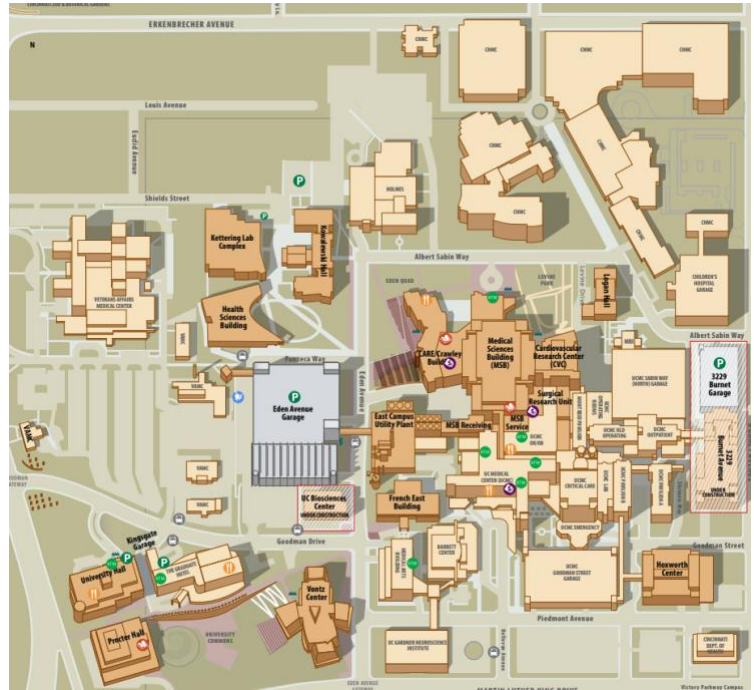


FACILITIES AND OTHER RESOURCES OF CCTST AND PARTNER INSTITUTIONS

A. OVERVIEW

The scientific environment at CCTST partner institutions provides the ideal environment to achieve the CCTST 4.0 goals. The comprehensive facilities and resources available at the University of Cincinnati College of Medicine (UCCOM) and Cincinnati Children's Hospital Medical Center (CCHMC) described below, combined with a vast array of diverse, dedicated, and experienced faculty and staff, will ensure the programs' success. What this document cannot capture is the CCTST's "secret sauce," the highly collaborative environment and potential for true lifespan clinical and translational science (CTS) and clinical and translational research (CTR), given the partnership between a pediatric and an adult academic health center that have tremendous strengths in CTS and CTR. A robust cadre of investigators, trainees, and staff from each of the CCTST affiliate institutions are actively involved in CCTST programs and/or directly derive benefit from it. The geographic proximity (six square blocks) of the Academic Health Center (AHC) institutions (shown in figure) promotes team science and collaboration. All partners are committed to the success of the CCTST.

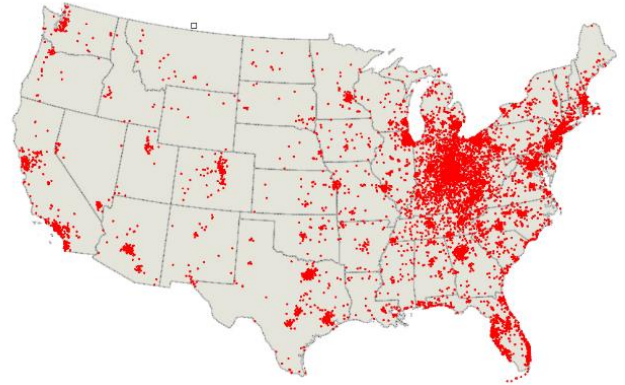


University of Cincinnati (UC)

Founded in 1819, UC is leading urban, public universities into a new era of innovation and impact through its strategic direction, Next Lives Here, underscoring the power of creativity, ingenuity, invention, and inclusion. UC is one of 146 institutions classified as housing the very highest research activity by the Carnegie Classification of Institutions of Higher Education and is ranked 33rd in total research spending among all public colleges and universities (n=410) by the National Science Foundation. UC received \$309.3 million in sponsored program funding in FY2022, 78.5% from federal sources. U.S. News & World Report ranks UC in the Top Tier of America's Best Colleges. Powered by a total annual FY24 budget of \$1.77 billion and an endowment of nearly \$1.8 billion (among the top 25 public universities in the U.S. and 79th largest in the U.S. and Canada), UC has a regional economic impact of \$10.6 billion – and statewide, UC increases the economic base by \$22.7 billion. UC supports over 125,000 regional jobs. That means one out of every 12 jobs in the region is supported by the activities of the university. UC serves a diverse community of 50,921 students across 14 colleges. UC is increasingly diverse, with racial and ethnic minorities making up 26% of this year's student body, an increase from 25.5% in Fall 2022 and 24.1% in Fall 2021. As the global founder of cooperative education, UC remains a world-class leader in experience-based learning. U.S. News & World Report ranks UC's co-op program in the Top 5 in the country. The university has 200+ years of history as a research pioneer, with a culture strongly emphasizing collaboration to achieve innovative results that can be applied to solving complex problems and furthering scientific advancement. The university fosters early-stage research and launches start-up companies via an expanding innovation incubator, the 1819 Innovation Hub, providing a key location amidst Cincinnati's rising Innovation Corridor. The 1819 Innovation Hub is the nexus for business and industry to partner with university faculty and students. Partnering with UC's 1819 Innovation Hub are a wide range of visionaries: From seed-stage investors like CincyTech (one of the most active in the nation) to established corporations like Procter & Gamble to consultancies. The University of Cincinnati and its affiliates are home to over 6,000 full- and part-time faculty internationally recognized for innovative teaching and research, especially in the practical applications of their discoveries. UC is home to Ohio Centers of Excellence dedicated to advanced energy and sustaining the urban environment; transforming healthcare in the 21st century; intelligent air and space vehicle energy systems; nanoscale sensor technology; design and innovation; and music and theater arts.

University of Cincinnati College of Medicine

UCCOM received \$210 million in sponsored awards in 2022-2023, including about \$100 million in NIH funding. As of July 2023, UCCOM endowments totaled \$612,933,879. The economic impact of UCCOM is \$979 million and \$4.9 billion in aggregate from 2011 to 2015. Full-time, part-time, and adjunct/volunteer/visiting faculty at the College of Medicine (COM) (excluding pediatrics) number 946, distributed among five basic science and 18 clinical departments. **UC Health**, established in 2009, is an integrated academic health system serving the Cincinnati region. UC Health includes UC Medical Center (UCMC), West Chester Hospital, Daniel Drake Center for Post-Acute Care, Bridgeway Pointe Assisted Living, UC Physicians, Lindner Center of HOPE and several specialized institutes. Many UC Health locations have received national recognition for outstanding quality and patient satisfaction. In FY 2022, UC Health served more than 513,422 unique patients from all 50 states (right) across four inpatient campuses and 65 outpatient locations. UC Health's emergency departments received 102,401 visits.



The **Department of Internal Medicine** is home to 357 faculty from 10 divisions, 135 residents, 87 fellows and 280 staff. Administratively, it is divided into 4 areas: educational, clinical, research and veteran's affairs. Physicians within the Department are part of the UC Health University of Cincinnati Physicians group practice, providing comprehensive clinical services in primary care and all medical subspecialties. New clinical practice programs include a diabetes center, sleep center and heart and vascular center. The Department is deeply committed to its research mission and to the training of future clinical investigators and researchers in foundational, clinical, translational, outcomes and other health care-associated research areas. Faculty research is often interdisciplinary and collaborative between clinical and basic scientists, including projects with investigators at CCHMC, the Cincinnati VA Medical Center, the James L. Winkle College of Pharmacy, and the College of Education, Criminal Justice, and Human Services. The Department has particular research strengths in: cancer, with numerous collaborators across the Academic Health Center, including the CCHMC Hematology Oncology Unit; cardiovascular health, including a Cardiovascular Center of Excellence; digestive diseases, including the Hepatology Research Group, one of the premier research groups involved in the study of HCV and HBV co-infections in the context of HIV; diabetes and obesity; infectious diseases, including the AIDS Clinical Trial Unit; outcomes research; rare lung diseases including LAM and pulmonary alveolar proteinosis; and sickle cell disease, including participation in national clinical trials of the Sickle Cell Research Network.

