

FACILITIES AND OTHER RESOURCES

INSTITUTIONAL ACADEMIC, EDUCATIONAL, AND CLINICAL RESOURCES

The **University of Pittsburgh (Pitt)**, founded in 1787, is one of the oldest institutions of higher education in the United States. The University's five campuses include **16** undergraduate, graduate, and professional schools, and two University Centers which collectively offer **715** degree and certificate programs. Total enrollment in the fall term of **2023** was **33,771** students. The University employs **5,930** faculty, **719** research and post-doctoral associates, and **8,801** staff. The main campus is in a metropolitan area with a population of over **2.3** million.

The University of Pittsburgh is consistently recognized for scholarly excellence, ranking (#145) in the top **5** percent among the leading **2,671** universities in the world according to the *2024 Times Higher Education World University Rankings*. *U.S. News & World Report* (2023-24) places Pitt (rank #45) among the top 2.25 percent of universities worldwide in its "Best Global Universities" list, which ranks **2000** leading universities in 95 countries based on schools' academic research and reputation. Pitt is No. **32** (top 2 percent of 1,500) among the **nation's top public schools** in the 2023-24 *U.S. News & World Report* Best Colleges rankings.

Funding from the National Institutes of Health is considered the benchmark of overall stature among research-intensive academic health centers. Since 1999, the University of Pittsburgh has annually ranked among the top 9 recipients of NIH funding*. In an analysis of NIH FY23 funding, Pitt ranks sixth in dollars awarded to educational institutions with \$658.3 million in total funding. Additionally, Pitt ranks in the top 2% of U.S. universities in externally funded R&D expenditures (\$1.16B) per the most recent Higher Education Research and Development Survey (2022).

*With exception of #11 in 2021.

Sources: All sources are as noted plus the University of Pittsburgh Fact Book 2023 and Census Reporter.

University of Pittsburgh Schools of the Health Sciences

Collectively, the **six** Schools of the Health Sciences form an internationally renowned educational and research powerhouse with a demonstrated legacy of advancing scientific discovery, clinical innovation, and interdisciplinary training. The researchers, administrators, and providers we prepare are leading the future of health care on a global scale. The schools include **Dental Medicine, Health and Rehabilitation Sciences, Medicine, Nursing, Pharmacy, and Public Health**. Together, they currently occupy approximately 4.2 million gross square feet of research, academic, and administrative space in various buildings.

Since July 2020, these schools have been led by Anantha Shekhar, senior vice chancellor for the health sciences and John and Gertrude Petersen Dean of the School of Medicine at the University of Pittsburgh. Dr. Shekhar is a nationally recognized educator, researcher, administrator, and entrepreneur with major contributions in medicine and life sciences. An accomplished neuroscientist, Shekhar led seminal research studies identifying novel treatments for schizophrenia, depression, and anxiety disorders, and founded multiple biotechnology companies to develop these therapies for patient use. Prior to joining Pitt in 2020, he held roles of increasing leadership responsibility at Indiana University School of Medicine, the nation's largest medical school, for 37 years. He was awarded the President's Medal of Honor (IU's highest honor), as well as the Sagamore of the Wabash Award (the highest honor bestowed by the governor of Indiana) for his transformative contributions to advancing life sciences research and innovation across IU and the state of Indiana. Dr. Shekhar is a tenured member of the National Academies of Sciences, Engineering, and Medicine's Forum on Drug Discovery, Development, and Translation; and a board member of the Clinical Research Forum in Washington, D.C., which convenes leaders at the highest levels in academia, government, and industry to address challenges and opportunities in clinical research. He also serves on the boards of directors at UPMC, UPMC Children's Hospital of Pittsburgh, UPMC Magee-Womens Hospital, UPMC Presbyterian and UPMC Shadyside.

Of the \$658.3 million awarded to the University of Pittsburgh in NIH fiscal year 2023, 94% (\$618.2M) was generated by the Schools of the Health Sciences. These schools also generated 80% (\$918.4 million) of the University's \$1.16 billion in R&D expenditures in 2022, with nearly 63% of this amount occurring in the School of Medicine. In 2023, the University of Pittsburgh was announced as the third highest recipient of funding from the NIH, receiving more than **\$675** million in funding for Federal Fiscal Year 2022—approximately **78%** of which went to the School of Medicine.

