸ [www.cdc.gov/pcd/issues/2012/11_0117.htm#:~:text=An%20AHI%20of%20more%20than,as%20severe%20OSA%20\(9\).](http://www.cdc.gov/pcd/issues/2012/11_0117.htm#:~:text=An%20AHI%20of%20more%20than,as%20severe%20OSA%20(9).)

⁶⁹ pubmed.ncbi.nlm.nih.gov/37698405/

Blood Diseases and Resources

Venous and arterial thrombotic disorders—such as pulmonary embolism, venous thromboembolism, myocardial infarction, and stroke—are major causes of global morbidity and mortality.⁷⁰ Certain diseases and conditions can also raise a person’s chances of thrombosis,⁷¹ commonly called a blood clot. These include a stroke, paralysis, chronic heart disease, high blood pressure, surgical procedure, or recent cancer treatment. Women who take hormone therapy pills, birth control pills, are pregnant, or are within the first six weeks after giving birth are also at higher risk for clotting disorders. People who smoke and older adults (ages 60 years and older) are also at increased risk. Current treatments to prevent blood clots, namely anticoagulants and platelet antagonists, can lead to an elevated risk of bleeding.⁷² A 2015 study found that one-third of American adults ages 40 years and older were taking preventive aspirin or other antiplatelet medications.⁷³ Improved therapeutic strategies that diminish this risk would have a huge clinical impact. In a recent animal study funded by NHLBI, researchers designed a new compound called macromolecular polyanion inhibitor (MPI-8).⁷⁴ The compound prevented blood clots in mice, did not increase bleeding, and was well tolerated even in high doses. This finding may lead to significant changes in how doctors care for patients at risk for thrombosis, without raising the risk of bleeding.

NHLBI started the REDS program in 1989 to protect the U.S. blood supply from threats, improve the benefits of transfusions, and reduce the risks of transfusions.⁷⁵ After 30 years, now in its fourth phase, REDS aims to evaluate and

PATH-HHT Trial

Hereditary Hemorrhagic Telangiectasia (HHT), also known as Osler-Weber-Rendu disease, is a rare genetic disorder that affects 1 in 5,000 people worldwide.¹ Malformed blood vessels cause excessive bleeding from the nose (epistaxis) and gastrointestinal tract, requiring medical treatment, blood transfusions and impairing quality of life. Historically, there have been no effective medical therapies for HHT.² People of all ages, sexes, genders, races, and ethnicities are affected by HHT and experience the problems associated with the disorder, some of which are life-threatening.

The Pomalidomide for the Treatment of Bleeding in HHT (PATH-HHT) trial was exploring the use of an oral medication called pomalidomide, approved by FDA to be used in some cancers, for the treatment of HHT symptoms at 11 research centers across the United States. Adults suffering from HHT with moderate to severe epistaxis who require iron infusions or blood transfusions were enrolled in this study. NHLBI-funded researchers began enrolling patients in 2019 and with the active support of the patient organization CureHHT achieved sufficient number of participating patients to conclude, earlier than expected, that pomalidomide is efficacious to treat HHT.³

The early conclusion of the trial for investigational drug efficacy is strong evidence that pomalidomide will become the first ever effective treatment option for patients with this rare disorder.

¹ my.clevelandclinic.org/health/diseases/15618-hereditary-hemorrhagic-telangiectasia-hht

² www.cdc.gov/ncbddd/hht/index.html

³ curehht.org/

⁷⁰ www.nature.com/articles/nature06797#additional-information

⁷¹ www.nhlbi.nih.gov/health/venous-thromboembolism/causes

⁷² www.ncbi.nlm.nih.gov/books/NBK519025/#:~:text=Oral%20anticoagulants%20are%20classified%20as,be%20reversed%20with%20vitamin%20K.

⁷³ [www.ncbi.nlm.nih.gov/pmc/articles/PMC4612173/#:~:text=One%2Dthird%20\(33%25\)%20of,reported%20taking%20other%20antiplatelet%20medications.](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4612173/#:~:text=One%2Dthird%20(33%25)%20of,reported%20taking%20other%20antiplatelet%20medications.)

