

The University of Pittsburgh Clinical and Translational Science Institute (CTSI), which was launched in 2006 as one of the 12 inaugural Clinical and Translational Science Award (CTSA) Hubs and has received over \$394M from federal, foundation, and industry sponsors since its inception, provides education, connections, funding, tools, and services to advance clinical and translational science across the University's six health sciences schools and UPMC. The CTSI mission is to "accelerate the dissemination and implementation, and hence the impact, of translational research."

CTSI is formally organized in 12 service cores that facilitate and support study team assembly, study design, study conduct, and dissemination and implementation. CTSI services include assistance with all aspects of the research process: statistical and study design, data collection and management, data analysis and modeling, finding collaborators and research resources, preparing protocols and documents for regulatory oversight, addressing ethics considerations, stakeholder and community engagement, study recruitment, human-centered design tools and techniques, single- and multi-site clinical trial planning, commercialization support, and dissemination and implementation. CTSI also provides training, including formal degree programs through the Institute for Clinical Research Education (ICRE), and continuing education for all research team members (community, staff, students/trainees, faculty) on good clinical and research practice, the responsible conduct of research, and methods to enhance the rigor and reproducibility of research. Online playbooks provide on-demand, asynchronous support in all these areas as well, and multiple pilot funding programs and competitions provide >\$500K in grants annually.

CTSI maintains a Research Data Warehouse comprising UPMC EHR data dating back to 2004 on >4.7 million UPMC patients that can be used for phenotyping, EHR-based research (through the Health Record Research Request or R3 service), and cohort discovery. Additional types of data integrated into the Research Data Warehouse at the patient-level include (or will include) images, insurance claims, clinical text, environmental exposures (data from NOAA and EPA), and investigator-collected research data. Investigators can also use the web-based Accrual to Clinical Trials (ACT) program, which CTSI leads, to quickly and efficiently conduct real-time cohort discovery in >160M patients across 57 CTSA hubs throughout the US.

The CTSI Pitt+Me Research Participant Registry and recruitment framework platform uses ICD-9/10 diagnoses and demographics from the EHR plus participant-chosen research preferences to algorithmically match >268K registry participants with specific studies, a process that has resulted in the referral of >239K participants to individual studies. UPMC patients (or parents of pediatric patients) are invited to join Pitt+Me at every clinical office registration kiosk (>700 offices) and through MyUPMC. Participants can sign up for the research registry, manage personal information and study match preferences, and self-screen for studies via a convenient online web portal. Automatically generated personalized recommendations are sent to participants via email or USPS, and the Pitt+Me registry itself and hundreds of studies open for recruitment are promoted on social media (Facebook, Twitter). As part of the larger recruitment framework platform, Call Center staff interview interested participants by telephone using pre-screening questions customized to the specific study and then refer eligible participants to study coordinators. Faculty investigators and study coordinators can then follow up on participant referrals using their own web-based platform, the Pitt+Me Study Portal.

Studies with community member stakeholders as full research team members will soon be identified in Pitt+Me with community-partnered "badging". For studies to receive such badging, CTSI Research Facilitators will help investigators locate and involve stakeholders in every phase of research through Community Ambassadors and Community Engagement Studios. Investigators and community members can complete Community Partners Research Ethics Training (CPRET) and certification, research ethics training approved by the University of Pittsburgh Human Research Protection Office for community partners involved in research studies to allow them to serve as study team members on

IRB-approved protocols. CTSI works to promote both research receptivity (community members are open to messages about research) and research reciprocity (studies are informed by stakeholder-sourced ideas) in partnership with over 200 community organizations. Working directly with investigators, Research Facilitators provide training, guidance, and resources to help study teams “design for impact”, and the CTSI IMPACT Core will provide expertise and resources to help disseminate and implement research findings that are relevant to specific stakeholders, healthcare settings, policies, communities, and populations.

CTSI supports the conduct of translational research at 11 specialized clinical and translational research programs (CTRPs) that service >11K inpatient and outpatient research visits annually for studies of specialized cohorts across the lifespan (e.g., newborns, cancer patients, inpatients, individuals with physical disabilities), including 3 practice-based research networks in children, women, and older adults. Investigators can use CTRPs to implement research inventions and specialized data collection (e.g., sleep studies). Even before the COVID-19 pandemic, CTSI began working to expand the UPMC remote monitoring program to enable TeleResearch to increase research accessibility for those residing in rural Pennsylvania and those unable to attend study visits due to public health concerns, accessibility, transportation, or scheduling conflicts. At an institutional level, the CTSI Clinical Trials Efficiency Team works to promote system-wide study start-up efficiency, promoting parallel versus sequential review processes (e.g., Sponsored Programs, IRB, Conflict of Interest) and facilitating the startup of clinical studies and multicenter trials.

All Pitt investigators are encouraged to leverage the CTSI Discovery Biobank, which serves as an institutional resource for banking DNA samples from participants across the lifespan. CTSI Discovery collects biospecimens from consented UPMC patients (>9K to date), extracts and stores DNA for research sequencing, and runs a pharmacogenomics panel in the CLIA-certified UPMC Genome Center. All pharmacogenomics data are linked with EHR data in the Research Data Warehouse, and clinically actionable results are returned to UPMC EHR (Epic) along with electronic decision support to support precision prescribing by providers. Investigators who wish to obtain genomic data for their study participants but do not want to set up their own biobanking process can use CTSI Discovery instead.

In addition, the CTSI ICRE has a distinguished history of and established infrastructure for successfully training students, residents, postdoctoral fellows, and junior faculty in clinical and translational science and supporting their career development. The ICRE brings all of the CTS training programs under one organization and into one physical space. The ICRE is the infrastructure for degree, certificate, online microcredential, and career development programs for trainees all stages of education and career development. It includes core faculty and mentors from all six schools of the health sciences plus Engineering, Arts and Sciences, and Social Work.

In all respects, CTSI serves as the bridge between Pitt’s research enterprise and UPMC’s clinical enterprise. CTSI leverages UPMC data and resources that fulfill investigator needs, such as the Research Data Warehouse and Pitt+Me enrollment via UPMC kiosks, and CTSI advances Pitt research programs that address UPMC’s clinical needs, including the implementation of evidence-based innovations and best practices. UPMC in turn serves as a regional learning health system for developing, demonstrating, disseminating, and implementing Pitt scientific discoveries facilitated by CTSI and serving as an operations partner in the CTSI Implementation Lab. Other Implementation Lab partners, including the UPMC Health Plan, Allegheny County Health Department, VA Pittsburgh Health System, and Children’s Community Pediatrics network, likewise provide real-world venues for real-time implementation of evidence-based practices and tools arising from clinical and translational research conducted at the University of Pittsburgh and beyond.