In 2022, NIH supported **50** Ruth L. Kirschstein National Research Service Award (NRSA) Institutional Research Training Grants (T32) at the University of Pittsburgh, the vast majority awarded within the six Schools of the Health Sciences.

Diversity, Equity, Inclusion

The University of Pittsburgh strives to increase the number of faculty to conduct research, educate students and engage in services designed to eliminate health disparities and improve wellbeing in the Pittsburgh region, nationally and around the world. One initiative launched in late 2020 called for the hire of 50 faculty members over four years, with the Schools of the Health Sciences responsible for half of that total. In 3.5 years, 72 faculty members (83%) were hired in the health sciences of 87 total hired across the University (174% of goal). Those hires bring a wealth of academic interests to Pitt — from reducing sexually transmitted diseases among young people to preclinical biomarker discovery in lung cancer.

UPMC (University of Pittsburgh Medical Center)

UPMC (University of Pittsburgh Medical Center) is affiliated with each of the Pitt Schools of the Health Sciences and provides exemplary patient care, educates the next generation of health care professionals, and advances biomedical research. As an integrated global health enterprise and one of the nation's leading academic health care systems, with \$28 billion in annual revenue, UPMC is the largest non-governmental employer in Pennsylvania with nearly 100,000 employees; more than 6,600 affiliated physicians, including more than 5,000 employed by the health system and 1,636 who are also full-time faculty in the UPSOM; 42 tertiary care, specialty, and community hospitals; as well as specialized outpatient facilities, cancer centers, rehabilitation facilities, retirement and long-term care facilities, imaging services, physician offices, and a health insurance plan covering more than 4 million members.

Historically, UPMC has provided Pitt Health Sciences with approximately \$240 million annually to support academics, research, and teaching. This institutional structure has led to enormous success for each component of our academic mission, including substantial accomplishments in training and research. The UPMC Graduate Medical Education Program has ~ 1,500 medical residents and 450 clinical fellows in programs approved by the Accreditation Council for Graduate Medical Education. Internationally renowned programs include pediatrics, internal medicine, emergency medicine, and family medicine, among many others. Dedicated to advancing the well-being of our diverse communities, UPMC provides more than \$4.8 billion every year in community benefits, more than any other health system in Pennsylvania. **UPMC is an ideal partner in patient care, education, and advancement of new medical breakthroughs and technologies.**

University of Pittsburgh Innovation Institute

In fiscal year 2023, the U.S. Patent and Trademark Office (PTO) issued **114** patents to University of Pittsburgh, which has steadily moved up the list of the top recipients of U.S. utility patents among worldwide universities according to the National Academy of Inventors (NAI) and the Intellectual Property Owners Association (IPO). Among the top 100 worldwide universities named as the first assignee on utility patents granted by the U.S. PTO, Pitt ranked **#19** for the 2023 calendar year up from **#20** in 2020 and **#28** in 2019. In the most recent five-year period (2018-2022), issued patents to Pitt inventors increased **35** percent over the previous five fiscal years (2013-2017) from 373 to 506. Startups based on Pitt discoveries have increased **54** percent in the same time period from 54 to 83, reflecting the expanded funding, mentoring, and educational resources available through the university's growing innovation and entrepreneurship ecosystem.

The progress of the Pittsburgh innovation ecosystem is getting noticed. Startup Genome, a leading policy advisory and research organization for public and private entities committed to accelerating the success of their startup ecosystems, reported in May 2022 that Pitt had jumped 10 spots in its ranking of the top 100 emerging global startup ecosystems, from 23rd to 13th. In North America, it ranked Pitt as the fifth highest emerging ecosystem.

Source: Pitt Office of Innovation and Entrepreneurship, 2023 fiscal year impact report, and website of Innovation Institute (2/2024)

University of Pittsburgh Health Sciences Library System (HSLs)

The HSLs at the University of Pittsburgh offers a wide array of research and information services, educational opportunities, and resources in print and electronic format to faculty, students, and researchers in the Schools of the Health Sciences.