⁷⁴ www.nature.com/articles/s41467-023-37709-0

⁷⁵ www.nhlbi.nih.gov/science/recipient-epidemiology-and-donor-evaluation-study-reds-program

improve the safety and availability of the nation’s blood supply, as well as the safety and effectiveness of transfusion therapies across the lifespan with a new focus on understudied populations, including newborns, children, and pregnant women. This phase is a seven-year multicenter program in the United States and Brazil, charged with conducting epidemiologic and laboratory studies in blood donors and transfusion recipients.

NHLBI funds the BLOODSAFE program,⁷⁶ the goal of which is to enhance the availability and delivery of safe blood for transfusion into patients from low or lower-middle income countries in Sub-Saharan Africa. BLOODSAFE supports projects that develop and test effective and sustainable strategies to increase the number of safe blood donors. It also aims to improve the quality and safety of blood supplies and to enhance blood delivery to patients in need, especially in remote settings.⁷⁷

The Cure Sickle Cell Initiative (CureSCi)⁷⁸ is an NHLBI-led collaborative research effort to accelerate the development of genetic therapies to cure sickle cell disease. The initiative aims to transform the lives of many people affected by sickle cell disease—an estimated 100,000 Americans and more than 20 million worldwide—by creating a collaborative, patient-focused research environment. At this time, only bone marrow transplants can cure sickle cell disease, but they are most effective in children who have well-matched donors. CureSCi has identified and supports promising genetic therapies, which are currently being evaluated in multicenter clinical trials. Two therapies have been submitted to the FDA for review and approval by the investigational new drug sponsors, and preliminary results of these clinical trials are expected within three to five years. CureSCi has focused on curative strategies that use genetic therapies to modify hematopoietic stem cells, which make red and other blood cells, to prevent genetic mutations from making sickle-shaped red blood cells. This could make curative therapies available to a wider range of people with sickle cell disease. One CureSCi clinical trial opened for enrollment in 2022,⁷⁹ and enrollment is expected to begin in the second trial in the first half of 2024.

Budget Policy: The FY 2025 President’s Budget request for this research program is \$491.9 million, a decrease of \$1.0 million or 0.2 percent compared with the FY 2023 Final level.

⁷⁶ bloodsafe-research.org/#:~:text=BLOODSAFE%20supports%20projects%20that%20develop,need%2C%20especially%20in%20remote%20settings.

⁷⁷ pubmed.ncbi.nlm.nih.gov/37679772/

⁷⁸ www.nhlbi.nih.gov/science/cure-sickle-cell-initiative

⁷⁹ clinicaltrials.gov/study/NCT05353647?term=NCT05353647&rank=1

Center for Translation Research and Implementation Science

In July 2020, NHLBI and the National Institute on Minority Health and Health Disparities (NIMHD) started CEAL to establish a research approach that ensured the participation of racial and ethnic minority communities in COVID-19 vaccine research trials that were underway.⁸⁰ Moving forward, CEAL's successes provide a foundation for broadening its mission to address the host of health disparities that plague the very same communities. CEAL teams are located in 21 regions across the country, leverage existing relationships and partnerships, and recently expanded activities to address state and local concerns including social determinants that challenge health within specific communities. NHLBI is leveraging this community engagement research platform to support scientific initiatives that address other major public health issues, including maternal health and the impact of climate on health in areas across the country. NHLBI is utilizing the lessons learned through CEAL to enhance research within American Indian, Alaska Native, Asian, Native Hawaiian, and Pacific Islander communities, and partnering with other NIH programs to address other research priorities like the National Human Genome Research Institute's interest in improving understanding of and participation in genomic research. Through meaningful community engagement, CEAL has the potential to transform discovery into health impact and reduce disparities.

