## UNIVERSITY OF PITTSBURGH School of Medicine FACT BOOK » 2023/2024



#### UNIVERSITY OF PITTSBURGH 2023–24 SCHOOL OF MEDICINE FACT BOOK

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ABOUT THE COVER: Alan Magee Scaife Hall West Wing addition

#### Overview

The University of Pittsburgh School of Medicine trains and develops physician leaders and scientists who are agents of change. Our students learn that they will become vital members of interprofessional teams and that each team member brings unique and valuable expertise to the care of the patient. This is at the core of our mission.

At Pitt Med, a simple phrase expresses our admiration and gratitude for excellence in education: "Hail to Pitt." Each letter in HAIL has meaning. Every student is trained to be a healer who looks, listens—especially to patients—and learns; an activist working toward changing a systemic problem or social condition; an innovator and improviser constantly finding better solutions; and a leader who will be a champion of those less fortunate.

Pitt-trained students are prepared for leadership in science, education, clinical care and administration. They will develop scientific breakthroughs, harness entrepreneurial energy, teach future physicians, make health care more accessible and eliminate health disparities.

We pledge to sustain these goals by advancing excellence in innovation, research, education, clinical and translational medicine, and systematic professional development.

## About the Dean



ANANTHA SHEKHAR, MD, PHD, is senior vice chancellor for the health sciences and John and Gertrude Petersen Dean of the University of Pittsburgh School of Medicine. He is a nationally recognized educator, researcher and entrepreneur with major contributions in medicine and life sciences.

At Pitt, Dr. Shekhar leads all six health sciences schools that, for more than a century, hav<u>e been educational and</u> research leaders in their respective fields, propelling scientific discovery and clinical innovation that advance human health. Education at the schools of the health sciences—Dental Medicine, Health and Rehabilitation Sciences, Medicine, Nursing, Pharmacy, and Public Healthemphasizes interdisciplinary instruction and leadership that incorporates the most advanced techniques and technologies to prepare future researchers, physicians, and health care providers and administrators for careers of leadership and service. Dr. Shekhar's responsibilities include shaping the careers of more than 6,000 faculty and staff members, as well as the academic success of approximately 5,000 students annually, all while supporting Pitt's position as a top-ranked recipient of National Institutes of Health (NIH) research dollars. He also works closely with UPMC, one of the nation's largest health care systems, to ensure that health care delivery, biomedical research and education—already among the nation's elite—continue to flourish.

Innovation, transformation and successful collaborations across the private, public and philanthropic sectors have defined Dr. Shekhar's distinguished career. His work focuses on the role of brain abnormalities that could lead to stress and psychiatric disorders. A number of grants from NIH, private foundations and commercial collaborations have supported his research; overall, he has coauthored more than 200 original scientific papers published in leading basic science and clinical journals.

Dr. Shekhar's areas of expertise include basic and clinical research on the effects of stress, stress-induced psychiatric disorders and clinical psychopharmacology. His laboratory has developed several translational models for psychiatric disorders and identified novel targets for neuropsychiatric disorder treatments that are now in commercial development. He is also founder of a number of biotech companies developing novel therapies.

Dr. Shekhar is an elected member of the National Academies of Sciences, Engineering, and Medicine's Forum on Drug Discovery, Development, and Translation. Dr. Shekhar, who was born in India, earned his medical degree at St. John's Medical College, Bangalore, and PhD in neuroscience at Indiana University.

### Demographics

As of the 2023-24 academic year, 586 MD students are registered in the School of Medicine, including 331 (56%) women, 244 (41%) men and 18 (3%) students who chose not to list their gender.

Of these, 232 (33%) are from Pennsylvania and approximately 111 (19%) are from groups that are underrepresented within the medical profession.

There are 421 registrants in PhD programs (including those in the Medical Scientist Training Program). Of these, 55% are women, 43% are men and 2% registered as other or unreported. Ninety of these registered students are from Pennsylvania, and 48 are from groups that are underrepresented within the school's PhD programs. One hundred sixty-one students are registered in MS programs, and 38 are registered in certificate programs.

For 2023, 8,782 applications for admission were received, and 1,020 prospective students were interviewed for a first-year class of 148 medical students.

The School of Medicine has 2,609 regular faculty members. Of these, 2,538 are full-time and 71 part-time. The school has 1,670 volunteer faculty members. Of these, 1,419 are clinical volunteer faculty and 251 are volunteer faculty. Seventy-three regular faculty members are part of the Academy of Distinguished Medical Educators, an organization that recognizes and rewards excellence in teaching and educational scholarship.

#### Curriculum

After four years of development, the School of Medicine rolled out its new Three Rivers Curriculum (3RC) in fall 2023, beginning with the incoming Class of 2027. The University of Pittsburgh School of Medicine has long been recognized nationally and internationally for educational excellence and is currently ranked nationally at #10 for primary care, #13 for research and #16 for clinical medicine globally in the 2023-24 issue of U.S. News & World Report Best Colleges. The updated curriculum will advance the school even further to the forefront of medical education worldwide.