HSLs supports instruction, research, and clinical care in the health sciences for University of Pittsburgh faculty, students, and staff, and UPMC residents and fellows. Faculty librarians offer assistance throughout the research process. Classes on evidence-based searching, scholarly communication and research impact, citation management, instructional and visual design, and special topics are offered regularly and customized for courses and groups. Research and instructional services are also provided by the specialized teams of Data Services and Molecular Biology Information Services (MBIS). The MBIS runs a four-facet service with the following goals: (1) identify, procure and implement commercially licensed bioinformatics software, (2) teach hands-on workshops using bioinformatics tools to solve research questions, (3) provide in-person and email consultations on software/databases and (4) maintain a web portal providing overall guidance on the access and use of bioinformatics resources and MBIS-created webtools. HSLs licenses 11 proprietary bioinformatics software and database packages for more than 9,000 registered users.

Library users have access to more than 12,500 electronic journals in the health sciences, as well as **7,000** e-books and **129** databases or publisher collections of full-text information. In FY20, we added over 1,500 new resources. HSLs provides a wide range of resources and services such as books, journals, databases, e-resources and collections, information access points, customer service and technical support, internal and external metadata creation, multimodal technology development, and document delivery services.

HSLs leads a \$16 million dollar grant from the National Library of Medicine to run the Network of the National Library of Medicine All of Us Program Center for 2022-2026. This center coordinates national engagement and training activities in support of the NIH All of Us Research Program. The program serves the broader community and engages with a variety of health information stakeholders both regionally and nationally.

University of Pittsburgh Clinical Translational Science Institute (CTSI)

The University of Pittsburgh 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.

In addition to cataloging and linking COVID-19 research studies to available resources, CTSI has awarded \$900,000 to 17 research projects out of more than 150 submissions to address various aspects of the COVID-19 pandemic. CTSI also assisted the National Institute of Allergy and Infectious Diseases (NIAID) with contacting more than 400,000 potential U.S. study participants and coordinating logistics for a study to determine the spread of COVID-19 across the country.

PittCTSI serves as the integrative academic home for clinical and translational scientists across the University's six schools of health science and UPMC. PittCTSI has even advised research projects based outside the schools of health sciences in disciplines as diverse as engineering and liberal arts.

CTSI-supported programs and resources extend to all six of Pitt's schools of the health sciences and, through community engagement efforts, to the Pittsburgh region. UPMC is an active partner in this initiative, providing important access to extensive clinical resources and potential research participants. CTSI also has established collaborative relationships with other Pittsburgh-area institutions, including the Urban League of Greater Pittsburgh, Carnegie Mellon University, and RAND Corporation. Through the establishment of multiple cores, CTSI is building institutional infrastructure, including educational, programmatic, facility, and equipment resources, to support a wide range of clinical and translational research:

- Biomedical Modeling
- Biomedical Informatics
- Biostatistics, Epidemiology, and Research Design (BERD)
- Community PARTners (Partnering to Assist Research and Translation)
- IMPaCT (Implementation to Maximize Population and Community Translation)
- Innovation

- Pilot Funding
- Regulatory Knowledge and Support
- Research Inclusivity
- Team Science and Workforce Development
- Clinical Research Facilities, Trial Implementation and Enrollment

CTSI Pitt+Me Research Participant Registry Recruitment

The CTSI Pitt+Me® Research Participant Registry has enrolled >325K children and adults from among UPMC's >6M patients as well as community members who self-report an interest in participating in research and agree to be contacted about specific studies for which they may be eligible. Pitt+Me is a mobile-friendly, cloud-based informatics platform designed to increase participation in research through the application of research registry, study match and screening infrastructure and tools. Investigators and coordinators register new studies, manage study criteria, and follow up on participant referrals. Research participants are automatically matched to studies by the recruitment platform, which executes a weighted-matching algorithm based on age, race, gender, ethnicity, ICD-9/10 diagnosis criteria from the UPMC electronic health record, and/or self-reported preferences for research areas of interest. Study matches are sent to participants on a monthly or quarterly basis via email or US mail.

CTSI Precision Medicine Initiative

In 2016, NIH chose CTSI to help build the foundational partnerships and infrastructure needed to launch its All of Us Research Program, which aims to engage 1 million or more research participants to revolutionize how disease is prevented and treated based on individual differences in lifestyle, environment, and genetics. Pitt was awarded \$4.2 million in the first year, with the potential for up to \$69 million over six years. Pitt's project, called All of Us Pennsylvania, began enrolling the first of an anticipated 100,000 to 200,000 patients in the region in mid-2017 and will fund pilot studies using accrued data to advance precision medicine.