University of Cincinnati Gardner Neuroscience Institute:

The UC Gardner Neuroscience Institute (UCGNI) offers its patients unparalleled access to cutting-edge research, world-class clinical trials, the most advanced technology and the latest innovations in medical treatment and care. UCGNI includes the region's only Comprehensive Stroke Center, Level IV (highest) Epilepsy Center, and Level I (highest) Trauma Center and Neurocritical Care facility. It is the national coordinating center for StrokeNet, a member of the Network for Excellence in Neuroscience Clinical Trials, Cincinnati's hub for the Cancer Genome Atlas Research Network, and founding member of the National Network of Depression Centers. UCGNI is made up of more than 125 faculty members representing 15 clinical specialties. In the past year, UCGNI has performed more than 2,700 surgeries, appeared in over 100 published articles in peer-reviewed academic journals, and had 67 corporate studies and 49 University of Cincinnati studies in neurology.



Centers of Excellence: Through its 2007-2008 strategic planning process, the CoM identified 4 Centers of Excellence: cancer, cardiovascular disease, neuroscience, and diabetes and obesity. These are areas in which the CoM has recognized quality, a track record of success, opportunities for funding, and an ability to advance translational research and deliver high-quality personalized care. The CoM will also continue to develop programs in gastrointestinal disorders, immunology, inflammation, and infectious diseases. Broad themes for the Centers include women's health, diseases across the life cycle, multidisciplinary critical care

services, innovative technology and environmental and urban health care. The Centers are a focal point of UC's \$1 billion fundraising campaign.

Cincinnati Children's Hospital Medical Center

CCHMC, home to faculty of the UC Department of Pediatrics and the Cincinnati Children's Research Foundation, has 1,067 faculty and is a strength of the AHC and CCTST. CCHMC is a 762-bed non-profit organization serving as the AHC's pediatric teaching facility and as the only children's hospital in the Cincinnati metropolitan area, employing 18,589 faculty and staff. CCHMC is a national and global leader in pediatric clinical care, research, education, community and population health, and advocacy. CCHMC ranked #1 on the 2023-2024 Honor Roll of America's Best Children's Hospitals compiled by U.S. News & World Report. The Department of Pediatrics was ranked #2 among U.S. medical schools in the 2023 Best Medical School rankings by U.S. News & World Report. In addition, CCHMC was recognized as one of America's Most Innovative Companies by *Fortune* in 2023 (and the highest of any children's hospital). It was recognized by *Forbes* as one of America's Best Employers for Diversity for 2023, the only children's hospital recognized in the Top 20 for diversity excellence by *DiversityInc*, ranked 9th nationally in the list of best employers for women by *Forbes*, and received the Healthcare Equity Leader award from the Human Rights Campaign for exceptional LGBTQ+ healthcare. CCHMC offers 16 patient care sites throughout the region, the area's only Level I pediatric trauma center and pediatric cardiac ICU, and a satellite campus for psychiatric services. In FY2023, CCHMC had 1,652,584 total patient encounters, including 173,507 Emergency Department/Urgent Care visits, 37,836 surgical procedures, 1,445,961 outpatient visits, and 33,116 admissions. In 2021 CCHMC opened the Critical Care Building (CCB), a 249-bed, 632,000 square foot facility housing all critical care clinical programs (NICU, PICU, CICU) along with a new, expanded emergency department, bone marrow transplant unit, expanded clinical pathology laboratories, and additional support space for clinical operations.

Cincinnati Children's Research Foundation (CCRF) is home to faculty of the UC Department of Pediatrics and 54 research divisions. William Cooper Procter, a benefactor of the hospital, established the CCRF with a building devoted to research in children's diseases that opened in 1931. He included a \$2.7 million endowment and stipulated that income from the endowment would exclusively support research and development, a principle that continues to form the philosophical approach to supporting research. Today the CCRF endowment is valued at >\$2 billion and supports research across CCHMC.

Sponsored program awards for the CCRF, home to faculty of the UC Department of Pediatrics and 54 research divisions, totaled \$295.9 million in FY2023, the second-largest total for a pediatric center nationally. Of this total, 79.6% (\$235.5 million) was federally funded. Industry, foundation and other non-federal support was 20.4% of total sponsored funding, or \$60.4 million. CCRF efforts were supplemented by >\$60M in endowed internal funding for laboratory and applied research costs. The CCRF has 54 research divisions and 1,067 faculty: the Department of Pediatrics accounts for 826 of the faculty totals. In FY23, CCHMC trained 273 clinical fellows, covering nearly all the sub-specialty areas; 136 research post-doctoral fellows; 180 research associates; and 228 pediatric residents. CCHMC also holds the second-highest number of NIH training (T) awards (n=10) and the highest number of NIH Fellowship (F) Awards (n=19) among all children's hospitals in the U.S. CCRF research resulted in the publication of more than 2,400 peer-reviewed articles in 2022.



James L. Winkle College of Pharmacy

The College of Pharmacy, the first west of the Alleghenies and 4th oldest college of pharmacy in the nation, was established in 1850 as a private, independent college of pharmacy and joined UC in 1954. It assumed its current name in 2007 to recognize a \$10 million gift to fund scholarships, research, and faculty recruitment. The College has 35 faculty members. The College's research-intensive MS/PhD program has 60 students in the Pharmaceutical Sciences program and 570 students in the online graduate certificate and master's program across several disciplines: Drug Development, Cosmetic Science, Health Outcomes, Pharmacy Leadership, and Pharmacogenomics. The College has 272 students in its 4-year PharmD program, offered since 2000. Extramural faculty research funding was \$3.5 million in FY23. Areas of interest include pharmacoconomics, cancer, dermatology, drug penetration, drug delivery technology, cosmetic science, cardiovascular disease, infectious disease, and neuropharmacology.

College of Nursing

The **College of Nursing**, founded in 1889, is ranked 51st among 681 ranked U.S. Nursing schools and 37th among 201 online MSN programs by *U.S. News & World Report*. The first college to offer a baccalaureate degree in nursing (1916), it has offered a doctorate program since 1990, the same year a Center for Nursing Research, now the Institute for Nursing Research and Scholarship, was developed. Additional programs include an RN to BSN online program, an accelerated program, and a Master of Science in Nursing program with a spectrum of online and onsite specialties available. In 2003, it became the first college of nursing in Ohio to offer a cooperative education program, which now includes the University of Cincinnati Medical Center and Cincinnati Children's Hospital Medical Center. The College's 70 faculty received \$2.3 million in extramural funding in FY23. Programs and research are supported by organizations such as the Midwest Nursing Research Society, Sigma Theta Tau, the Transcultural Nurses Society, and various federal agencies within the U.S. Department of HHS, including the CDC and HRSA. Research areas include nursing education innovations, interpersonal violence, vulnerable populations and health disparities, aging, and co-morbid conditions. Enrollment includes 2,7274 undergraduate and graduate students. The 36 PhD students focus on specific research interests and methodologies under the direction of senior faculty nurse scientists. Established in Fall 2010 with CCTST/CTSA support, the Doctorate of Nursing Practice (DNP) program emphasizes advanced practice nursing, utilizing the best evidence in delivering nursing practice and leadership in complex health care systems. The College is a leader in leveraging technology in healthcare education and in providing diverse educational opportunities for nurses, including nurse scientists and nurse educators.

College of Allied Health Sciences

The **College of Allied Health Sciences**, founded in 1998, has 316 faculty and 2,912 students, including master's and doctoral students. The College houses the Departments of Clinical and Health Information Sciences, Communication Sciences and Disorders, Rehabilitation, Exercise, Nutrition Sciences, and the School of Social Work. Research areas of interest are specific to each program and include child language development, traumatic brain injury, stroke, maternal, childhood and adolescent nutrition, and deafness. Faculty extramural research support in FY2018 was nearly \$3.2 million. The College offers a 5-year MD/MS in Nutrition dual degree program with the College of Medicine, which allows medical students to develop a comprehensive knowledge of human nutrition and skills in research design and implementation.