#### Three Rivers Curriculum

Throughout the 3RC, key content threads, like social medicine, leadership, interprofessional education and clinical reasoning, are interlaced with student education. The Foundations segment is the phase that shifts from mostly large lecture sessions to case-based, small-group learning. Weekly cases unfold and build over a condensed 15-month period, culminating in weekly formative assessments, monthly summative assessments and three formative progress tests. These case-based workshops enhance active learning and student engagement with dedicated educators who serve as the students' mentors and collaborators. The Foundations segment includes one semester of Keystone Fundamentals to develop foundational science knowledge in anatomy, immunology, genetics and microbiology. In addition, students will develop core clinical skills and societal connections. To support individual learning styles and build a strong foundation in self-directed learning, flex weeks have been added to decelerate learning and allow



students time for professional enrichment and remediation activities. Following Foundations, students participate in approximately one year of clerkships, beginning in February of their second year, where they gain essential patient care experience. Students then begin their transition into residency through the Bridges phase, beginning in March of their third year and continuing through graduation, where students acquire more clinical knowledge and skills and focus more on their planned specialties.

For more information: https://www.omed.pitt.edu/curriculum/curriculum-map

#### Longitudinal Research Project

All medical students engage in a scholarly research project that is incorporated longitudinally throughout the curriculum. A wide range of opportunities include traditional laboratory-based or clinical research experiences, as well as alternatives, such as health policy, epidemiology and comparative effectiveness research, that appeal to individual student interests and long-term career aspirations. Projects aim to illustrate the mechanics of scientific investigation; teach students how to develop a hypothesis and how to collect, analyze, and interpret data; encourage students to pursue research opportunities; and help them understand the fundamental thought processes that lead to success in clinical medicine.

The Class of 2023 was the 17th class to complete the four-year longitudinal research project experience. Their endeavors resulted in 311 manuscripts published, 89 submitted and 101 in preparation at the time of graduation. Additional research accomplishments of the Class of 2023 included 389 presentations at national or international conferences and 113 at regional or local meetings. These new graduates received 59 national or state awards and 135 local awards in recognition of their research.

#### Simulation Training

Simulation training allows medical students to engage in comprehensive learning activities using hybrid courses that combine state-of-the-art online learning with immersive, hands-on opportunities. In the anatomy suite, use of virtual reality tools like Microsoft HoloLens and an Anatomage Table, offer a highly realistic and interactive three-dimensional representation of human anatomy to complement cadaveric dissection. Pitt's Peter M. Winter Institute for Simulation Education and Research (WISER) offers task-specific models combined with CAE Vimedix augmented reality learning, which uses HoloLens technology and three-dimensional ultrasound probes to develop proficiency in point-of-care ultrasound diagnostic skills. Simulation training allows students to practice and perfect their skills in suturing, airway management and proper techniques for conducting heart and lung exams, as well as breast, pelvic and prostate exams, which often leads students to seek additional elective time with these sophisticated training tools. WISER is considered one of the world's leading academic accredited medical simulation training centers, pairing the latest lifelike computer-based simulation technology with medical education so that students can learn and perfect clinical procedures before performing them on actual patients.

For more information: www.wiser.pitt.edu



#### **Standardized Patients**

Throughout their medical education, students encounter standardized patients—actors who are specially trained to present realistic and consistent behavior, symptoms and medical histories in simulated doctor-patient interactions. These sessions are designed to help students develop their clinical skills and learn how to deal with unusual or unexpected circumstances in a safe and constructive environment. Students find that these experiences reinforce lessons they have learned through other components of the curriculum and, in a realistic way, make them relevant. A standardized patient can contribute to the learning process by stepping out of character to offer feedback on the encounter and an assessment of the student's performance.

#### Longitudinal Alliance Program

The Longitudinal Alliance Program is an established activity at the School of Medicine that focuses on connecting a student with a patient in the student's first year of medical school. Faculty choose moderately complex cases, and the students maintain relationships with these patients throughout the course of their education. Students grow in knowledge and experience as they accompany the patients to medical visits and observe the course of their health over time. The student clinical experience is supported by a program of physician-mentored small-group sessions. In these sessions students discuss their patient's experience with illness and care and the biological, psychological and social factors that influenced those experiences.

#### Community Alliance Program

A flagship of the new curriculum is an innovative Community Alliance Program (CAP) geared toward strengthening the school's service to the community and enhancing students' ability to address the social determinants of health in their future careers. As part of CAP, groups of 8-10 students and their faculty advisor or longitudinal educator will forge an alliance with a community partner organization (CPO) to learn and support the work of the partner over a one-year period. CAP plans to facilitate continued student connection with the community partner beyond the first year of medical training to develop long-term partnerships with 16 CPOs, facilitating engagement for 150 students annually. Through these intentional, respectful, longitudinal and largescale engagements with community engagement and improve health equity indicators and, ultimately, health outcomes.

#### Streams

Streams, similar to a minor in college, enable students to cultivate their enthusiasm for a particular aspect of medicine through hands-on experiences, faculty mentoring, research projects and other activities throughout all four years. Three stream categories—advocate, innovator and leader—each encompass areas of focus, such as population health, entrepreneurship, and education.

For more information: https://www.omed.pitt.edu/streams



#### Global Engagement

School of Medicine collaborations connect Pittsburgh with China, France, Ghana, Honduras, India, Ireland, Italy, Kazakhstan, Malawi, the Philippines and many other nations. Medical students, residents and young investigators who train in this milieu encounter a wide variety of influences and discover a great many opportunities to broaden their horizons. Here are a few examples:

The School of Medicine has a historic agreement with **Tsinghua University**, one of China's elite institutions of higher learning for science and technology. Since 2012, a significant proportion of students from Tsinghua's medical school spend two years in Pittsburgh immersed in biomedical research. As of summer 2023, Pitt's Tsinghua Scholars program has hosted 195 participants. In 2017, the original group of Tsinghua Scholars graduated from Tsinghua University's medical school, becoming the first Pitt-trained Tsinghua scholars to earn their medical degrees. Tsinghua has recently added an MD/PhD option to its degree offerings, with selected students becoming eligible for the PhD portion of the combined degree after an additional research year at Pitt Med.