According to the World Health Organization, approximately 38.4 million people globally are currently living with HIV;⁸¹ those with access to effective antiretroviral therapy and care are generally able to manage the virus to live long, full lives. The American Heart Association reports that, as people living with HIV age, they are at higher risk of various chronic medical conditions, including hypertension and other forms of cardiovascular disease.⁸² NHLBI's Heart, Lung, and Blood Co-morbidities Implementation Models in People Living with HIV (HLB-SIMPLE) program,⁸³ is a collection of research studies co-funded by the NIH Fogarty International Center. Researchers from African and American universities are working together with governments, community partners, and health facilities to test strategies for delivering effective hypertension detection, prevention, and treatment initiatives to affected individuals. There are currently studies in Botswana, Mozambique, Nigeria, South Africa, Uganda, and Zambia. These distinctive implementation clinical trials are designed to test and estimate costs for strategies to foster sustainable and scalable uptake of effective interventions in routine clinical, public health, and community settings. These implementation studies will help to ensure that all people living with HIV can access the care they need to maintain their health and wellbeing—beyond just medications to suppress HIV. Moreover, the ongoing methodological training opportunities supported by this consortium will increase the late-stage translation research workforce available to move discoveries into practice.

Heart and lung disease are the leading causes of illness and death in the United States, and the disease burden is unequal across groups defined by race, ethnicity, sex, gender, and socioeconomic status.⁸⁴ Numerous programs have been proven to reduce heart or lung disease, but too often they are not put into practice in the communities where they are most needed. In September 2020, the Disparities Elimination through Coordinated Interventions to Prevent and

⁸⁰ www.nhlbi.nih.gov/news/2020/COVID-19-nih-funds-community-engagement-research-efforts-areas-hardest-hit

⁸¹ www.who.int/data/gho/data/themes/hiv-aids

⁸² www.ahajournals.org/doi/10.1161/CIR.0000000000000695

⁸³ www.hlbsimple.org/

⁸⁴ www.nhlbi.nih.gov/science/health-disparities-and-inequities

Control Heart and Lung Disease Risk (DECIPHeR) Alliance⁸⁵ was created, comprised of seven implementation research centers throughout the country. This seven-year (2020-2027) cooperative agreement has two phases.⁸⁶ The first phase (2020-2023) was exploratory, including community engagement activities such as establishing community advisory boards and working with high-burden communities to articulate locally relevant implementation strategies. The second phase of the Alliance, which began in 2023, builds on connections made and lessons learned in the first phase to test implementation strategies for optimally and sustainably delivering proven evidence-based multi-level interventions in clinical practice and community settings to reduce or eliminate cardiovascular and pulmonary health disparities.

Budget Policy: The FY 2025 President’s Budget request for CTRIS is \$126.6 million, a decrease of \$0.3 million or 0.2 percent compared with the FY 2023 Final level.

Division of Intramural Research

The MRI Technology Program,⁸⁷ within the NHLBI Division of Intramural Research (DIR), focuses on the development of novel MRI technology for cardiac imaging, lung imaging, and MRI-guided cardiovascular catheterization procedures. When doctors need detailed images of the lungs, they frequently use chest CT scans. Over the years, these scans have been particularly useful in diagnosing lung diseases—so useful, in fact, that around 80 million people in the United States get them every year.⁸⁸ However, radiation doses for CT scans can be hundreds of times higher than conventional X-rays. NHLBI’s innovative MRI technology program now makes it possible to maintain good image quality when testing for certain lung diseases while eliminating radiation exposure. To achieve this, NHLBI researchers developed new techniques to capture and process images using low-field MRI scanners.⁸⁹ Researchers then applied novel, advanced reconstruction methods using contemporary computational power integrated into the clinical environment using the “Gadgetron,” an open-source tool for medical image reconstruction. The program emphasizes translation of new methods to clinical applications by collaborating with cardiologists, pulmonologists, radiologists, and critical care physicians. Recently, these NHLBI researchers conducted a clinical trial to test a lower energy version of an MRI to make it possible to scan people with metal devices in their body, or to be used when conducting invasive heart procedures using metal tools. The technique provides accurate measures of a number of cardiac functions and locations within the heart without exposure to ionizing radiation. The researchers are now testing whether cardiovascular magnetic resonance (CMR) scans, which use lower power rays, can still create high image quality by technical optimization of the CMR signal. Among other goals, the trial will assess the potential of CMR to be used for accurate imaging instead of the conventional MRI scan.