Source: Updated language from CTSI's Exec. Director of Marketing and Comms, 6/7/24.

University of Pittsburgh Health Sciences Clinical Trials Office (HS-CTO)

The plans for the development of the inaugural Health Sciences Office of Clinical Trials at the University of Pittsburgh started in late 2023 and marked a significant advancement in clinical research infrastructure at Pitt. The office is designed to operate under a collaborative and hybrid model that brings together researchers, clinicians, industry partners, and other stakeholders working together role in reducing the activation time for clinical trials, ensuring that new treatments reach patients faster; ultimately improving patient outcomes and advancing the frontiers of medical science.

The primary mission of this newly formed office is to facilitate efficient and ethical clinical research and to support clinical trials operations across Pitt and UPMC, a milestone in accelerating medical innovations.

The office responsibilities are to deliver education and training, foster collaborations across Pitt-UPMC and with external partners and sponsors and assist Pitt/UPMC investigators in translating scientific discoveries into therapeutic interventions.

A range of services covering the lifecycle of a study are provided - from its initial design, trial activation, financial management, and tracking of subject accrual to its completion and closeout. The HS-CTO has dedicated staff to support business and research partnerships with various sponsors, including industry, federal, and non-profit organizations.

Budget Development & Coverage Analysis

- Creating and standardizing budget templates and financial models tailored to specific clinical trials.
- Building and evaluating budgets that accurately reflect the comprehensive costs associated with conducting clinical trials. This ensures that expenditures and revenues are forecasted and monitored.
- Execution of coverage analyses to delineate costs billable to insurance vs those billable to research.

Service Provider Coordination, Budgeting & Sponsor Negotiations

- Supports streamlining coordination with service providers and strategic negotiations with sponsors to secure terms that ensure favorable financial and operational outcomes for clinical trials.

Study Expense, Research Subjects Enrollment Tracking, Invoicing Support

- Overseeing financial transactions associated with clinical trials, tracking participant enrollment metrics accurately, and supporting the invoicing process and timely billing.

Research Finance Billing & Compliance

- Safeguarding financial integrity in clinical trials by ensuring financial processes comply with institutional and federal guidelines, thereby minimizing fiscal risks.

Clinical Trials Management System (CTMS) Support & Training

- Providing continuous technical support and training for users of the CTMS to ensure proficient use and maximize the system's utility.

Source: Updated language from CTO, ACV Clinical Trials Operations, 6/7/24.

University of Pittsburgh Health Sciences Services Research Data Center (HSRDC)

The Health Services Research Data Center (HSRDC) is a University of Pittsburgh cost center established in 2011 to provide information technology (IT) services to research projects. The HSRDC provides Data Management, Application Development, Infrastructure, Solutions Architecture, and other services for clinical and translational research at Pitt, including retrospective studies, clinical trials, or implementation science projects.

HSRDC Computing and Statistical Support

Data management and analysis activities specific to research utilizes the HSRDC platform, a state-of-the-art computing facility specifically designed to provide a high-throughput computing platform for analysis of large, health data sets directly in a secure environment.

- The HSRDC uses Hyperconverged infrastructure with 6 TB of memory, 240 vcpus, and PB scale SSD Storage dedicated to analytics. The user interface utilizes VMware-based “virtual desktops” running Windows 11, which allows users to work directly on the secure server while still providing a familiar computing experience.
- Users access their virtual desktops by way of a two-factor authentication process (passwords and tokens) via a secure socket layer (SSL) 256-bit VPN connection around an encrypted virtual desktop connection. Upon logoff the virtual desktop is deleted to ensure no malware can persist in the environment. Virtual Desktops are isolated from the internet via enterprise firewalls, further mitigating risk of data loss. Any data leaving the secure servers, summary data, does so through an audited data interchange zone.
- A variety of statistical software licenses are maintained on the virtual desktops such as; SAS, STATA, SPSS, ArcGIS, NVivo, Python and R permitting a wide array of data manipulation and statistical analyses directly on the virtual desktops.
- Servers containing protected health information are protected by multiple firewalls and physical security measures in accordance with the Health Insurance Portability and Accountability Act (HIPAA) and other governmental security standards. These servers run on a separate infrastructure to maximize throughput. This allows users to directly work with data containing PHI in a highly secure environment, obviating the need to store sensitive data on laptop or desktop computers, which are more of a security risk.
- The entire system is housed within the University's Network Operations Center, a secure facility with redundant power feeds, fire protection, electronic access controls, and 24x7 monitoring. In the event the on-prem hardware is not sufficient, and authorized by the data owner, we can extend our infrastructure into different cloud providers; eg. Azure and AWS, keeping the same level of security around the data and network.