In 2017, the School of Medicine and UPMC partnered with the **Institut de la Vision in Paris**, a global leader in basic and clinical vision research that is developing treatments for currently untreatable retinal diseases and vision disorders. The School of Medicine then entered an agreement with three additional world-renowned French research institutions: the Université Pierre et Marie Curie of the Sorbonne Universités in Paris, the Institut National



de la Santé et de la Recherche Médicale (Inserm), and the Centre National de la Recherche Scientifique (CNRS). These partnerships have enabled collaborative ophthalmology, vision, and neuroscience research, as well as extensive scientific and educational exchange.

The School of Medicine has also maintained a robust relationship with Malawi. Pitt-affiliated medical students and residents routinely complete rotations at **Kamuzu Central Hospital**, a government referral and teaching hospital in Lilongwe. These residents, students and other members of the School of Medicine have played a crucial role in providing inpatient hospital care and facilitating teaching and training programs for medical students and trainees from Malawi.

In 2012, the School of Medicine was selected to guide the **Republic of Kazakhstan's Nazarbayev University** (NU) as it established its own medical school. The school aims to educate physician-scientists to become the Central Asian nation's next leaders in health care, medical education and biomedical research. Pitt has partnered with NU to institute a U.S.-style curriculum; design and develop teaching facilities; recruit and train school leadership and faculty; plan organizational and administrative structures, policies and procedures; and develop courses, syllabi and clinical experiences with the participation of physician-educators from Kazakhstan and around the globe. The NU School of Medicine welcomed its first class in 2015 and began accepting international students in 2017. The inaugural class of NU MDs graduated in May 2019.

The School of Medicine launched a pilot course in 2021 that paired two fourth-year students with medical professionals in Kenya to offer the future physicians experience in global medicine. The new elective, **Global Telemedicine with the Addis Clinic** (www.addisclinic.org), had students starting their days at 6 a.m. in Pittsburgh to log on with clinical officers in Kenya. These officers provided guidance as students engaged with patients to conduct a history and limited physical exam. In the afternoons, the students presented each daily case and clinical reasoning to Pitt faculty, creating a plan for an additional workup or case management before sharing it with the clinical officer back in Kenya. The program expanded in 2022 and now enrolls four to six additional students each year.

The University of Pittsburgh School of Medicine has partnered with three other institutions—University of Maryland, Baltimore, University of Alabama at Birmingham, and Baylor College of Medicine—to form a consortium for the NIH Fogarty International Center-funded **Integrated Network of Scholars in Global Health Research Training** (INSIGHT). A total of 145 faculty members across the multidisciplinary consortium are working with institutions in 24 low- and middle-income countries (LMIC) in sub-Saharan Africa, South Asia, Latin America and the Caribbean to support mentored research training in global health for U.S. doctoral candidates and U.S. and LMIC postdoctoral fellows. The INSIGHT program focuses on four disease tracks, four population tracks and three science tracks that concentrate on global health research and other priorities identified by the LMIC partner institutions.

#### Opportunities for In-Depth Study

The **Medical Scientist Training Program** (MSTP, an MD/PhD program) provides an opportunity for medical students interested in a biomedical research career to undertake doctoral work at either the University of Pittsburgh or Carnegie Mellon University in basic science, engineering or public health. After two years of medical school, students complete PhD work before returning to medical training. Both degrees are completed in an average of seven to eight years. MSTP classes integrate research and clinical training throughout the curriculum. The program, funded by a grant from NIH with support from the Office of the Dean, offers full tuition and a yearly stipend. For consideration, American Medical College Application Service applications must specify MD/PhD as the program sought at Pitt.

#### For more information: www.mdphd.pitt.edu

The **Clinical Scientist Training Program** (CSTP) is a competitive one-year research training program that provides medical students interested in clinical research careers an opportunity to learn clinical research approaches and skills through mentored research and coursework provided through the Institute for Clinical Research Education. Most students apply to the CSTP in their second or third year of medical school to commit to full-time research during the following year. Selected students are appointed as research fellows and receive a living stipend, travel funds, health insurance and tuition toward a graduate certificate in clinical research. After successful completion of the fellowship year, students receive a CSTP scholarship toward their final year of medical school.

#### For more information: www.icre.pitt.edu/cstp/

The **Physician Scientist Training Program** (PSTP) is a five-year program for exceptionally talented students who, in addition to the regular curriculum, dedicate a year and two summers to laboratory-based research training and engage in six research and professional development-focused PSTP enrichment courses that prepare them for careers in academic medicine. NIVERSITY OF PITTSBURGH SCHOOL OF MEDICINE » 2023-24 FACT BOOH

PSTP students receive partial tuition assistance for the four years of medical school plus a stipend during the two research summers and the research year.

For more information: www.pstp.pitt.edu

#### Other Research Opportunities

Upon completing their first year of medical studies, approximately 95% of students in the Class of 2025 engaged in various summer research programs. In addition, some medical students take a year off at some point to earn a master's degree in public health, biomedical ethics or a related field; others participate in a year-long program of specialized study or research available through Pitt's CSTP, PSTP, or an individual department; and still others take part in prestigious national fellowship programs like those sponsored by NIH, the Sarnoff Cardiovascular Research Foundation, or the Howard Hughes Medical Institute.

