

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 \$450M 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 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.

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. Soon, all the EHR data from participating ACT hubs, not just counts, will be available for online research through the ENACT (Evolve to Next-gen ACT) Network, such as conducting virtual clinical trials and finding “patients like mine”.

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 >300K registry participants with specific studies, a process that has resulted in the referral of >250K 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.

To further enhance engagement and enrollment in research, 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 400 community organizations. CTSI Community Engagement Facilitators help investigators locate and involve stakeholders in every phase of research. For example, CTSI will support, coordinate, and facilitate Community Engagement Studios – in which the Facilitator uses human-centered design tools and

exercises to equitably involve all participants in discussions and decision making – and will cover the cost of paying participants for the first studio per investigator, with grant awards funding studio participant stipends in subsequent studios. In addition, 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. In return, the Community PARTners Core encourages investigators to support reciprocity by participating as an active member of the CTSI Speakers Bureau, contributing to the *Take Charge of Your Health* page in the *New Pittsburgh Courier*, or leading a Lunch and Learn session on their research area.

The Community PARTners Core also supports a group of Special Populations Liaisons, research staff with unique expertise in engagement of special populations across the lifespan. These include groups who are not commonly engaged in research, such as pregnant mothers, newborns, and the elderly, as well as those historically underrepresented in biomedical research, such as individuals with physical disabilities, African Americans, and the LGBTQ communities. The liaisons are supported by a “Mind Bank” of expert scientists made up of faculty with expertise in research across the lifespan or with special populations. The Mind Bank helps investigators and liaisons develop strategies to integrate special populations into their studies.

Working directly with investigators, our CTSI Implementation Facilitator will provide training, guidance, and resources to help study teams “design for impact”, and the CTSI IMPACT (Implementation to Maximize Population and Community Translation) Core will provide expertise and resources to help disseminate and implement research findings that are relevant to specific patient groups, communities, clinicians, healthcare settings, payors, and policies.

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 women, older adults, and family medicine. 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. CTSI is working with the internationally recognized THREAD platform to enable Pitt investigators to conduct distributed clinical trials and remote clinical research. 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 (~15K 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.

CTSI issues several pilot funding opportunities throughout the year ranging from \$25,000-\$100,000 with bonus funding for applications that include a training component for an early career investigator (student, postdoc, new faculty) from a background underrepresented in biomedical research and/or meaningful community involvement. In addition, CTSI has managed the Pitt Innovation Challenge (PInCh), which is designed to generate innovative solutions to challenging health problems, provide applicants with experience and training in developing pitches, and provide awardees with project management training and commercialization processes and investor networking. Since 2014, PInCh has awarded over \$6.6 million to 132 projects that subsequently generated over \$65 million in post-award investments.

In support of education and training, the CTSI Institute for Clinical Research Education (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 clinical and translational research training programs under one organization and into one physical space. The ICRE is the infrastructure for multiple degree, certificate, online microcredential, and career development programs for 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. The ICRE prioritizes mentee and mentor development and offers mentor training through the Entering Mentoring curriculum, mentoring contracts and related tools, and workshops in how to be a responsible mentee and get the most out of the mentoring relationship.

CTSI also supports research staff career development, such as Orientation to Research Fundamentals, which is an intensive and interactive workshop consisting of three half-day sessions that cover the basic concepts required to successfully coordinate a research study and provide an overview of the research resources and regulatory requirements for conducting clinical research at Pitt, and specialized workshops such as Innovations in Informed Consent and Recruitment. CTSI also maintains a supportive Pitt-wide network of clinical research coordinators who share advice and best practices with each other and keep coordinators informed through our Coordinator Connect newsletter.

Faculty, trainees, and staff can all take advantage of the CTSI Responsible Conduct of Research (RCR) Center, which offers a comprehensive set of in-person workshops and customized programs that address the 9 topic areas essential for robust training in RCR as well as critical career development skills, such as preparing grant applications and manuscripts, team science, and peer review. Typically, 5-7 live workshops are offered each month during the academic year, including a Rigor and Reproducibility series, and our team also creates customized training plans and workshops for programs seeking specialized RCR education tailored to their research focus and trainee needs.

Finally, 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.