The HSRDC houses < 100 TBs in the cloud and on-premises and has common infrastructure, with the ability to customize, set up both on-premises and in the cloud. This enables investigators to work in the environment that is most efficient for their research. *Services Provided by HSRDC*

- **Data Management** – The HSRDC has experience hosting EHR, Claims, Administrative, and large file-based datasets such as omics data sets. The team has experience in database administration and data management from small MB databases to multi-TB data warehouses. The HSRDC has many tools, along with T-SQL, for both on-premises and cloud tools to provide ETL, QA, and create analytic datasets based on the study team's specifications. We do database design and loading as well as connect to existing data lakes to import data based on study needs. The data team is comprised of four members.
- **Systems Architecture** – The HSRDC works with study teams to find the best approach to their data flow for optimum efficiency. This can be taking advantage of existing systems, or we can design a custom solution based off our current infrastructure when appropriate. The HSRDC takes advantage of cloud services from Azure and AWS such as Synapse, Datafactory, App Services, and many others to decrease the build time. The infrastructure team is comprised of two individuals.
- **Application Development** – The HSRDC builds custom applications when needed to fit the data flow and aims of a project. We have built eDCFs, screening alerts, screening and enrollment processes, learning management systems, and decision support tools. The HSRDC has several reusable microservices related to study applications to decrease development time.
- **REDCap (Research Electronic Data Capture)** – REDCap is a free, secure, web-based application developed at Vanderbilt University, and designed to support electronic data capture for research studies. Databases can be quickly developed and customized, usually by the researcher without assistance. REDCap is particularly well-suited to collect and track Clinical Report Form (CRF) data, schedule study events (e.g., patient visits) and conduct surveys. The Pitt REDCap is 21 CFR Part 11 compliant, and has a rich access and authentication model, which makes support for multi-institutional studies easy to manage. Currently over 5000 REDCap projects exist at Pitt, ranging from student survey projects to extensive longitudinal research studies.

Source: Updated language from Pitt HS Director of Research IT, 6/7/24.

University of Pittsburgh School of Medicine (UPSOM)

UPSOM is ranked **#13** in the list of Best Medical Schools for Research and **#11** in Best Medical Schools for Primary Care (*US News/World Report 2023-24*)

The University of Pittsburgh School of Medicine (UPSOM) includes the following 30 departments: Anesthesiology, Biomedical Informatics, Cardiothoracic Surgery, Cell Biology, Computational and Systems Biology, Critical Care Medicine, Dermatology, Emergency Medicine, Family Medicine, Immunology, Medicine, Microbiology and Molecular Genetics, Neurobiology, Neurological Surgery, Neurology, Obstetrics, Gynecology, and Reproductive Sciences, Ophthalmology, Orthopedic Surgery, Otolaryngology, Pathology, Pediatrics, Pharmacology and Chemical Biology, Physical Medicine and Rehabilitation, Plastic Surgery, Psychiatry, Radiation Oncology, Radiology, Structural Biology, Surgery, and Urology. The two newest of these departments —Plastic Surgery and Cardiothoracic Surgery — reflect the School of Medicine position at the leading edge of medical education and clinical practice, as well as the recent and rapid evolution of surgical subspecialties as independent disciplines.

Within UPSOM, **areas of research emphasis and strength** include drug discovery and design, vaccine development, comparative effectiveness research, organ transplantation and immunology, stem cell biology and tissue engineering, medical device development, vascular biology, cancer research and therapy, cardiovascular biology and cardiology, bioinformatics and computational biology, psychiatry, neurobiology, systems neuroscience, and neurological surgery, structural biology, precision medicine, and clinical research and clinical trials. As of the 2023-2024 academic year, the School of Medicine has 587 MD students (342 women, 58%; 245 men, 42%), 19% of whom are from groups underrepresented in medicine.