Academic Health Center Campus

The AHC campus includes 16 buildings spanning nearly 2.5 million gross sq. ft. on 56 acres in the central Cincinnati neighborhoods of Avondale and Corryville. The **Medical Sciences Building (MSB)**, which opened in 1974 and is at the center of the AHC, is a 13-floor, 918,003 gross sq. ft facility (includes Receiving and Service space) with 1,080 faculty offices and 200 research laboratories totaling over 210,000 sq. ft., as well as all the preclinical and clinical departments of the COM (except Pediatrics and Pediatric Surgery, Anesthesia, Radiology, Pathology, and Psychiatry, all housed at Cincinnati Children's), the Health Sciences Library, classrooms, teaching laboratories, and animal facilities. The building supports basic (discovery), translational, analytics, and clinical research. The **Health Sciences library** is conveniently housed within the MSB on the Entrance level and contains computer workstations for students and faculty alike. MSB contains the largest meeting room in the College of Medicine (Kresge), which can seat a total of 592. The MSB is physically joined to UC Medical Center (formerly University Hospital), described below. The attached nine story, 240,000 gross sq. ft. Center for Academic & Research Excellence (CARE)-Crawley wing, which opened in September 2008, encompasses over 70,000 sq. ft. of laboratories as well as library, administrative, meeting, and recreational space. These upgrades foster the continued growth of the AHC's biomedical research grants and contracts, just as the addition of the MSB, the Cardiovascular Center (1996), the free-standing Vontz Center for Molecular Studies (1999), and the Reading Campus/Metabolic Diseases Institute (2001) have done. Formerly known as the Genome Research Institute (GRI), the Reading Campus is 8 miles north of the AHC and comprises 10 buildings containing over 382,000 gross sq. ft. of laboratory and office space on a 25-acre campus. This Campus houses research faculty in the Metabolic Diseases Institute, focusing on diabetes and obesity, lipids and arteriosclerosis, and cancer metabolism. The Campus includes about 30 principal investigators and over 300 staff.

UC Undergraduate Campus

Faculty and trainees from the UC undergraduate campus (a short shuttle ride from the AHC), which

includes the Colleges of Design, Architecture, Art and Planning (DAAP, routinely ranked among the top design schools in the world), Engineering and Applied Sciences (CEAS), Business, Arts and Sciences, Law, and Education, Criminal Justice and Human Services (CECH), support CCTST services or obtain support from it.

AHC Commitment to Diversity, Equity, and Inclusion

UC, the UCCOM, and CCHMC are highly committed to DEI and are recognized nationally for inclusive excellence. They recognize a broad and inclusive concept of diversity that includes race, ethnicity, gender, age, disability status, socioeconomic status, history of disadvantage, gender identity and expression, sexual identity, sexual orientation, religion, and regional or national origin. The CCHMC Office of Academic Affairs launched a DEI strategic plan for faculty in 2021 that is supported by a steering committee, DEI directors, DEI liaisons, and a DEI coordinator and has resulted in multiple positive outcomes, including a 33% increase in underrepresented minority faculty. Both UCCOM and CCHMC have recently launched programs to enhance the recruitment of research faculty who are underrepresented in medicine and science and to create cultures of inclusive excellence.

B. RESEARCH FACILITIES AND RESOURCES

UC Office of Clinical Research (OCR) and CCHMC Office for Clinical and Translational Research (OCTR)

The OCR and OCTR provide resources and infrastructure to researchers to facilitate the effectiveness and efficiency of clinical and translational research, including clinical trials. OCR and OCTR support clinical research via recruitment and marketing, compliance, education and training, research support services, clinical trial monitoring, and medical writing for IND and IDE submissions to the FDA. More details are provided in the table below.

Summary of OCR and OCTR Services			
Coordination Support	Early Phase Trial Support	Multisite Trial Support	Marketing/Recruitment Support
<ul style="list-style-type: none"> Logistical considerations Study start-up Design of source documents/Case Report Forms Patient recruitment, screening, consenting, and follow-up. Drug administration and accountability Phlebotomy, specimen processing, and storage Data management Study close-out Billing oversight 	<ul style="list-style-type: none"> Consultation on regulatory requirements (FDA and IRB) Regulatory submissions FDA meetings and inspections Investigator-initiated IND support Development of clinical study documents (protocol, consent forms, etc.) Ancillary services (imaging, lab, infusion, investigational pharmacy, etc.) Clinical study monitoring 	<ul style="list-style-type: none"> Liaison with CCHMC IRB Work with external sites to get initial IRB approval Management of all modifications, continuing reviews, and study closure reports EpiCare access Submission of reportable events Aid in development of SOPs Maintenance of regulatory trial master file Assistance with agency audits 	<ul style="list-style-type: none"> Printed materials Digital and physical recruitment boards Social media Email or newsletter Web text (for a custom website) External platforms (e.g., ResearchMatch, StudyKik, HighEnroll) TV, radio, billboard, or bus ads

Schubert Research Center (SRC)

The CCTST was instrumental in developing the SRC and continues to ensure the quality and efficiency of services through the SRC. Located in the CCHMC Clinical Sciences Pavilion, connected to the main hospital and across from the UC Medical Science Building, the SRC brings together all services supporting pediatric and adult clinical trials in one location, making the planning and conducting process convenient for investigators and participants. The SRC has 28 exam rooms, preparatory lab for biospecimen processing, packaging and shipping room, metabolic kitchen, body composition laboratory with DXA scanners, vascular research laboratory, and imaging center. With this comprehensive setup, the clinic is fully equipped to conduct research studies on participants across the lifespan, from infants to older adults.

CCHMC and UCCOM Shared Facilities

Both CCHMC and the UCCOM have a vast array of shared facilities available to investigators; listed below.

UCCOM Research Shared Facilities
Advanced Cell Analysis Service Center
Biosafety Level 3 Facility
Center for Advanced Structural Biology
Center for Biostatistics and Bioinformatics Services
Center for Clinical and Translational Science and Training
Center for Health Informatics
Clinical Studies Participant Recruitment Service
Fernald Database and Biospecimens Service
Genomics, Epigenomics and Sequencing Core
Inhalation Core Facility
Live Microscopy Core
Mouse Metabolic Phenotyping Center
Preclinical Imaging Core
UC Flow Cytometry Core
UC Histopathology Core Laboratory
UC Proteomics Laboratory
UC Radiology Imaging Services Core Laboratory
UCCC Biospecimen Shared Resource

CCHMC Research Shared Facilities
Animal Behavior Facility
Bio-Imaging and Analysis Facility
Bionutrition Research Facility
Cardiovascular Imaging Research Laboratory
Cell Manipulation Lab
Cell Processing Core
Comprehensive Rodent and Radiation Shared Facility
Data Management and Analysis Collaborative
Discover Together Biobank
Genomics Sequencing Facility
Information Services for Research (IS4R)
Imaging Research Center
Integrated Pathology Research Facility
Investigational Pharmacy
Mass Spectrometry Facility (Clinical and Biomedical)
Media Lab Facility
MEG Research Facility
Metagenomic and Microbiome Facility
NMR-based Metabolomics Facility
Office for Clinical & Translational Research
Pluripotent Stem Cell Facility
Proton Therapy Research Facility
Qualitative Methods and Analysis Collaborative
Research Flow Cytometry Facility
Single Cell Genomics Facility
Transgenic Animal and Genome Editing Facility
Translational Trials Development and Support Laboratory
Vector Production Facility
Veterinary Services
Viral Vector Core

C. TRAINING PROGRAMS

Master of Science and Certificate in Clinical and Translational Research: The Clinical & Translational Research (CTR) graduate education program offers two Master of Science (MS) degree tracks (Principal Investigator and Clinical Research Professionals tracks) and a Graduate Certificate in CTR. The CTR graduate

education program was initiated in 2009 with the support of the Clinical and Translational Science Award (CTSA) funded - Center for Clinical & Translational Science & Training (CCTST, UL1TR001425). The Master of Science in Clinical & Translational Research - Principal Investigator (MSCTR-PI) track is intended to provide clinicians and biomedical researchers with a terminal degree with the necessary preparation for successful career development and tools to conduct independent clinical and/or translational research. The MSCTR-PI track offers training in epidemiology, biostatistics, clinical effectiveness, molecular epidemiology, clinical trials, quality improvement, informatics, grant writing, and translational research that will enable translation of scientific advances into applications for improved clinical practice and human health. The Master of Science in Clinical & Translational Research - Clinical Research Professionals track (MSCTR-CRP) is designed for clinical research professionals who coordinate, manage, and lead collaborative research projects and clinical trials. The objective of the MSCTR-CRP track is to provide clinical professionals the necessary preparation for successful careers in clinical research by providing students a strong foundation in research methodology, program/project management, training in research ethics and the Institutional Review Board (IRB) process. Both the PI and CRP tracks are 30-credit hour programs designed to be completed in 2-3 years, on a part-time basis. Students in the PI track must complete a thesis while students in the CRP track may complete a thesis or capstone project. The Graduate Certificate in Clinical and Translational Research program gives students an introduction to the field of CTR, with coursework in epidemiology, statistics, and research ethics. The graduate program in clinical research is supported in part by the CCTST and by student tuition and institutional support, and is directed by Patrick Ryan, PhD. Annually, these programs have between 40-50 students enrolled in the MSCTR-PI track, 10-15 students enrolled in the MSCTR-CRP track, and 35-50 students enrolled in the Certificate programs. A 10-credit hour Certificate program was added in 2009, which may be taken online as of 2011. Faculty are drawn from several departments of the Colleges of Medicine and Pharmacy. All program faculty are actively engaged in clinical studies. The MS in Clinical Research program is funded in part by the CCTST and by student tuition and institutional support, and is directed by Scott Langevin, Ph.D. and Patrick Ryan, Ph.D. Annually, these programs have between 40 and 50 students enrolled in the MS programs, 35-50 enrolled in the Certificate programs, and ~10 enrolled in the CRP track. A Graduate Certificate in Community-Engaged Research for Health was added in 2022 and is geared towards graduate students, faculty members, and academic or community researchers who are interested in integrating community engagement into their research design. Course topics include an overview of community-engaged research for health equity, ethics, introductory research methods and dissemination, community psychology, racism in research, and communicating and translating scientific results to public audiences. The program is offered completely online and is a collaboration between the Department of Pediatrics in the College of Medicine and the Department of Psychology in the College of Arts and Sciences.