In the United States, rural populations have higher rates of death associated with heart disease compared to urban populations.⁹⁰ Additionally, high blood pressure, a major risk factor for heart

⁸⁵ decipheralliance.org/

⁸⁶ www.nhlbi.nih.gov/node-general/frequently-asked-questions-decipher-ug3uh3-rfa-hl-20-003

⁸⁷ www.nhlbi.nih.gov/science/mri-technology

⁸⁸ www.nhlbi.nih.gov/news/2020/medical-imaging-advances-may-reduce-radiation-risk-vulnerable-patients#:~:text=Over%20the%20years%20these%20scans,higher%20than%20conventional%20X%20Drays.

⁸⁹ pubmed.ncbi.nlm.nih.gov/31573398/

⁹⁰ www.nhlbi.nih.gov/science/health-disparities-and-inequities#:~:text=In%20the%20United%20States%2C%20rural,and%20stroke%20than%20urban%20populations.

disease, is more common and not as well controlled in adults who are Black or Hispanic compared to adults who are white. In a recent study conducted by NHLBI, researchers examined the incidence of heart disease by rurality status across race and sex in a large community cohort of Black and White adults in the southeastern U.S.⁹¹ Among a large cohort of predominantly low-income Black and White participants, heart failure incidence was 21 percent higher among adults living in rural areas. Results varied by race-sex group, with Black men living in rural areas experiencing the highest rate of heart failure. This substantial excess risk persisted after adjustment for biological, behavioral, and sociocultural risk factors. The results underscore the importance of examining the effect of rurality by race-sex group, as researchers observed that both White and Black women had an increased risk of heart failure associated with rurality, in contrast to White men, who had no rurality-associated risk of heart failure. Researchers called for personalized prevention, focusing on rural women and rural Black men as key groups, and for further research to elucidate the association between rurality and risk of heart failure.

In 2023, more than 20,000 people will be diagnosed with acute myeloid leukemia (AML), a group of rare blood cancers associated with a 31.7 percent 5-year relative survival rate.⁹² One method of treatment is a stem cell, or bone marrow, transplant from donors for patients who are in remission. Unfortunately, the disease reoccurs in approximately 30 percent of patients after allogeneic hematopoietic cell transplant and is the most common cause of post-transplant death. NHLBI researchers aimed to create a metric to determine whether or not a patient receiving a stem cell transplant was at increased risk for subsequent relapse and death. Research suggests that measuring the small number of cancer cells that remain post-treatment, or measurable residual disease (MRD), may provide information regarding risk for subsequent relapse and mortality. However, there is no standard method for AML MRD testing. Researchers used targeted deep DNA sequencing to look for disease-associated variants using the blood of AML patients.⁹³ Among patients with AML in first remission prior to stem cell transplant, the presence of two genetic variants (*FLT3-ITD* or *NPM1*) above a certain level was associated with increased relapse and worse survival compared with those without variants detected. This strategy may also be applied to diagnose and understand the etiology of other chronic diseases, such as sickle cell disease.

For individuals who have received organ transplantation, continual monitoring is needed to ensure continued health of the patient and prevent donor organ rejection. Given the need for intense immunosuppressive regimens, lung transplant patients are at especially increased risk of infection and organ rejection soon after transplant. Post-transplant monitoring typically involves routine bronchoscopies (a procedure to examine the interior of the lungs)⁹⁴ along with biopsies, especially during the first year post-transplant. In an effort to implement a less invasive detection and monitoring approach during the COVID-19 pandemic, NIH researchers tested the cell-free DNA (cfDNA) levels in the blood of lung transplant recipients.⁹⁵ When a cell dies, it releases pieces of double-stranded DNA into the bloodstream, collectively known as cfDNA.