#### Graduate Degree Programs

The **Interdisciplinary Biomedical Graduate Program** (PhD) combines a core curriculum with research and a dissertation focused on a choice of cell biology and molecular physiology, cellular and molecular pathology, molecular genetics and developmental biology, or molecular pharmacology.

The cross-campus **Center for Neuroscience Graduate Training Program** (PhD) introduces students to the fundamental issues and experimental approaches in neuroscience and trains them in the theory and practice of laboratory research.

The **Biomedical Informatics Training Program** (PhD, MS, or certificate) applies modern information technology to health care, education, and biomedical research.

Offered by the University of Pittsburgh and Carnegie Mellon University, the **Joint Program in Computational Biology** (PhD) is designed to develop expertise in the use of computational methods, like comparative genomics, machine learning and data integration, to identify and solve complex biological problems.

The **Molecular Biophysics and Structural Biology Graduate Program** (PhD) trains students in a broad range of cutting-edge technologies used to study the function of biological macromolecules in physical terms and covers a diversity of research topics in molecular biophysics and structural biology. This program brings together faculty across the Kenneth P. Dietrich School of Arts and Sciences and the School of Medicine at the University of Pittsburgh as well as faculty of various departments at Carnegie Mellon University.

The goal of the **Integrative Systems Biology Program** (PhD) is to train students in emerging transformative methodologies that emphasize genomics, proteomics, complex cellular pathways, and the dynamics of cellular and organismal function. Students in this program operate at the exciting interface among basic bench-top biology, computational analysis of big data sets, and the emergence of 21st-century clinical translation.

The **Program in Microbiology and Immunology** (PhD) aims to train highly motivated graduate students as self-reliant scholars in an environment with



ready access to the breadth of expertise, approaches, and subdisciplines that constitute the diverse fields of microbiology and immunology.

The **Biomedical Master's Program** (MS) is designed for students who desire additional training, mentoring, and advising to strengthen their academic and professional credentials for admission to health professional schools or for entry into the biomedical workforce.

The Computational Biomedicine and Biotechnology Program (MS) focuses on the interface between computer science and applied biology and will generate leaders who can translate cutting-edge computational technologies into real-world advances in biomedicine and biotechnology.

Pitt's Institute for Clinical Research Education (ICRE) offers 15 degree and career development programs that are customizable to meet the needs of students from diverse training backgrounds conducting research in a variety of areas. Degree programs include:

- Clinical and Translational Science (PhD), a rigorous program that teaches advanced knowledge of concepts needed to conduct independent and innovative research.
- Clinical Research (MS or certificate, with five specialty tracks), which provides intensive training in the design and implementation of high-quality clinical research involving human participants.
- Medical Education (MS or certificate), which prepares academically oriented health care professionals to become outstanding teachers of medicine.
- Comparative Effectiveness Research (certificate), a multidisciplinary, comprehensive, and individualized training program.

Also offered are clinical research training programs for junior faculty, preand postdoctoral students, medical students and residents, and diversity-focused mentoring and skills-development programs for medical students, postdoctoral fellows, and faculty at Pitt as well as fellows and faculty at minority-serving institutions.

#### Institutes and Centers

**Aging Institute** Toren Finkel, MD, PhD, Director

Center for Military Medicine Research Ronald Poropatich, MD, MS, Director

**Center for Vaccine Research** W. Paul Duprex, PhD, Director

Clinical and Translational Science Institute Steven E. Reis, MD, Director

**Drug Discovery Institute** D. Lansing Taylor, PhD, Director

Institute for Clinical Research Education Doris Rubio, PhD, Director

**Institute for Precision Medicine** Adrian Lee, PhD, Director

Magee-Womens Research Institute Yoel Sadovsky, MD, Director

McGowan Institute for Regenerative Medicine Chandan K. Sen, PhD, MS, Director

#### Pittsburgh Institute for Neurodegenerative Diseases

J. Timothy Greenamyre, MD, PhD, Director

**Pittsburgh Liver Institute** Satdarshan (Paul) Monga, MD, Director

Thomas E. Starzl Transplantation Institute Fadi G. Lakkis, MD, Scientific Director

**UPMC Hillman Cancer Center** Robert L. Ferris, MD, PhD, Director

Vascular Medicine Institute Stephen Chan, MD, PhD, Director

#### Research Strengths & Resources

Within the School of Medicine, areas of research concentration include the biology of aging; neuroscience; vision and vision restoration; hearing loss and restoration; comparative effectiveness research; genome stability and tumorigenesis; reconstructive and regenerative medicine; biomedical device development; vascular, developmental, structural, computational, and systems biology; immunology, including immunological approaches to cancer; cancer virology; and clinical research/clinical trials; among others.

#### Imaging

Imaging technologies are essential tools for University of Pittsburgh faculty investigating all facets of biology. The University's Center for Biologic Imaging

is the largest optical imaging facility in the country. The center houses the latest electron, super-resolution, live-cell and high-speed confocal microscopes. These tools enable visualization of life, ranging from the individual molecule to the whole body. Advances in high-speed confocal imaging at Pitt enable the collection of truly massive 3D data sets that push the limits of data collection and visualization. One exciting advancement in visualization is the ability to explore data through virtual reality. For example, researchers can wander the brain at a cellular level, meander through blood vessels, track a virus as it invades the brain and observe the structural complexities of a pig's eye. The technology gives scientific data sets an undeniable wow factor. More importantly, it provides a striking visual perspective that can lead to new observations and questions.