Molecular Epidemiology in Children's Environmental Health: This interdisciplinary training program, funded in part by an NIH T32 training grant (Kelly Brunst, PhD, PI) equips predoctoral students, resident/fellow MDs, and postdoctoral PhDs with the knowledge and skills to undertake epidemiological and clinical studies using molecular markers of exposure, effect, and susceptibility. Housed within the Department of Environmental and Public Health Sciences, the program also involves faculty from the Departments of Pediatrics and Molecular Genetics, Biochemistry and Microbiology. Training consists of didactic course and laboratory experience utilizing state-of-the-art methodology in molecular methods. Students participate in health studies examining the impact of environmental exposures on complex diseases and disorders, such as obesity, allergy and asthma, diabetes, cardiovascular disorders, neurological disorders, and juvenile arthritis. Full tuition and an annual stipend are provided.

MS and PhD in Epidemiology: Offered through the Department of Environmental Health, the MS requires 1 year of full-time graduate study or its equivalent, and a minimum of 30 graduate credits in addition to a written thesis. The PhD requires 3 years of full-time graduate study or its equivalent, and a minimum of 90 graduate credits, 60 of which must be from didactic course work, in addition to the dissertation. Courses required of both degrees include Environmental Health Seminar, Epidemiology and Biostatistics Seminar, Ethics in Research, Introduction to Biostatistics, Introduction to Epidemiology, Introduction to SAS Programming, Design & Management of Field Studies in Epidemiology, and Molecular Epidemiology. Additional course requirements of the PhD include Advanced Physiology, Regression Analysis, Experimental Design, and Categorical Data Analysis (Rates & Proportions).

MS in Drug Development: A unique collaboration between academia, industry and government, the MS in

Pharmaceutical Sciences with Specialization in Drug Development is offered through the College of Pharmacy and designed as a 2-year part-time curriculum primarily intended for full-time employees in the Cincinnati metropolitan region. Established in 2004, the program is open to individuals holding post-baccalaureate degrees in pharmacy, nursing, medicine, and other related biomedical sciences. Courses include Global Drug Development, Pre-clinical Product Development, Regulatory Affairs, Clinical Trials Design, Project Management, Drug Delivery Devices, Pharmacovigilance, and Pharmacoeconomics. A total of 30 credit hours are required for the degree. The program was developed through close collaborations between the College of Pharmacy and other units of the AHC, regional pharmaceutical companies, and clinical research organizations. Master of Public Health: The UC MPH program was approved by the Ohio Board of Regents in December 2007 and began enrolling students in September 2008. Housed in the Department of Environmental Health (described above), its mission is to prepare students for leadership in public health practice and research by generating, evaluating, and applying evidence to improve the public's health. This education will be provided from a multidisciplinary perspective, employing active-learning strategies, and in collaboration with the full array of community institutions and organizations involved in the health of the public. The UC MPH program is one of the first public health training programs in the nation to emphasize an evidence-based approach to safeguarding and improving the public's health. In cooperation with the Health Promotion and Education Program of the Division of Human Services, the MPH is also offered with a concentration in Health Education. This is primarily a practitioner's degree for those desiring to work as public health educators in departments of public health, voluntary agencies, and other community health organizations. In cooperation with Environmental Health faculty, concentrations in environmental public health and biostatistics were added in 2012. The UC MPH program became a founding member of the Association of Schools and Programs of Public Health (ASPPH) in 2013.

MD/MS in Nutrition Program: Offered jointly by the Colleges of Medicine and Allied Health Sciences, the MD/MS in Nutrition dual-degree program is completed over 5 years, with core courses and guided electives for the MS typically completed between the 3rd and 4th years of medical school. The required master's thesis is completed during the 4th year of medical school. The program provides medical students with 1) a comprehensive knowledge in the biochemical and physiological aspects of human nutrition; 2) knowledge of methodologies used in nutrition research and nutrition intervention and 3) skills in research design, implementation, evaluation, and interpretation. The combined knowledge of nutrition and medical principles encourages multidisciplinary approaches to investigative efforts of major public health problems such as diabetes, obesity, cardiovascular disease and cancer, and improves the ability of the practitioner to use behavioral strategies to enhance patient compliance with lifestyle recommendations.

MD/MBA Program: Offered jointly by the UC CoM and Carl H. Lindner College of Business, this dual degree program is designed for highly qualified students who desire to complement their standard medical education with a greater understanding of the economics, finance, marketing, and management of the health care system. Students apply during their second or third year of medical school. The program typically takes 5 years to complete via one of 3 curriculum pathways. Graduates have expanded career options including management positions in major health care organizations.

Graduate Programs in Biomedical Sciences

CoM programs include approximately 573 graduate students with >60 MD/PhD students and >250 postdoctoral fellows annually. Across training programs in the CoM, in 2023 has four F30s, eight F31 and F32s, in addition to one T35 and one T42.

Biomedical Informatics: The Doctor of Philosophy in Biomedical Informatics Program at the University of Cincinnati, which commenced in 2015, provides an in-depth knowledge of the key analytical concepts underlying informatics and data science applications to biomedical research. The program leverages partnerships between the CoM, CCHMC, and the UC College of Engineering and Applied Sciences to provide a framework of transdisciplinary educational opportunities. The program has assembled a group of 36 informatics faculty spanning three Colleges, five College of Medicine Departments, and ten CCHMC Divisions. Coursework and fields of study span topics of computer and decision science, computational and systems biology, bioinformatics, clinical informatics, public health informatics, and biostatistics. The program currently includes 20 MDs and MD/PhD students. Coursework is individualized by adapting to student background and prior proficiency. An environment of professionalism and collaboration among world-class

research groups, faculty, and students is the foundation to educating the next generation of biomedical data scientists. In addition, the Department dually operates a graduate certificate program in biomedical informatics with the UC School of Engineering and closely coordinates with Engineering's computer science (bioinformatics track) PhD program. The Department also works closely with other area organizations on pipeline programs (e.g., UC and Northern Kentucky University undergraduate and graduate programs; COM's Summer Undergraduate Research Fellowship program) for student recruitment and various relevant UC-based PhD and MSTP programs for informatics cross-training opportunities for these students. Courses for these programs are shared when possible. The Department also commenced a pediatric medical residency program in clinical informatics in Fall of 2016. CCHMC now houses a clinical informatics fellowship program.

Cancer and Cell Biology: The Interdisciplinary Graduate Program in Cancer and Cell Biology is an extensive, interdepartmental graduate program with expertise in many critical areas of modern cancer and cell biology. The Program involves more than 75 faculty from 12 Departments in the UC CoM and CCHMC and is administered by the Department of Cancer and Cell Biology. Faculty selected to join the program are recognized leaders in their fields and provide excellence and dedication in graduate training. Consequently, the Program's graduate students excel in research and are highly successful in their scientific careers. Successful Program completion typically involves 4 to 5 years beyond the bachelor's degree, varying according to background and special interests. The Program's philosophy is that PhD training must be intellectually stimulating, congenial, and geared toward a successful career in modern research. Requirements include 90 credit hours (30 of which are coursework), successful completion of the Doctoral Qualifying Examination in the Program's second year, and a thesis.