⁹¹ jamanetwork.com/journals/jamacardiology/article-abstract/2800877?resultClick=1

⁹² seer.cancer.gov/statfacts/html/amyl.html

⁹³ jamanetwork.com/journals/jama/fullarticle/2802059?guestAccessKey=9e9d4fbc-d6f8-4dfa-993c-f1ca98c07380&utm_source=For_The_Media&utm_medium=referral&utm_campaign=ftm_links&utm_content=tf1&utm_term=030723

⁹⁴ <https://www.nhlbi.nih.gov/health/lung-tests>

⁹⁵ [www.jhltonline.org/article/S1053-2498\(21\)02630-9/fulltext](https://www.jhltonline.org/article/S1053-2498(21)02630-9/fulltext)

Transplant recipients have cfDNA from both their own cells and the donated cells. Previous research has shown that the relative amounts of donor-derived cfDNA (dd-cfDNA) compared to recipient-derived cfDNA has the potential to be a useful biomarker of organ rejection, but this has not been tested as a method of routine clinical monitoring. NHLBI researchers periodically collected blood from patients within three years of their transplant and found that increased levels of dd-cfDNA indicated either rejection or infection of the donated tissue, suggesting this method is a convenient and reliable way to monitor health. Additional testing is needed to establish clinical guidelines and may be applicable for the use of monitoring the health of other transplanted organs.

NHLBI's Intramural Sickle Cell Branch⁹⁶ conducts research to understand sickle cell disease and identify markers of disease severity. Specific projects aim to better predict long-term outcomes and to develop therapies through genetics and genomics. The Branch is also developing and improving treatments for severe pain episodes, also known as pain crises. These pain crises may occur without warning, when sickled cells block blood flow. People describe this pain as sharp, intense, stabbing, or throbbing.⁹⁷ Recently, a proof-of-concept clinical study showed that the pyruvate kinase activator, mitapivat (AG-348), has disease-modifying potential in patients with sickle cell disease.⁹⁸ It improved red and white blood cell counts and hemoglobin concentration, increased blood oxygen levels, and reduced sickling in patients with sickle cell anemia. Pain crises are a main clinical feature for people with sickle cell disease. Finding ways to lessen these occurrences provides much needed benefit.

Budget Policy: The FY 2025 President's Budget request for NHLBI intramural research is \$266.8 million, an increase of \$12.6 million or 4.9 percent compared with the FY 2023 Final level.

Research Management and Support

RMS activities include administrative and technical functions that support and enhance the effectiveness of the Institute's research investments. This includes providing administrative, budgetary, logistical, and scientific support in the review, award, and monitoring of research grants and clinical trials, training awards, and research and development contracts. RMS functions also encompass strategic planning, trans-NHLBI and NIH coordination, evaluation of the Institute's programs, regulatory compliance, international coordination, interactions with other Federal agencies and Congress, and dissemination of research findings to the public.

Budget Policy: The FY 2025 President's Budget request for RMS at NHLBI is \$164.1 million, an increase of \$6.6 million or 4.2 percent compared with the FY 2023 Final level.

⁹⁶ www.nhlbi.nih.gov/about/intramural-research/sickle-cell

⁹⁷ www.nhlbi.nih.gov/health/sickle-cell-disease/health-effects

⁹⁸ <https://ashpublications.org/blood/article-abstract/doi/10.1182/blood.2022015403/485276/A-Phase-1-Dose-Escalation-Study-of-the-Pyruvate?redirectedFrom=fulltext>