#### Immunotherapy

Pitt and UPMC are partners in efforts to harness the body's natural defenses to improve treatment outcomes through immunotherapy. The UPMC Enterprises Translational Sciences Discovery Pipeline is an integral part of this collaboration. With a \$200 million investment by UPMC, the University has partnered with Wexford Science & Technology, LLC, and several of its partners to create a world-class space for labs, offices, start-up companies and industry partners. The property, known as The Assembly, sits adjacent to UPMC Hillman Cancer Center and UPMC Shadyside. It represents Pitt's largest development project to date aimed at strengthening the city's innovation district and builds upon Pitt and UPMC's longstanding record of success in research and patient care. With support from UPMC's Translational Sciences Discovery Pipeline, investigators seek ways to fine-tune the immune system to fight cancer cells; explore immune transplantation in conjunction with solid organ transplantation to reduce rejection and reliance on immunosuppressive medicines; and examine how immunotherapy can combat conditions like cardiovascular disease, obesity and sickle cell disease.

#### Neuroscience

Researchers at Pitt combine clinical and basic science expertise to study normal and abnormal brain functions to advance understanding of neurodegenerative diseases like Alzheimer's and Parkinson's diseases, as well as advancing new lines of inquiry in fields like sensory neurosystems. Pitt neuroscientists strive to identify the molecular and genetic mechanisms underlying disorders with neurological underpinnings to find ways to harness those mechanisms to treat and repair neuronal injuries. The new 410,000-square-foot Mercy Pavilion brings research breakthroughs closer to patients by housing visual and physical rehabilitation facilities and research space side-by-side. The pavilion also houses Pitt's Rehab Neural Engineering Labs, which focus on decoding and understanding signals from the brain and peripheral nervous system to help treat visual and mobility impairments. Additionally, the newly launched National Sports Brain Bank, a long-term observational study and brain donation registry for former contact sport participants, will provide insight into the link between contact sports and neurodegenerative disorders like chronic traumatic encephalopathy and Alzheimer's disease.

#### Precision Medicine and Big Data

The Institute for Precision Medicine applies new knowledge in genetics, genomics and other disciplines toward advancing evidence-based medicine to improve disease prevention and treatment models. Current goals focus



Paul Duprex, PhD, director of the Center for Vaccine Research on research and clinical implementation of pharmacogenomics and the development of computational infrastructure for analysis and sharing of large-scale phenotype (clinical) and genotype data. The School of Medicine collaborates with the Pittsburgh Supercomputing Center and Carnegie Mellon University to handle and analyze these biomedical big data.

#### **Clinical and Translational Science**

Pitt established the Clinical and Translational Science Institute (CTSI) in 2006 as part of a nationwide consortium of 12 institutions sponsored by NIH to speed the translation of biomedical research findings into clinical practice and evidence-based health policy. CTSI facilitators help researchers find study participants and provide clinical research guidance, education and training through the Institute for Clinical Research Education. Another vital resource within CTSI is the Pitt+Me research registry, which reached 300,000 registrants in August 2023. The Pitt+Me registry helps connect researchers with patients interested in participating in research and clinical trials. Funding for CTSI's efforts to date has reached nearly \$420 million. Additionally, the new integrated Pitt/UPMC clinical trials office will bolster the volume of clinical trials by expediting clinical trial operations.

#### Shared Research Facilities

The University has established and supports more than 60 shared research facilities to augment investigator-initiated research, of which 41 are within the School of Medicine. State-of-the-art spatial and single-cell genomics, as well as high-throughput RNA and DNA sequencing, are available through the Center for Advanced Genomics. Additionally, Pitt combined efforts in proteomics, metabolomics and lipidomics into the Health Sciences Mass Spectrometry Core. The Gnotobiotic Animal Core Laboratory, a facility that allows for experiments requiring germ-free (without bacteria, fungi and exogenous viruses) and gnotobiotic (known microbiota composition) mice, and the Regional Biocontainment Laboratory enable investigators to gain access to Biosafety Level 2 Plus and Biosafety Level 3 research laboratory spaces. The Pitt Biospecimen Core remains one of the largest biorepositories in the country offering de-identified specimens to researchers.

#### Office of Research, Health Sciences, Grant Assistance

The Office of Research, Health Sciences (OORHS) assists health science researchers in obtaining funding for their projects by offering grant application guidance, scientific review and editing. The Bridge Funding Program and OORHS offer financial support for promising projects with a strong potential for external funding. OORHS also administers the UPMC Competitive Medical Research Fund, which provides pilot funding for early-stage Pitt investigators conducting research in the biomedical sciences.

#### Research Funding

NIH funding is considered the benchmark of overall stature among research-intensive academic health centers. Since 1998, **the University of Pittsburgh has annually ranked among the top 10 recipients of NIH funding.** This year, the University of Pittsburgh ranked third in NIH funding, its highest ranking ever. The University of Pittsburgh received more than **\$675 million**—approximately 81% of which went to the School of Medicine.

Overall, the University of Pittsburgh has budgeted approximately **\$1 billion** for research of all kinds in fiscal year 2023; **67% of this amount is for research in the School of Medicine.** As a result of its success, the School of Medicine has invested significantly in research endeavors, including disciplines like computational and systems biology, as well as developmental, cellular and structural biology.

## Selected Achievements

[1913] Maud L. Menten, MD, PhD, and Leonor Michaelis, MD, develop the Michaelis-Menten Equation. One of the first concepts taught in biochemistry, the equation is crucial to understanding how enzymes function and underlies the development of most drugs over the past century. Menten also investigated the mobility of proteins in the presence of electric fields, called electrophoresis. This work provided important information on differences in the size and mobility of hemoglobin molecules and predated Nobel laureate Linus Pauling's work on sickle cell disease by several years.