UPSOM also has 553 graduate students in PhD programs including 123 students in master's programs, and 26 students in certificate programs. The University of Pittsburgh/Carnegie Mellon University combined MD/PhD Medical Scientist Training Program was established in 1983 and is funded primarily by an NIH MSTP T32 grant. The spirit of interdisciplinary, inter-institutional collaboration that pervades Pitt and Carnegie Mellon

University fosters a dynamic environment for promising students to launch research careers that integrate medicine and science. Exceptional investigators at both universities serve as potential mentors for the 112 MD/PhD students (46 MSTP students in the UPSOM graduate program and 56 in the UPSOM MD program). Carnegie Mellon University is adjacent to and within easy walking distance of the Pitt campus. The Interdisciplinary Biomedical Graduate Program offers PhD training in Cell Biology and Molecular Physiology, Cellular and Molecular Pathology, Molecular Genetics and Developmental Biology, and Molecular Pharmacology. Other PhD-granting programs include the Center for Neuroscience Graduate Training Program, Biomedical Informatics Training Program, Joint Program in Computational Biology, Molecular Biophysics and Structural Biology Program, Integrative Systems Biology Program, Program in Microbiology and Immunology, Computational Biology, Oncology, and Clinical and Translational Science.

For 2023-24, the School of Medicine has 2,784 regular plus 2,018 volunteer faculty members. Of these, 73 are members of the Academy of Distinguished Medical Educators. The Class of 2024 was the 18th class to complete the four-year longitudinal research project experience. Their endeavors resulted in 291 manuscripts published, 81 submitted and 74 in preparation at the time of graduation. Additional research accomplishments of the Class of 2024 included 457 presentations at national or international conferences and 59 at regional or local meetings. These new graduates received 35 national and international awards and 173 local awards in recognition of their research.

INSTITUTIONAL RESEARCH RESOURCES AND CENTERS

General brief description of shared resource support

The University of Pittsburgh Schools of Health Sciences support over fifty shared biomedical research resources. Supported facilities range from the Peptide and Peptoid Synthesis Facility to the Center for Advanced Genomics and the Genomics Analysis Core to the Health Services Research Data Center. The areas of expertise represented by these facilities include but are not limited to: multiple modalities of *in vivo* and *in situ* imaging and microscopy for clinical and preclinical research, high dimensional 'omics data generation (mass spectrometry, next generation sequencing and spatial biology) and analysis, specialized assay techniques with high precision and/or multiplexing capabilities, and a variety of data and computing related matters.

Specific descriptions of shared resources

The **Biomedical Mass Spectrometry Center (BMSC)** is a campus-wide shared facility dedicated to advancing the use and application of mass spectrometry in basic, translational, and clinical research. The center combines innovative high-resolution mass spectrometry with classical biochemical approaches to identify and quantify biologically relevant proteins.

The **Center for Medicine and the Microbiome (CMM)** was established to foster innovative basic, translational, and clinical research in the microbiome. The Centers comprised of MD and PhD researchers in multiple disciplines who work together to understand the role of the microbiome in health and disease and to apply this knowledge to develop novel diagnostic and therapeutic strategies. The Center provides a home for interdisciplinary studies of the microbiome and integrating work of basic and clinical scientists with access to large clinical cohorts in order to efficiently test new ideas and rapidly disseminate pioneering treatments.

The **Center for Research Computing (CRC)** is focused on increasing the productivity of Pitt researchers through the application of advanced computing. In addition to supporting research in fields such as engineering, chemistry and genomics, Pitt CRC—a resource for the entire University community—adds value to work in biostatistics, economics, and linguistics, among many other areas. The CRC offers access to cutting-edge computer hardware and software, workshops, and consultation on refining projects at the code level – such as stronger algorithms to take advantage of parallel processing – and at the level of improving the user experience for researchers who begin taking advantage of high-performance computing using a familiar graphic user interface.