**NATIONAL INSTITUTES OF HEALTH
NATIONAL HEART, LUNGS, AND BLOOD INSTITUTE**

Appropriations History

Fiscal Year	Budget Estimate to Congress	House Allowance	Senate Allowance	Appropriation
2016	\$3,071,906,000	\$3,035,062,000	\$3,135,519,000	\$3,115,538,000
Rescission	-	-	-	\$0
2017 ¹	\$3,113,533,000	\$3,190,474,000	\$3,242,685,000	\$3,206,589,000
Rescission	-	-	-	\$0
2018	\$2,534,803,000	\$3,256,521,000	\$3,322,774,000	\$3,383,201,000
Rescission	-	-	-	\$0
2019	\$3,112,032,000	\$3,423,604,000	\$3,490,171,000	\$3,488,335,000
Rescission	-	-	-	\$0
2020	\$3,002,696,000	\$3,658,822,000	\$3,694,771,000	\$3,624,258,000
Rescission	-	-	-	\$0
Supplemental	-	-	-	\$103,400,000
2021	\$3,298,004,000	\$3,655,428,000	\$3,728,307,000	\$3,664,811,000
Rescission	-	-	-	\$0
2022	\$3,845,681,000	\$3,866,828,000	\$3,841,998,000	\$3,808,494,000
Rescission	-	-	-	\$0
2023	\$3,822,961,000	\$3,943,702,000	\$3,946,557,000	\$3,982,345,000
Rescission	-	-	-	\$0
2024	\$3,985,158,000	\$3,982,345,000	\$3,982,345,000	\$3,982,345,000
Rescission	-	-	-	\$0
2025	\$3,997,086,000	-	-	\$0

¹ Budget Estimate to Congress includes mandatory financing.

**NATIONAL INSTITUTES OF HEALTH
NATIONAL HEART, LUNGS, AND BLOOD INSTITUTE**

Authorizing Legislation

Recipients	PHS Act/Other Citations	U.S. Code Citations	2024 Amount Authorized	FY 2024 CR	2025 Amount Authorized	FY 2025 President's Budget
Research and Investigation	Section 301	42 Section 241	Indefinite	\$3,982,345,000	Indefinite	\$3,997,086,000
National Heart, Lung, and Blood Institute	Section 401(a)	42 Section 281				
Total Budget Authority				\$3,982,345,000		\$3,997,086,000

AMOUNTS AVAILABLE FOR OBLIGATION

NATIONAL INSTITUTES OF HEALTH
NATIONAL HEART, LUNGS, AND BLOOD INSTITUTE

Amounts Available for Obligation¹
(Dollars in Thousands)

Source of Funding	FY 2023 Final	FY 2024 CR	FY 2025 President's Budget
Appropriation	\$3,982,345	\$3,982,345	\$3,997,086
Mandatory Appropriation: (non-add)	-	-	-
<i>Type 1 Diabetes</i>	(\$0)	(\$0)	(\$0)
<i>Other Mandatory financing</i>	(\$0)	(\$0)	(\$0)
Subtotal, adjusted appropriation	\$3,982,345	\$3,982,345	\$3,997,086
OAR HIV/AIDS Transfers	\$2,813	\$0	\$0
Subtotal, adjusted budget authority	\$3,985,158	\$3,982,345	\$3,997,086
Unobligated balance, start of year	\$0	\$0	\$0
Unobligated balance, end of year (carryover)	\$0	\$0	\$0
Subtotal, adjusted budget authority	\$3,985,158	\$3,982,345	\$3,997,086
Unobligated balance lapsing	-\$237	\$0	\$0
Total obligations	\$3,984,921	\$3,982,345	\$3,997,086

¹ Excludes the following amounts (in thousands) for reimbursable activities carried out by this account:
FY 2023 - \$23,861 FY 2024 - \$23,861 FY 2025 - \$23,911

BUDGET AUTHORITY BY OBJECT CLASS

**NATIONAL INSTITUTES OF HEALTH
NATIONAL HEART, LUNGS, AND BLOOD INSTITUTE**

Budget Authority by Object Class¹

(Dollars in Thousands)