**[1950] Philip S. Hench, MD**, a 1920 graduate of the School of Medicine, and two other scientists win the Nobel Prize in Physiology or Medicine for discoveries relating to the hormones of the adrenal cortex.

**[1952]** A killed-virus polio vaccine is developed by **Jonas Salk, MD**, and a team of researchers. The introduction of the vaccine to the public in 1955 led to a rapid and dramatic drop in the incidence of this previously unpreventable disease.

**[1958] Peter J. Safar, MD**, demonstrates the efficacy of mouth-to-mouth ventilation and combines his discoveries with other scientists' work on chest compression to develop the ABCs of cardiopulmonary resuscitation (airway, breathing, and circulation).

**[1961] Klaus Hofmann, PhD**, leads a team that develops a synthetic form of adrenocorticotropic hormone that performs all the biological functions of the naturally occurring hormone.

(Left) Gwendolyn Sowa, MD, PhD, Endowed Professor and Chair, Department of Physical Medicine and Rehabilitation, and co-director of the Ferguson Laboratory for Orthopaedic and Spine Research

(Right) José-Alain Sahel, MD, Distinguished Professor and Eye and Ear Foundation Professor and Chair, Department of Ophthalmology



# \$675 MILLION IN NIH FUNDING IN 2022

**\$1**B FOR RESEARCH IN 2023 UNIVERSITY OF PITTSBURGH SCHOOL OF MEDICINE » 2023-24 FACT BOOK

[1962] Niels K. Jerne, MD, undertakes landmark research on antigenantibody interactions. Two articles produced during his time at the School of Medicine were among those later cited by the Nobel committee as providing the basis for his prize-winning work. Jerne won the Nobel Prize in physiology or medicine in 1984.

#### [1964] Panayotis G. Katsoyannis,

**PhD**, performs the first chemical synthesis of a polypeptide hormone, insulin, and combines it with biologically active material, providing the means to explore and validate previous assumptions about the active amino acids in the insulin molecule.

#### [1964] Julius S. Youngner, ScD,

sheds new light on the cause of immune and inflammatory responses by discovering that nonviral agents, as well as viral ones, can trigger interferon induction. Within the next decade, **Youngner** and others discover that certain viruses have mechanisms that can inhibit the action of interferons. He also identified a second type of interferon, now called gamma-interferon, that displays typical antiviral capabilities plus a host of distinctive properties.

[1967] Dr. Safar is instrumental in founding the Freedom House Ambulance Service, which was based in Pittsburgh's predominantly African American Hill District neighborhood. Over its eight years in operation, Freedom House set a new standard for ambulance service and helped establish national guidelines for community-wide emergency medical services.

**[1979]** In the first of several landmark papers on lead exposure in children, **Herbert Needleman, MD**, reports in the New England Journal of Medicine that subclinical exposure to lead is associated with lower IQ.

**[1980]** Investigators isolate and cultivate Legionella micdadei (Pittsburgh pneumonia agent) from human lung tissue. A team led by

Canadian-born physician and biochemist Maud Leonora Menten (1879–1960) made important contributions to enzyme kinetics and histochemistry.





Jonas Salk's polio vaccine research team at work

**A. William Pasculle, ScD**, goes on to delineate the microbiology, epidemiology, clinical syndrome, and environmental ecology of this organism, which is the second leading cause of legionellabased pneumonia.

[1984] Thomas E. Starzl, MD, PhD, performs the world's first double transplant operation (simultaneous heart and liver) on a 6½-year-old girl from Texas.

[1985] Bernard Fisher, MD, and team are the first to recognize the systemic pattern of breast cancer development, leading to the conclusion that lumpectomy combined with radiation therapy is as effective as mastectomy in treating breast cancer. Fisher's group went on to show the effectiveness of chemotherapy and hormonal therapy (tamoxifen) in preventing recurrence.

**[1991]** Following his earlier work in establishing the clinical utility of the immunosuppressants cyclosporine and tacrolimus (FK506), **Dr. Starzl** explores the theory of chimerism as a means of boosting transplant organ tolerance and reducing dependence on immunosuppressive drugs by proving that cells from donor organs intermingle with a transplant patient's own tissues.

[1996] Investigators led by John W. Mellors, MD, discover that plasma HIV load plays the critical role in determining the prognosis of AIDS patients.

[2000] Researchers led by **Bora E. Baysal, MD, PhD**, and **Bernard Devlin, PhD**, discover that a mutation in a gene encoding a mitochondrial protein is the cause of hereditary paraganglioma. This study is the first to link the structure of mitochondrial DNA to tumor development.

[2004] In collaboration with colleagues in Sweden, researchers complete the first human study of a radioactive dye called Pittsburgh Compound B (PiB) developed by William E. Klunk, MD, PhD, and Chester A. Mathis, PhD, to detect, using PET scanning, the beta-amyloid deposits that are associated with Alzheimer's disease. Subsequent research correlates detection results in living patients with their later autopsy results to confirm the effectiveness of PiB in signaling the presence of beta-amyloid deposits.

#### [2007] Gary A. Silverman, MD, PhD, and Clifford J. Luke,

**PhD**, overturn the long-held view of necrosis as a chaotic, irreversible process by showing it to be part of a regulated response to stress by SRP-6, a powerful protein known as a serpin that they believe might be harnessed to either target or spare cells as a way to better manage cancer, heart disease, stroke or neurological conditions.