Environmental Health and Public Health Sciences: For decades, one of the top-funded academic units of its type in the country, the Department of Environmental Health, now the Department of Environmental and Public Health Sciences, has the largest graduate program in the CoM, offering training in epidemiology and biostatistics, environmental genetics and molecular toxicology, industrial and occupational hygiene, occupational and environmental medicine, and public health. Research centers housed in the DEH include the NIEHS-funded Center for Environmental Genetics (CEG), whose mission is to promote integrative research among basic and applied scientists, epidemiologists, and clinicians to develop an understanding of the complex relationship between genetic predisposition factors and environmental exposures. Training programs include the interdisciplinary Molecular Epidemiology in Children's Environmental Health, funded in part by an NIH T32 grant, which equips predoctoral students, resident/fellow MDs, and postdoctoral PhDs with the knowledge and skills to undertake epidemiological and clinical studies using molecular markers of exposure, effect, and susceptibility. The DEH also houses the MS and Certificate in Clinical and Translational Research described above, which require 30 and 10 semester credit hours, respectively, offered in multiple tracks.

Immunology: Study of the immune system in health and disease, from the molecular level to that of whole organisms, has become a significant focus of biomedical research over the last decade. The Immunology Graduate Program at UC and CCHMC aims to provide unparalleled training for the next generation of forward-thinking and innovative immunologists. The program offers rigorous coursework and practical training in some of the world's most outstanding immunology laboratories. The top-notch faculty's extensive experience in teaching and expertise in all areas of immunology provides the student with a well-rounded immunology training experience and preparedness for a post-graduate career path in immunology. The Program provides access to outstanding core facilities, including state-of-the-art flow cytometry and cell sorting, 2-photon imaging, gene targeting and transgenic mouse core, bioinformatics core, gene expression core, pluripotent stem cell facility, laser capture microdissection core, viral vector core, and many others. All PhD students accepted to the program receive full tuition remission, a nationally competitive stipend, and a health insurance plan. The Immunology Graduate Program also offers full-time and part-time tracks leading to the MS degree.

Molecular and Developmental Biology: Based at CCHMC, the Molecular and Developmental Biology Graduate Program offers world-renowned faculty leading research teams integrating basic research in model organisms with translational research into disorders and diseases in children. Major research areas include cancer biology, cardiovascular biology, gastrointestinal development, genetics/gene therapy, genomics/bioinformatics, hematopoietic system, immunology, molecular embryology, neurobiology, other organ systems, pulmonary biology, reproductive biology, stem cell biology, and visual systems. The

musculoskeletal, urogenital, auditory, and integumentary systems are also studied. All students must complete required courses in developmental biology, graduate-level biochemistry, molecular biology, and cell biology. As students prepare to enter their second year, they initiate their research and spend more time in the lab and less time in the classroom. The average time to obtain a PhD in the MDB Program is five years, well below the national average of 6-1/2 years. Most students can fulfill their course requirements in the first 18 months, freeing them to focus on laboratory research and the completion of thesis-related experiments. Students participate in laboratory rotations during the first year to gain insight into areas of interest before choosing a faculty advisor and developing a dissertation project. Students are encouraged and expected to publish their contributions in peer-reviewed scientific journals. Unlike some graduate school programs, students are not required to hold teaching assistantships to help pay for their financial aid, so more time can be spent in the lab conducting research. In addition, students in the Program have many opportunities to share their research findings and polish their presentation skills via an annual symposium of student research presentations, a university-wide poster presentation contest, attendance at national meetings, weekly journal clubs, and informal lunches with top scientists worldwide.

Molecular, Cellular, and Biochemical Pharmacology Program: Based in the Department of Pharmacology and Cell Biophysics, the Program is designed to train the next generation of scientists, innovators, and leaders in pharmacology. Students engage in a contemporary curriculum, including thesis research training in faculty mentored research programs. Thesis research involves novel therapeutic target discovery and adding new knowledge to existing chemical and biological molecular entities. Completion of the Program leads to successful careers in academia and in pharmaceutical and governmental organizations. Students complete a series of laboratory research rotations and build their knowledge foundation by conducting basic and advanced courses in cell and molecular biology, receptor pharmacology, advanced topics in pharmacology, laboratory research methods, experimental design (including biostatistics, data analysis and interpretation), biotechnology, seminar presentations and "hot papers" journal club. Classes and research activities require a full-time, year-round commitment. PhD degree requirements can be completed in 4 years. Thesis research areas involve mechanistic and quantitative aspects of potential and established drug targets and developing new biotechnologies for high impact disease interventions using state-of-the-art biotechnology and pharmacological methods. A variety of experimental diseases in transgenic and gene-ablated/suppressed models from single molecules to entire organisms are used in research. Students conduct thesis research supported by faculty, department, and institutional state-of-the-art biotechnology laboratory resources, including numerous core facilities, high throughput screening for drug targets and drug entities, genomics, proteomics, gene array, bioinformatics, transgenics, MRI, ultrasound, and confocal, imaging, and fluorescent cell sorting. The doctoral program has a 1:1 student-to-faculty ratio, assuring personal mentoring and interactions to closely advise and guide the professional development of each student to a career pathway tailored to their interests and strengths.

Molecular Genetics: The Department of Molecular Genetics, Biochemistry, and Microbiology currently includes 19 primary faculty, 23 affiliate faculty, and ~45 graduate students annually, along with a significant population of postdoctoral fellows, all supported by numerous research and administrative staff. The Graduate Program provides a collegial atmosphere that fosters top-quality research combined with in-depth coursework, seminars, and journal clubs. In this environment, students learn to apply the latest scientific technology to research areas, including gene and chromosome structure, regulation of gene expression, protein chemistry and engineering, structural biology, membrane structure and function, intracellular trafficking, signal transduction pathways, oncogenes and growth factors, and pathogenic mechanisms. For many of these studies, a variety of genetic systems are employed, including human, mouse, *Drosophila*, and yeast. In addition to well-equipped faculty laboratories, the department houses several core laboratories to facilitate the research process, including DNA sequencing, synthesis and genotyping, mouse transgenic and gene targeting facilities, and state-of-the-art NMR and X-ray crystallographic facilities. Furthermore, students have access to the CoM's extensive genomics, proteomics, and bioinformatics cores, providing the tools to capitalize on the human and other genome projects. While there is no requirement (or expectation) for graduate students to teach, a certificate program entitled Preparing Future Faculty (PFF) is available, which exposes students already embarked on a graduate degree to a series of seminars on effective teaching practices and conducting an academic job search, while providing internship opportunities in local undergraduate institutions where faculty roles and duties can be experienced via a "shadowing" program with an individual faculty member.

Neuroscience: The aim of the Graduate Program in Neuroscience is for PhD students to develop technical expertise, communication skills, and critical thinking skills essential for successful research careers in academia or industry. Critical ingredients include classroom training, rich exposure to a broad base of basic and translational neuroscience seminars and presentations, and research training that emphasizes modern approaches to understanding nervous system function. The Program supports study in a wide range of research areas, including but not limited to neural development; neurobiology of addiction; biology of neurological diseases and neurodegeneration; neuroimaging; neuroendocrinology of stress, obesity, and diabetes; and cognitive neuroscience. The Program includes over 90 faculty in multiple departments in the Colleges of Medicine, Arts & Sciences, Engineering, Pharmacy, and Allied Health, as well as CCHMC. All students have access to a full range of core facilities, including genomics, proteomics, functional MRI, confocal microscopy, and rodent behavioral and metabolic phenotyping. This program houses ~ 30 students, supported by training grants from NINDS, NIDDK and NIBIB and generous gifts from the Daniel L. Kline fund.

Pathobiology and Molecular Medicine: The Graduate Program in Pathobiology & Molecular Medicine is administered by 2 clinical departments: Pathology and Internal Medicine. Doctoral students in the Program are exposed to each of these disciplines in a program of study that unites contemporary investigative research in biomedical sciences with an understanding of human disease and the challenges that face effective treatment. All students participate in a core curriculum of academic courses for the first year, comprised of a series of lectures and laboratories that encompass basic molecular and cellular biology and the molecular mechanisms of human disease. Additional elective coursework and 2 to 3 research laboratory rotations are tailored to the student's individual research interests. The student also has the option of participating in an industrial or government research entity. At the beginning of the second year, students select from approximately 41 participating faculty laboratories and begin work on their independent research project. General focus areas are cardiovascular and lipid disorders; digestive and kidney disease; endocrine, metabolic, and bone disorders; hematologic and oncologic disease; and immunology and infectious diseases. The completion of all requirements for the PhD degree generally takes 5 years.