OBJECT CLASSES	FY 2024 CR	FY 2025 President's Budget
Total compensable workyears:		
- Full-time equivalent	966	966
- Full-time equivalent of overtime and holiday hours	1	1
- Average ES salary	\$224	\$230
- Average GM/GS grade	12.8	12.8
- Average GM/GS salary	\$140	\$144
- Average salary, Commissioned Corps (42 U.S.C. 207)	\$124	\$130
- Average salary of ungraded positions	\$170	\$174
- Personnel Compensation	-	-
11.1 Full-Time Permanent	\$84,655	\$87,026
11.3 Other Than Full-Time Permanent	\$44,475	\$45,720
11.5 Other Personnel Compensation	\$7,208	\$7,410
11.7 Military Personnel	\$2,863	\$2,997
11.8 Special Personnel Services Payments	\$13,345	\$13,719
11.9 Subtotal Personnel Compensation	\$152,546	\$156,871
12.1 Civilian Personnel Benefits	\$49,984	\$51,657
12.2 Military Personnel Benefits	\$519	\$543
13.0 Benefits to Former Personnel	\$0	\$0
- Subtotal Pay Costs	\$203,049	\$209,072
21.0 Travel & Transportation of Persons	\$2,899	\$2,963
22.0 Transportation of Things	\$474	\$484
23.1 Rental Payments to GSA	\$0	\$0
23.2 Rental Payments to Others	\$9	\$9
23.3 Communications, Utilities & Misc. Charges	\$234	\$240
24.0 Printing & Reproduction	\$3	\$3
25.1 Consulting Services	\$120,470	\$123,717
25.2 Other Services	\$118,900	\$113,326
25.3 Purchase of Goods and Services from Government Accounts	\$324,346	\$328,189
25.4 Operation & Maintenance of Facilities	\$421	\$424
25.5 R&D Contracts	\$152,631	\$155,989
25.6 Medical Care	\$1,989	\$2,067
25.7 Operation & Maintenance of Equipment	\$16,475	\$16,630
25.8 Subsistence & Support of Persons	\$0	\$0
25.0 Subtotal Other Contractual Services	\$735,233	\$740,342
26.0 Supplies & Materials	\$15,848	\$16,193
31.0 Equipment	\$10,407	\$10,630
32.0 Land and Structures	\$4,253	\$4,346
33.0 Investments & Loans	\$0	\$0
41.0 Grants, Subsidies & Contributions	\$3,009,858	\$3,012,725
42.0 Insurance Claims & Indemnities	\$0	\$0
43.0 Interest & Dividends	\$78	\$78
44.0 Refunds	\$0	\$0
- Subtotal Non-Pay Costs	\$3,779,296	\$3,788,014
- Total Budget Authority by Object Class	\$3,982,345	\$3,997,086

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

**NATIONAL INSTITUTES OF HEALTH
NATIONAL HEART, LUNGS, AND BLOOD INSTITUTE**

Salaries and Expenses
(Dollars in Thousands)

Object Classes	FY 2024 CR	FY 2025 President's Budget
<i>Personnel Compensation</i>		
Full-Time Permanent (11.1)	\$84,655	\$87,026
Other Than Full-Time Permanent (11.3)	\$44,475	\$45,720
Other Personnel Compensation (11.5)	\$7,208	\$7,410
Military Personnel (11.7)	\$2,863	\$2,997
Special Personnel Services Payments (11.8)	\$13,345	\$13,719
Subtotal, Personnel Compensation (11.9)	\$152,546	\$156,871
Civilian Personnel Benefits (12.1)	\$49,984	\$51,657
Military Personnel Benefits (12.2)	\$519	\$543
Benefits to Former Personnel (13.0)	\$0	\$0
Subtotal Pay Costs	\$203,049	\$209,072
Travel & Transportation of Persons (21.0)	\$2,899	\$2,963
Transportation of Things (22.0)	\$474	\$484
Rental Payments to Others (23.2)	\$9	\$9
Communications, Utilities & Misc. Charges (23.3)	\$234	\$240
Printing & Reproduction (24.0)	\$3	\$3
<u>Other Contractual Services</u>	-	-
Consultant Services (25.1)	\$120,470	\$123,717
Other Services (25.2)	\$118,900	\$113,326
Purchase of Goods and Services from Government Accounts (25.3)	\$224,717	\$228,262
Operation & Maintenance of Facilities (25.4)	\$421	\$424
Operation & Maintenance of Equipment (25.7)	\$16,475	\$16,630
Subsistence & Support of Persons (25.8)	\$0	\$0
Subtotal Other Contractual Services	\$480,983	\$482,359
Supplies & Materials (26.0)	\$15,848	\$16,193
Subtotal Non-Pay Costs	\$500,451	\$502,252
Total Administrative Costs	\$703,500	\$711,323