[2008] Researchers led by Yuan Chang, MD, and Patrick S. Moore, MD, MPH, who previously identified the Kaposi's sarcoma-associated herpesvirus, use novel sequencing technology to identify a previously unknown polyomavirus that is strongly linked with a rare but deadly skin cancer called Merkel cell carcinoma.

#### [2011] A team including Michael Boninger, MD, Andrew B. Schwartz, PhD, and Elizabeth Tyler-Kabara, MD, PhD,

demonstrates successful use of a brain-computer interface that allows a man who had been paralyzed seven years earlier in a motorcycle accident to give his girlfriend a "high-five" using a robotic arm maneuvered by his thoughts.

[2013] A team led by Angela Gronenborn, PhD, and Peijun

**Zhang, PhD**, describes for the first time the 4-million-atom structure of HIV's capsid, or protein shell. The findings could bolster efforts to defeat an often-changing virus that has been a challenge to conquer.



Organ transplantation pioneer Thomas Starzl

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[2013] For the first time, a mouse heart was able to contract and beat again after its own cells were stripped from the extracellular area matrix and replaced with human heart precursor cells, Lei Yang, PhD, reports in Nature Communications. The result suggests that a functional organ could be regenerated by placing human-induced pluripotent stem cells into a three-dimensional

[2013] A first-of-its-kind vaccine developed by Olivera Finn, PhD, and colleagues successfully prompts the immune system to respond to early indications of colon cancer in people at high risk for the disease.

scaffold.

#### [2014] Robert Friedlander, MD,

MA, and colleagues identify for the first time a key molecular mechanism by which the abnormal protein found in Huntington's disease can cause brain cell death. The findings could one day lead to ways to prevent the progressive neurological deterioration that characterizes the condition.

#### [2015] A team led by Cecilia Lo,

PhD, identifies mutations associated with congenital heart disease in 61 genes, many not previously known to cause the disease. The study indicates that the antenna-like cellular structures called cilia plav a critical role in the development of these heart defects.

#### [2016] A team led by Mark T.

Gladwin, MD, engineers a protein that reverses carbon monoxide poisoning in mice, a discovery that could potentially lead to the creation of the first antidote in humans to the often-deadly poisoning.

#### [2018] José-Alain Sahel, MD,

and colleagues develop a wireless photovoltaic retinal prosthesis. The U.S. Food and Drug Administration

approved a clinical trial for advanced macular degeneration that enrolled its first patients in the Pittsburgh

#### [2019] Kyle Orwig, PhD, and

colleagues report success in achieving a live nonhuman primate birth resulting in part from sperm produced after immature testicular tissue had been cryopreserved and later used to restore fertility to the same animal. The study, the last step in a proof-of-concept model of cancer survivorship, offers hope that boys treated for cancer prior to puberty may someday father biological children of their own.

[2019] An international team of researchers and clinicians led by Graham Hatfull, PhD, reported that they successfully treated a seriously ill teenager with cystic fibrosis who had disseminated infection by Mycobacterium abscessus using a cocktail of genetically engineered phages. This accomplishment represents a number of firsts: the first genetically engineered phage treatment—in this case, to convert a lysogenic phage to a lytic variety—and the first treatment of a mycobacterium. Hatfull has a primary appointment in the Department of Biological Sciences, Dietrich School of Arts and Sciences, and a secondary appointment in the School of Medicine's Department of Computational and Systems Biology.

[2020] Using a genetically modified mouse organ transplant model, a research team led by Fadi Lakkis. MD, demonstrates that innate immune cells exposed to a foreign tissue can remember and initiate an immune response if exposed to that foreign tissue in the future. The findings could pave the way to drugs that lengthen long-term survival of transplanted organs.

[2020] Kacey Marra, PhD, and colleagues create a biodegradable nerve guide using a polymer tube filled with growth-promoting protein that can regenerate long sections of damaged nerves without the need for transplanting stem cells or a donor nerve.

[2021] José-Alain Sahel, MD, and colleagues report that, for the first time, a human patient with retinitis pigmentosa, a progressive disease leading to blindness, achieved partial functional recovery of vision using advanced optogenetic tools that manipulate proteins and cells with light. The result is the culmination of 12 years of work between scientists from Paris, Pittsburgh, and Basel, Switzerland.

[2021] Jennifer Collinger, PhD, Robert Gaunt, PhD, and colleagues report that artificial tactile perception delivered by careful electrode placement on the surface of the brain allows a paralyzed patient using brain-computer interface technology to "handle" objects with a robotic arm at twice the speed of doing so without the feedback.

#### [2021] Marco Capogrosso,

PhD, and colleagues develop a neurotechnology that delivers pulses of electricity through a pair of thin metal electrodes implanted along the neck to stimulate the spinal cord and instantly improve arm and hand mobility. This technology enables people affected by moderate to severe stroke to conduct daily activities more easily. The therapeutic effects of stimulation are seen to persist even after the device is removed, suggesting it could be used as both an assistive technology and a restorative method for upper limb recovery for stroke patients.