The **Center for Vaccine Research (CVR)** is housed in the Biomedical Science Tower 3 (BST3), which is located on the main campus of the University of Pittsburgh. The CVR is composed of two components — the Vaccine Research Laboratory (VRL) and the Regional Biocontainment Laboratory (RBL) — and has 18,000 square feet of laboratory and office space. Building on the University's existing strengths in the study of virology and immunology with an emphasis on emerging infections and HIV, the CVR engages a cross-section

of scientists from an array of disciplines in infectious disease research. Under the leadership of Director Paul Duprex, PhD, the CVR is expanding its footprint in vaccine research and development by expanding its team of world-class investigators. The CVR activities span basic research on molecular mechanisms of infectious diseases to the development of diagnostics, therapeutics, and vaccines. Moreover, the CVR supports interdisciplinary research efforts across the University and UPMC focused on emerging infections that threaten human health. A balance of basic, translational, and clinical research; emphasis on collegiate interaction; visionary leadership; and a synergistic environment are among the unique features that contribute to the unparalleled potential of this world-class research center.

The **Genomics Analysis Core** provides bioinformatics analysis for most types of genomic data including gene expression, copy number and methylation microarrays and next generation sequencing (NGS) data from whole genome, whole exome, targeted exome and RNA Seq.

The **Genomics Research Core** is equipped with state-of-the-art instrumentation and provides a variety of standard as well as customized genomic analyses to University researchers. The services include Sanger DNA sequencing, Next Generation sequencing of DNA and RNA, RNA/DNA extraction, purification and QC services, gene expression microarrays, whole transcriptome human and mouse microarrays, miRNA microarrays, TaqMan real-time PCR and Nanostring digital expression profiling for mRNA and miRNA, candidate gene and whole genome SNP array genotyping and NanoString CNV analysis.

The **Health Sciences Metabolomics and Lipidomics Core** is located in the Department of Pharmacology & Chemical Biology. The core aids with projects that range in size from isolated experiments to major collaborations involving global analyses related to metabolites and lipids, and metabolic flux studies. The core has working relationships with C3M, CMM and the Small Molecule Biomarker Core to facilitate highly collaborative research involving endocrinology and metabolism, the microbiome and quantitative biomarker analysis.

The **Health Sciences Sequencing Core at CHP** provides central support for Illumina next generation sequencing for RNA, DNA, FFPE and low input applications to the University of Pittsburgh research community. The core was established by a cooperative agreement between the University of Pittsburgh Schools of Health Sciences and the UPMC Children's Hospital of Pittsburgh.

Imaging Resources

Pitt has a variety of imaging cores using varied technologies. A partial listing includes:

- Biological Sciences Microscopy and Imaging Facility
- In Vivo Imaging Facility (IVIF) - Preclinical PET and PET-CT (Hillman Cancer Center)
- In Vivo Imaging Facility (IVIF) – Preclinical MRI (Hillman Cancer Center)
- In Vivo Imaging Facility (IVIF) – Preclinical Optical Imaging (Hillman Cancer Center)
- In Vivo Imaging Facility (IVIF) – Preclinical Ultrasound Imaging (Hillman Cancer Center)
- Center for Biological Imaging (CBI)
- Center for Ultrasound Molecular Imaging and Therapeutics
- Department of Neurobiology Microscopes
- Cryo-electron Microscopy (CryoEM) Facility
- Division of Laboratory Animals Research (DLAR) Imaging
- High Content Screening (HCS) Imaging Resources
- Laboratory of Physical Molecular Biology (chromatin fiber imaging)
- Magnetic Resonance Research Center (MRRC)
- Near Infrared Spectroscopy (NIRS) Brain Imaging Laboratory
- Neuroscience Imaging Center (NIC)/Neuroimaging Laboratory
- Ophthalmic Imaging Research Laboratory
- Pittsburgh NMR Center for Biomedical Research
- Positron Emission Tomography (PET) Facility
- Animal Imaging Core Facility (Rangos Research Center)

- Cell Imaging Core I and II Laboratories, (Rangos Research Center)
- Regional Biocontainment Laboratory (RBL) Clinical Imaging Core
- Nuclear Magnetic Resonance (NMR) Facility (Structural Biology)

The **Innovative Technologies Development (ITD) Core** provides cutting-edge gene targeting strategies using various methods, including CRISPR-Cas9 gene targeting in mice, classical transgenesis using transgenic vectors, and gene editing in cell lines using CRISPR.

The **Peptide and Peptoid Synthesis Core** provides standard and custom services for peptide & peptoid synthesis, purification and characterization including certified peptides for clinical trials.