DETAIL OF FULL-TIME EQUIVALENT EMPLOYMENT (FTE)

**NATIONAL INSTITUTES OF HEALTH
NATIONAL HEART, LUNGS, AND BLOOD INSTITUTE**

Detail of Full-Time Equivalent Employment (FTE)

Office	FY 2023 Final			FY 2024 CR			FY 2025 President's Budget		
	Civilian	Military	Total	Civilian	Military	Total	Civilian	Military	Total
Division of Intramural Research									
Direct:	432	13	445	443	12	455	443	12	455
Reimbursable:	18	-	18	18	-	18	18	-	18
Total:	450	13	463	461	12	473	461	12	473
Office of the Director									
Direct:	166	2	168	175	2	177	175	2	177
Reimbursable:	-	-	-	-	-	-	-	-	-
Total:	166	2	168	175	2	177	175	2	177
Division of Blood and Resources									
Direct:	26	1	27	27	1	28	27	1	28
Total:	26	1	27	27	1	28	27	1	28
Division of Lung Diseases									
Direct:	44	-	44	45	-	45	45	-	45
Total:	44	-	44	45	-	45	45	-	45
Center for Translation Research and Implementation Science									
Direct:	18	1	19	18	1	19	18	1	19
Total:	18	1	19	18	1	19	18	1	19
Division of Cardiovascular Sciences									
Direct:	121	-	121	122	-	122	122	-	122
Total:	121	-	121	122	-	122	122	-	122
Division of Extramural Research Activities									
Direct:	101	-	101	102	-	102	102	-	102
Total:	101	-	101	102	-	102	102	-	102
Total	926	17	943	950	16	966	950	16	966
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								
2021	12.7								
2022	12.7								
2023	12.8								
2024	12.8								
2025	12.8								

**NATIONAL INSTITUTES OF HEALTH
NATIONAL HEART, LUNGS, AND BLOOD INSTITUTE**

Detail of Positions¹

GRADE	FY 2023 Final	FY 2024 CR	FY 2025 President's Budget
Total, ES Positions	1	2	2
Total, ES Salary	\$212,100	\$447,044	\$459,561
General Schedule			
GM/GS-15	100	100	100
GM/GS-14	187	188	188
GM/GS-13	223	225	225
GS-12	75	81	82
GS-11	41	43	42
GS-10	0	0	280
GS-9	28	28	36
GS-8	1	1	1
GS-7	7	7	7
GS-6	3	3	3
GS-5	5	5	5
GS-4	6	6	6
GS-3	5	5	5
GS-2	2	2	2
GS-1	1	1	1
Subtotal	684	695	695
Commissioned Corps (42 U.S.C. 207)			
Assistant Surgeon General	1	1	1
Director Grade	4	4	4
Senior Grade	4	4	4
Full Grade	7	7	7
Senior Assistant Grade	0	0	0
Assistant Grade	0	0	0
Junior Assistant	0	0	0
Subtotal	16	16	16
Ungraded	286	286	286
Total permanent positions	650	650	650
Total positions, end of year	987	999	999
Total full-time equivalent (FTE) employment, end of year	943	966	966
Average ES salary	\$212,100	\$223,522	\$229,780
Average GM/GS grade	12.8	12.8	12.8
Average GM/GS salary	\$133,033	\$140,262	\$144,189

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