#### UPMC

Through its affiliation with UPMC, the School of Medicine offers students opportunities for clinical training, educational experiences and research in virtually any medical specialty. Although legally separate and distinct entities, the School of Medicine and UPMC share mutual interdependence and a synergy that is reflected in a common commitment to excellence in education, research and clinical care. As an integrated global health enterprise and one of the nation's leading academic health care systems, with \$26 billion in revenues, UPMC integrates 95,000 employees; more than 6,400 affiliated physicians, including more than 5,000 employed by the health system and 1,601 who are also full-time faculty of the School of Medicine; 40 tertiary care, specialty, and community hospitals; as well as specialized outpatient facilities, cancer centers, rehabilitation facilities, retirement and long-term care facilities, imaging services, doctors' offices, and a health insurance plan covering 4.5 million



(Top) Marco Capogrosso, PhD, assistant professor of neurological surgery, and colleagues attend an implantation of spinal cord stimulation electrodes into research participant Heather Rendulic; (Bottom) Rendulic holds a can of soup at Rehab Neural Engineering Labs.

As of Aug. 1, 2023, the UPMC Medical Education Program has about 1,500 medical residents and 460 clinical fellows in programs approved by the Accreditation Council for Graduate Medical Education.

#### U.S. News & World Report consistently ranks UPMC Presbyterian Shadyside among the nation's best hospitals in many specialties and ranks UPMC Children's Hospital of Pittsburgh on its Honor Roll of America's Best Children's Hospitals.

The core of the health system is located in the Oakland, Shadyside, and Lawrenceville neighborhoods of Pittsburgh, where the following healthcare facilities are interwoven with University of Pittsburgh facilities: UPMC Presbyterian, UPMC Montefiore, Eye and Ear Institute, UPMC Magee-Womens Hospital, UPMC Western Psychiatric Hospital, UPMC Hillman Cancer Center, UPMC Shadyside, and UPMC Children's Hospital of Pittsburgh.

UPMC Hillman Cancer Center is one of the largest integrated community cancer networks in the United States and the only National Cancer Institutedesignated Comprehensive Cancer Center in Western Pennsylvania, providing patients the latest advances in cancer research, prevention, detection, diagnosis and treatment.

UPMC's clinical programs have earned international recognition, drawing patients from around the world. In addition, the medical center is now transporting its expertise to other countries, including Italy (where it manages the Mediterranean Institute for Transplantation and Advanced Specialized Therapies in Palermo) and Ireland, as well as ventures in China, Kazakhstan and Croatia.

UPMC Transplant Services foster a multidisciplinary approach to the advancement of the clinical, scientific and social aspects of transplants to improve the lives of patients with end-stage organ failure and their families. The UPMC Liver Transplant Program leads the nation in overall





number of liver transplants performed from living donors. More than threequarters of all living-donor liver transplant procedures in Pennsylvania are performed at UPMC.

In recognition of its leadership in using information technology to improve clinical outcomes and efficiency, UPMC was named one of the country's "Most Wired" health systems for the 25th consecutive year—the only health care organization to be consistently recognized with that distinction during that time frame—according to the College of Healthcare Information Management Executives.

For more information: www.upmc.com

## **Cityof Bridges**

**Surrounded** by breathtaking views of tree-lined hills and valleys, Pittsburgh is situated at the convergence of the Allegheny, Monongahela and Ohio Rivers. Pleasure boats share the waters with barges transporting cargo under the city's distinctive yellow bridges. Vibrant, safe and affordable, Pittsburgh offers the amenities and lively culture of a large city, while retaining small-town civility and a neighborhood feel. The Pittsburgh metropolitan area is home to 27 colleges and universities, nine Fortune 500 companies and nearly 2.4 million people.





Pittsburgh's legacy of industriousness, forged by its iconic steel mills in the late 19th and early 20th centuries, now powers its innovations in robotics, life sciences, financial and business services, and more. The University of Pittsburgh is driving the city's growing ecosystem of innovation. BioForge Biomanufacturing Center, the University's massive life sciences project, will lead the region's transformation into a beacon of life sciences research and development.

While native Pittsburghers know what the city has to offer, in recent years multiple outlets have ranked it one of the best U.S cities to live in, dine in and visit. Pittsburgh was recently listed in the top 50 best places to live by U.S. News & World Report, named the #1 city for young people in the Northeast by HomeBuyer and the seventh best U.S. city in which to start a career by LinkedIn.

**There is always something to do in Pittsburgh.** Its three major professional sports teams—the six-time Super Bowl champion Pittsburgh Steelers, the 2016 and 2017 Stanley Cup champion Pittsburgh Penguins, and the Pittsburgh Pirates—have made Pittsburgh sports fans some of the nation's most avid and loyal. In addition, Pitt is home to a full range of sports teams that offer some of the finest performances in college athletics.

Pittsburgh has also made a name for itself as a hub for the arts, culture and education. The city's Cultural District is a bustling section of Downtown with theaters, art galleries, restaurants and historic landmarks like Heinz Hall. Additionally, from the globally recognized Warhol Museum to the August Wilson African American Cultural Center, its world-class museum network hosts a multitude of exhibitions, events, classes and performances year-round.

Pittsburgh also boasts an abundance of easily accessible and well-maintained outdoor spaces. Between Schenley Park, which lines Pitt's Oakland campus, and the 644-acre Frick Park, playgrounds, hiking and mountain biking trails, and more, outdoor activities are in ample supply in Pittsburgh. Just north of the city is the largest park in Allegheny County, North Park, which stretches a stunning 3,075 acres and features a 65-acre lake.

**Pitt's neighborhood, Oakland, is unquestionably the intellectual center of the community**. In the heart of Pitt's campus is the 42-story Cathedral of Learning, the second tallest university building in the world and home to more than two dozen Nationality Rooms styled to reflect the culture of the faraway places to which many Pittsburghers can trace their roots.

From a titan of the steel industry to a hub for innovation and technology, Pittsburgh is always evolving.

All photos courtesy of the University of Pittsburgh except those listed below.

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