Systems Biology and Physiology: The PhD program in Systems Biology and Physiology is focused on research training and includes opportunities for academic course work that supports the development of each student's research competence and confidence. Research in the program employs a wide range of classical and modern experimental methods including molecular biology, electrophysiology, genetic technology, bioinformatics and functional genomics, proteomics, and advanced imaging methods. Researchers work in the fields of cardiovascular, epithelial, pulmonary, and renal physiology, neurobiology, endocrinology, membrane biophysics, and cellular signal transduction. Students and faculty from a variety of different backgrounds and expertise are brought together to approach research questions using experimental, theoretical, and computational approaches. In this way teams of researchers help students discover new solutions to physiological questions. A combination of introductory lab experiences, core and advanced courses, seminars and journal clubs provide foundations on which to build a dissertation research project. Prior to graduation, all students must publish their research in major scientific journals. Students are provided financial support to present their findings at national scientific meetings and compete for research fellowship awards. On average, students in this program finish the PhD in about 5 years.

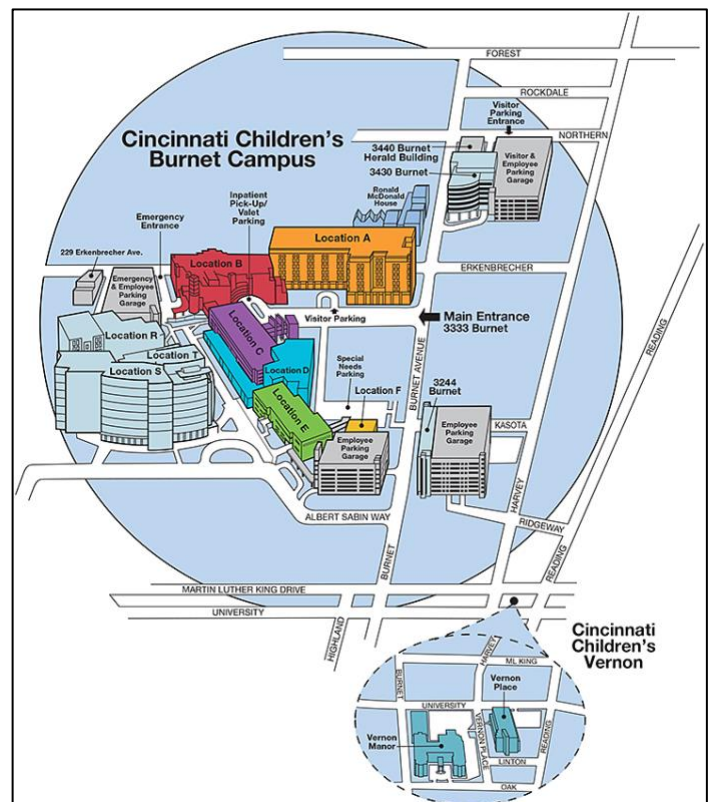
Medical Scientist Training Program: The Medical Scientist Training Program (MSTP) is the combined MD/PhD program of UC COM. Students typically complete their first 2 years of medical school and then shift their study to graduate school training in one of the College's 11 graduate programs. Upon successful completion of a PhD thesis, students then return to medical school and complete their final 2 years of clinical training. During these 2 years, students complete 5 required core clinical clerkships: internal medicine, surgery, obstetrics and gynecology, psychiatry, and pediatrics; 2 acting internships; and several primary care or specialty electives. During their final year, students are required to complete a senior research project that may be in the field of medicine that the student has chosen to pursue in the future or may be a continuation of the student's thesis work. MSTP students are recruited from a national pool of outstanding individuals at top undergraduate schools. About 190 applications are accepted annually for 9 positions. MSTP graduates typically go on to residency and fellowship training in major academic medical centers; many are now faculty members directing their own research programs in leading medical schools.

D. HEALTH CARE FACILITIES

University of Cincinnati Medical Center (UCMC), part of **UC Health**, traces its origins to the Commercial Hospital and Lunatic Asylum founded in 1821, the first hospital built in the U.S. primarily for teaching purposes. The hospital was later renamed Cincinnati General Hospital. In 1969, a new facility was constructed on the AHC campus. The institution was renamed University Hospital in 1982, and in 2009 established a more collaborative partnership with the University of Cincinnati and UC Physicians known as UC Health. The hospital was renamed UC Medical Center in December 2012. Many UC Health locations have received national recognition for outstanding quality and patient satisfaction. It's over 700 beds make it the largest hospital in the Cincinnati region. UCMC's unique services include: the UC Cancer, Cardiovascular and Neuroscience Institutes; the Burn Center, one of the few nationally certified major adult burn treatment centers in the US; and the region's best-equipped and busiest Level I Trauma Center. Its residency program in emergency medicine was the nation's first, established in 1970. UCMC's Transplant Center performs kidney, liver, and pancreas transplants. UCMC is the first hospital in the OH-KY-IN tri-state region to receive Advanced Disease-Specific Care Certification for Ventricular Assist Device (VAD) by the Joint Commission. The Medical Center's Cincinnati Center for Sustainment of Trauma and Readiness Skills (CSTARS), a joint initiative with the U.S. Air Force, is one of only 5 collaborative military/academic hospital training centers of excellence in the country. In 2013, UCMC was certified by the Joint Commission as an Advanced Comprehensive Stroke Center, a new level of certification reserved for institutions with specific abilities to receive and treat the most complex stroke cases. There is no higher stroke certification.

Cincinnati Children's Hospital Medical Center (CCHMC) is a not-for-profit hospital and research center pioneering breakthrough treatments, providing outstanding family-centered patient care and training health care professionals for the future. CCHMC was founded in 1883 and relocated in 1926 to its present site across the street from the University of Cincinnati College of Medicine (COM). CCHMC and UC COM facilities share a rich history of collaboration, provide an exceptional environment encompassing an extensive and diverse array of institutional and collaborative clinical, research, and training facilities and resources. In 2001, a formal agreement between CCHMC and UC COM was signed, whereby CCHMC acts as the Department of Pediatrics for COM, and UC and its Board of Trustees are responsible for academic activities, including faculty appointments and promotions, and conferring degrees. CCHMC and its Board are responsible for appointment of CCHMC medical staff, patient care, training and research at CCHMC. The CCHMC-COM leadership structure reflects a close bond: Dr. Tina Cheng is Chair of the Department of Pediatrics at COM and serves as Chief Medical Officer of CCHMC and Director of CCRF. Appointment of the Chair requires approval by both the CEO of CCHMC and the Dean of UC COM and is subject to approval by both Boards of Trustees. All CCHMC Chiefs of Service must be full time faculty at COM.

The 1,067 **faculty at CCHMC** are within the Departments of Pediatrics (Cheng, Chair, 41 divisions, 826 faculty members), Surgery (von Allmen, Chair, 11 divisions, 102 faculty members), Anesthesiology (McAuliffe, Chair, 73 faculty members), Radiology (Coley, Chair, 54 faculty members), and Patient Services (Tofani, Senior Vice President, 12 faculty), three large integrated clinical and research institutes (Cancer & Blood Diseases Institute, Heart Institute, and Perinatal Institute), and multiple interdisciplinary Centers of Excellence. CCHMC has a long and rich history of research focused on diseases of children and young adults, with expertise in genetic, environmental, and developmental origins of disease. Research breakthroughs have included the Sabin oral polio vaccine, rotavirus vaccine (Rotarix®), the first practical heart-lung machine, and the first successful bone marrow transplant for sickle cell disease. The



growth of full-time faculty with primary appointments has doubled in the last 10 years at CCHMC, and the institution has made substantial progress in recruiting a diverse faculty.