The **Pitt Biospecimen Core (PBC)** provides Pitt researchers with excess tissue materials obtained from clinical procedures performed at UPMC hospitals. The main purposes of the PBC are to provide a mechanism to simplify and streamline the process of research tissue accrual, storage and disbursement and to provide efficient research pathology support services. Services provided by PBC include human tissue and biological specimen procurement, honest broker services, research histology, annotation of clinical data, and tissue microarray services. The PBC contains a variety of solid tissues, cell aspirates, blood, peripheral blood mononuclear cells, as well as other clinical samples. Solid tissues are available from various disease states from sources including the gastrointestinal tract, liver, and lung.

Pittsburgh Supercomputing Center (PSC) is a joint effort of Carnegie Mellon University and the University of Pittsburgh. Established in 1986, PSC is supported by several federal agencies, the Commonwealth of Pennsylvania and private industry and is a leading partner in XSEDE (Extreme Science and Engineering Discovery Environment), the National Science Foundation cyberinfrastructure program. PSC provides university, government, and industrial researchers with access to several of the most powerful systems for high-performance computing, communications and data storage available to scientists and engineers nationwide for unclassified research. PSC advances the state of the art in high-performance computing, communications and data analytics and offers a flexible environment for solving the largest and most challenging problems in computational science.

The **Small Molecule Biomarker Core** uses state-of-the-art instrumentation to provide quantitative analysis of specific analytes in clinical samples and method development for analytes where a method does not currently exist. The highly sensitive and specific techniques employed by the Core provide accurate quantitation for multiple biomarkers from the same sample, which maximizes the ability to link basic science with clinical outcomes.

The **Transgenic and Gene Targeting Core** provides a broad, comprehensive range of services to Pitt investigators, including generation of gene edited mice, transgenic mice, ES cell microinjection into blastocysts to create germline competent chimera, cryopreservation and long-term storage of mouse sperm/embryos, recovery of mouse lines from cryopreserved germplasm, in vitro fertilization for mouse line rescue and re-derivation of pathogen free mouse strains.

The **Unified Flow Core** manages flow cytometry equipment and cores at each Pitt campus (Oakland, Bridgeside Point II, Children's Rangos Research building, and Hillman Cancer Center) and provides state-of-the-art flow cytometry and cell sorting services to the entire University of Pittsburgh research community as well as researchers at neighboring institutions. A skilled staff provides help with instrument setup, data analysis, and consultation for experiment design. Training is available to enable investigators and their staff to run the analytical cytometers themselves.

ANIMAL RESOURCES

University of Pittsburgh Animal Care and Use Program (ACUP)

The Pitt ACUP (Unit #000496) is fully accredited (last updated on July 11, 2023) by the Association for the Assessment and Accreditation of Laboratory Animal Care International (AAALAC). The ACUP is comprised of 15 separate buildings having approximately 324,510 square feet of animal housing, administrative, surgical, procedure, and other support space. A variety of vertebrate animal species is used for research at Pitt, ranging from zebra fish to rodents to nonhuman primates. The average daily census of this program is over 100,000 mammals. The day-to-day care of animals is managed by the Division of Laboratory Animal Resources (DLAR) and overseen by the Institutional Animal Care and Use Committee (IACUC). Pitt is registered as a research institution with the United States Department of Agriculture (23-R-0016) and has a

letter of assurance on file with OLAW, NIH (#A3187), which is valid through May 31, 2024.

The DLAR provides animal husbandry, veterinary support, and associated administrative support services to the animal-based research programs conducted within the Pitt Schools of the Health Sciences and veterinary support to animal-based research programs conducted within the School of Arts and Sciences. The DLAR also is responsible for six dedicated facilities that conduct Animal Biosafety Level 2 (ABSL2) research and four dedicated animal suites that conduct ABSL3 research, including a NIAID-funded Regional Biocontainment Laboratory with four animal-use suites and an aerobiology exposure area. Biosecurity measures are in place to protect the animal population from acquiring disease and to protect researchers from disease transmission.

The Pitt **Gnotobiotic Facility** is a fee-for-service core that accommodates experiments requiring germ-free (without bacteria, fungi, and exogenous viruses) and gnotobiotic (“known microbiota”) mice. Germ-free mice allow investigators to test the necessity and sufficiency of any microorganism or collection of organisms for a given phenotype. The Gnotobiotic Facility is a BSL2 facility and can support research using many infectious pathogens.