Today, CCHMC is a 762-bed non-profit organization serving as the UC Academic Health Center's (AHC) major teaching facility for pediatrics and as the only children's hospital in the Cincinnati metropolitan area (population 2.3 million). With operations exceeding \$3.1 billion annually, CCHMC employs >18,000 individuals with 7.4 million square feet of facilities. CCHMC offers 40 patient care sites throughout the region (Ohio, Indiana, Kentucky), the area's only Level I pediatric trauma center and pediatric cardiac ICU, and a satellite campus (College Hill) providing acute inpatient, outpatient, and residential psychiatric services. The number of CCHMC employees has more than doubled in the last 7 years. In FY2023, CCHMC had 1,647,997 outpatient encounters, including 170,027 Emergency Department/Urgent Care visits and 1,477,970 outpatient visits; there were also 33,116 admissions. In 2021 CCHMC opened the Critical Care Building (CCB), a 249-bed, 632,000 square foot facility housing all critical care clinical programs (NICU, PICU, CICU) along with a new, expanded emergency department, bone marrow transplant unit, expanded clinical pathology laboratories, and additional support space for clinical operations. Support for innovation and new technology were incorporated as key design principles for the CCB. Highlights include a wet lab facility for translational research studies located in the emergency department, a novel, research grade spectrally tuned circadian lighting system in the NICU, embedded neonatal MRIs in the emergency department and NICU, and state-of-the-art patient monitoring systems designed for continuous, real-time data capture and storage. While focused on providing primary, tertiary, and quaternary care for the population in our tri-state, patients have come from 68 countries and all 50 states, as well as Washington, DC and Puerto Rico.

For the past 10 years, CCHMC has consistently ranked in the top three Departments of Pediatrics and top four children's hospitals by the *US News & World Report*, and continues to be on the Honor roll, ranking in the top 10 for all 10 pediatric specialties in 2023. CCHMC ranked #1 on the 2023-2024 Honor Roll of America's Best Children's Hospitals compiled by *U.S. News & World Report*.

James M. Anderson Center for Health Systems Excellence at CCHMC is dedicated to improving the health of children and clinical outcomes through the generation of knowledge and the application of research into practice. Named in honor of the former President and CEO of Cincinnati Children's, the Anderson Center builds on our existing strength in quality improvement by creating a structured approach to accelerate the integration of health systems research and bedside application. It is committed to decreasing the time it takes for new knowledge to be put into practice and to teaching the next generation of experts who can spread health systems excellence here and elsewhere. The Anderson Center is a unique scientific resource for this project because of its extensive capacity and expertise as a local, state, and national resource for improving care in large networks of clinical sites. Anderson Center faculty have led over 60 learning collaboratives and supported the creation of 11 state-wide and national pediatric sub-specialty networks including the All Children Thrive Network, Autism Care Network, Cystic Fibrosis Learning Network, Epilepsy Learning Healthcare System, Fontan Outcomes Network, ImproveCareNow (Inflammatory Bowel Disease) network, National Pediatric Cardiology Quality Improvement Collaborative, Ohio Perinatal Quality Collaborative, Pediatric Rheumatology Care and Outcomes Improvement Network, and Children's Hospitals' Solutions for Patient Safety. Learning health networks have grown to encompass 558 teams across 286 pediatric care organizations in 43 states and Washington, DC, and five countries, including Belgium, Canada, Qatar and the United Kingdom. Systematic implementation of quality improvement science and increasing engagement and partnership with patients and families have resulted in improved outcomes, such as increases in remission and physical functioning and decreases in premature births, serious safety events and mortality.

The **Center for Health Care Quality** at CCHMC is a resource for health care providers throughout the world to make the highest-quality care a reality for children, adolescents and their families. Its goals are to: support projects to transform health care delivery systems in Cincinnati, the nation and the world; provide education in quality improvement methods and advanced experimental design to build capacity to advance the field of quality improvement in medicine; undertake research to design and test novel approaches to health care delivery and translate new knowledge rapidly into practice; and to work in partnership with professional and quality improvement organizations to disseminate quality improvement methods. Co-directed by Carole Lannon, MD, MPH and Peter Margolis, MD, PhD, the Center is currently working on several improvement initiatives related to preventive and developmental services, chronic illness care, office access and

efficiency, patient safety, and hospital care.

INNOVATIONS in Community Research is a community-collaborative program through which clinical psychologists work with community groups and non-profit agencies to enhance outcomes for underserved children, adolescents, and families in the Cincinnati community. As clinicians and researchers, co-directors Lori Crosby, PsyD and Monica Mitchell, PhD of the Division of Behavioral Medicine and Clinical Psychology at CCHMC have experience and expertise in a broad range of topics related to health disparities and community issues including violence prevention, teen pregnancy, premature birth, and community-based assessment and intervention. In addition, *INNOVATIONS* team members are proficient in qualitative and quantitative research design and methods, including survey development and focus group conduct, program evaluation and refinement, including implementing relationship - and developmentally based models of care, and cultural competence training.

The **Cincinnati Digestive Health Center** (DHC), established as an NIH “mini-center” in 2003, is now one of 17 Digestive Disease Research Core Centers funded by NIDDK. The only DHC dedicated to pediatric digestive diseases research, it has grown since inception from 34 to 105 investigators, spread across 20 divisions of Cincinnati Children’s and 8 departments of the UC COM. Funding has nearly tripled from \$12.5 million to \$35.6 million. The Center’s research is focused in 4 areas: 1) chronic liver disease, 2) inflammatory and diarrheal diseases (especially inflammatory bowel disease and eosinophilic gastrointestinal disorders), 3) obesity and the digestive system and 4) development and digestive diseases. Interrelated research cores in gene and protein expression, bioinformatics, pluripotent stem cell and organoid, and integrative morphology provide support for researchers and encourage collaboration. Center accomplishments to date include programming inducible pluripotent stem cells to give rise to intestinal organoids that display cellular phenotypes and 3-dimensional features of the small intestine, development of the first gene chip for use in the early diagnosis of at least 5 hereditary liver diseases and detection of genetic causes of jaundice in children and adults, as well as the discovery of the first gene associated with eosinophilic esophagitis.

Hoxworth Blood Center, located on the AHC campus, is the only facility of its kind for the Greater Cincinnati region. Hoxworth Blood Center is the only regional blood center owned and operated by a University in United States and is an independent academic department of the UC COM. Serving a 17-county area in Ohio, Kentucky and Indiana, Hoxworth collects, tests, processes, and distributes over 270,000 units of blood, blood components and cell therapy products annually to 31 hospitals and medical centers. Hoxworth Blood Center, a member of America’s Blood Centers, is licensed and regulated by the U.S. Food and Drug Administration and accredited by the American Association of Blood Banks, Foundation for the Accreditation of Cell Therapy, American Society of Histocompatibility and Immunogenetics and the College of American Pathologists. Founded by Dr. Paul I. Hoxworth in 1938, the Blood Center has grown to be an internationally recognized leader in transfusion medicine and cellular therapeutics. The Center has 7 neighborhood donor centers, more than 290 full- and part-time employees in 26 divisions which provide services beyond blood products, including apheresis, transplantation immunology, cellular therapy, immunohematology reference and research laboratories, and are supported by over 300 regional volunteers. Hoxworth’s Research Laboratory is leader in coordinating research projects in transfusion medicine, including clinical trials for transfusion medicine-related products. Its goal is to link basic research with clinical care, leading to improved methods that ensure the quality, safety, and efficacy of the blood and hematopoietic supply. Sponsored research support (FY2024, total cost) is over \$5M. The Center offers an ACGME-accredited fellowship program in blood banking and transfusion medicine for physicians.

The **UC Cancer Institute** was established in 2010 to encompass all cancer patient care, research and education missions within the CoM and throughout patient care settings in UC Health, including the UC Cancer Center, which has a long-standing reputation for providing the most advanced and complete range of cancer services available in the region. The Institute provides screening, diagnosis, and treatment for all types of cancer, and serves as a cancer education resource for patients, physicians, health professionals and the general community. Nearly 100 cancer Institute clinicians, who are faculty of UC COM, are joined by a team of nurses, pharmacists, dietitians, social workers, occupational and physical therapists, and financial counselors. Its faculty and staff conduct innovative clinical research, with over 170 active protocols, including 135 interventional studies, sponsored by cooperative programs through the National Cancer Institute and

pharmaceutical companies. In 2007, the UC Center was designated a Breast Imaging Center of Excellence by the American College of Radiology, the only facility in Greater Cincinnati to receive this recognition. In 2011, the Institute launched an adult bone marrow transplant service as a new component of its hematologic malignancies program, based at University Hospital, and in collaboration with the UC Neuroscience Institute, established the UC Brain Tumor Molecular Therapeutics Program, the first comprehensive brain metastasis translational research program in the US. In 2013, the Institute's Comprehensive Breast Cancer Center was recognized as a "Certified Quality Breast Center of Excellence" in the National Quality Measures for Breast Centers (NQMBC) Program—the highest distinction for excellence given by the NQMBC. This is the only Greater Cincinnati tristate program and only one of 42 centers nationally to gain this distinction. The Cancer Institute also includes the Proton Therapy Center, which represents the only center of its kind within 200 miles and one of less than 40 centers in the United States. The center houses the only gantry fully dedicated to basic proton research in the world.

Through a strategic planning process, the UC Cancer Institute identified 5 comprehensive cancer centers to serve as the initial focus of its efforts: breast, brain, gastrointestinal, head and neck, and lung. Each center includes multidisciplinary clinicians as well as scientists working in basic, clinical and population sciences. The institute is working to integrate faculty from the UC College of Nursing and James L. Winkle College of Pharmacy and other UC colleges into the disease-based centers. The Institute's infrastructure was designed to complement efforts of the Cincinnati Cancer Center, a collaborative initiative of the COM, UC Health and CCHMC (see description above).

Complementing its partnership in the CCC with other AHC institutions, CCHMC established its third interdisciplinary institute, the **Cancer and Blood Diseases Institute**, in 2009. As with the Heart and Perinatal Institutes previously formed, its goal is to closely integrate research and clinical care with institutional support to advance knowledge and deliver better outcomes, experiences and value for patients and their families. The institute structure strengthens CCHMC's ability to coordinate care delivery; foster collaboration among researchers, clinicians, and educators; compete for extramural funding; recruit outstanding faculty; and better utilize organizational resources. The Cancer and Blood Diseases Institute is expected to further bolster the CCC's efforts to achieve NCI designation as a Comprehensive Cancer Center.

The **Cincinnati VAMC**, located within the AHC complex, has 116 general medical, surgical, and acute mental health beds and serves veterans within a 50-mile radius of Cincinnati and beyond, encompassing 17 counties in Ohio, Kentucky and Indiana. It is accredited by the Joint Commission on Accreditation of Health Care Organizations (JCAHO). Its major clinical disciplines include Medicine, Neurology, Surgery, Psychiatry, Ambulatory Care, and Dentistry. Most of the University of Cincinnati house staff rotate through the VAMC. Annually, the hospital served 7,709 inpatients, who were provided 72,873 bed days of care, performed 4,037 surgical procedures, and had 600,491 outpatient visits. The VAMC also supports 6 community-based outpatient clinics and 1 health care access site in Fort Thomas, Kentucky. The Research Service supports a variety of research projects that are funded by VA Central Office, Department of Defense (DOD), National Institutes of Health (NIH), private foundations, and pharmaceutical industry. In fiscal year 2018, Cincinnati VAMC investigators received \$3.9 million in VA funding and \$4.6 million in extramural federal funding (\$4.3 million from DOD), which supported 60 active investigators in 85 research projects. There are ongoing projects in infectious disease, immunology, oncology, psychiatry, psychology, substance abuse, cardiology, endocrinology, pulmonary medicine, nephrology, and neurology. Cincinnati VAMC faculty and staff are actively involved in clinical and basic science research. The Cincinnati Education and Research for Veterans (CERV) foundation is based at the VAMC.

E. PATIENT RESOURCES AVAILABLE FOR RESEARCH

With over 700 registered beds and 9,747 employees, University of Cincinnati Medical Center (UCMC) is the largest hospital in the region and is the major referral center for many programs and therapeutic modalities not available elsewhere in the metropolitan area. In FY 2022, physicians at UC Health completed 2.5 million encounters across four inpatient campuses and 65 outpatient locations. UC Health's emergency departments received 106,746 visits. UCMC, West Chester Hospital, Drake Center for Post-Acute Care, Lindner Center of HOPE (psychiatric care), numerous outpatient care facilities throughout the region and UC Physicians (UCP), the practice group for 1,060 clinical faculty members at the UC College of Medicine (also 557 Advanced Practice Providers), together comprise UC Health. Clinical services are provided across 93

specialties/subspecialties. Finally, in FY 2022, UC Health initiated 236 new clinical trials as part of their portfolio of 1560 clinical trials already in progress.

CCHMC is the largest pediatric facility in the U.S. in terms of inpatient beds, annual admissions, total surgical procedures, outpatient surgical procedures, and emergency department visits. CCHMC is a not-for-profit children's hospital and as the only children's hospital in the Cincinnati metropolitan area (population >2 million) serves UCCOM as the major teaching facility for Pediatrics. With operations exceeding \$3.1 billion annually, CCHMC employs >18,000 individuals working in 7.4 million square feet of facilities, and offers 40 patient care sites throughout the region, as well as the area's only Level I pediatric trauma center and pediatric cardiac ICU, and a satellite campus providing inpatient, outpatient, and residential psychiatric care.

F. INSTITUTIONAL ASSETS FOR RESEARCH TRAINING

The Academic Health Center is the region's center of medical education. The COM currently annually trains 705 medical students, 573 MS and PhD students with >60 MD/PhD students, 854 residents and clinical fellows, and >260 postdoctoral fellows. UCCOM holds 17 NIH training (T) awards and NIH Fellowship (F) awards. In FY23, CCHMC trained 273 clinical fellows, covering nearly all the sub-specialty areas; 136 research post-doctoral fellows; 180 research associates; and 228 pediatric residents. CCHMC also holds the second-highest number of NIH training (T) awards (n=10) and the highest number of NIH Fellowship (F) Awards (n=19) among all children's hospitals in the U.S. Postdoctoral fellow training is funded largely by institutional funds of the Cincinnati Children's Research Foundation and by federal training grants. The James L. Winkle College of Pharmacy has 364 students, including the PharmD and MS/PhD programs. The College of Nursing has 2,727 undergraduate and graduate students. The College of Allied Health Sciences has 2,912 undergraduate and graduate students.

G. INFORMATICS INFRASTRUCTURE

Department of Biomedical Informatics: Established in 2000, Biomedical Informatics (BMI) is both an academic Division of the Department of Pediatrics and a component of the Cincinnati Children's Research Foundation (CCRF). In 2014, a Department of Biomedical Informatics was established at UC COM to integrate informatics academic, educational, service, and infrastructure efforts across UC and CCHMC. BMI includes 14 primary faculty, 16 secondary faculty, and over 100 trainees and staff. Together, the group operates both at UC COM and directly across the street on the 10th floor of CCHMC's "S" building in a combined assemblage of 16,000 square feet of contiguous space. The CCHMC space is directly adjacent to the Division of Biostatistics and Epidemiology, while the UC-COM space is next to the Department of Internal Medicine, a major collaborator. BMI faculty engage in collaborative and independent research in bioinformatics and clinical informatics, with particular focus in the areas of comparative/functional genomics, systems biology, and proteomics; natural language processing; genome-wide association studies of diseases; learning networks and distributed research networks; the use of data from electronic health records; and high-performance computing. Additionally, BMI maintains the IT infrastructure that supports research programs at CCRF, provides high end informatics resources across the UC College of Medicine, conducts research, and educates both focused trainees and the local research community, through a "community of practice" approach that aims to raise literacy for data science across the organization.

BMI's vision is "to be the leader in the development and application of innovative computational methods to produce actionable biomedical knowledge, more fully understand disease, and improve health." BMI's mission is to drive the next generation of understanding and discovery of disease causes and cures through data sciences and to broadly empower multiple communities to improve human health. The goals laid out in the strategic plan are to: 1) develop excellence and recognition for computational models of biological systems, for informatics to collect, process, share and interpret data cross research enterprises and health care systems, and to integrate data and knowledge to transform pediatric and adult health; 2) to lead the implementation of a cross-institutional collaborative culture of data sciences; 3) to increase participation and visibility in the national and global biomedical informatics research communities; and 4) to sustain and grow both degree-granting and institutionally-focused educational programs.

Biomedical Informatics Services. BMI offers resources and services to investigators at Cincinnati Children's and the University of Cincinnati College of Medicine through four linked Shared Facilities encompassing approximately 50 staff: Research IT, Clinical Data Services, Technology Development, and Health care

Analytics (see below). CCHMC Research IT operates independently from—and maintains a computational architecture distinct from—CCHMC Hospital IS. However, the two groups have a long history of tightly coordinated cooperation to support research, with a highly granular matrix of responsibilities, and shared use of network, data security, and policy/procedural infrastructures (see letter of support from CCHMC Chief Information Officer Marianne James). More details are provided in the Research IT section below, and specific details on capabilities can be found in the Data Analysis Core Facilities and Resources section.

Bioinformatics Collaborative Services (BCS). This group provides computational infrastructure, analysis expertise, and dedicated support for investigators to process, store, visualize, and interpret data obtained from diverse molecular -omics technologies. The BCS further provides specialized services for investigators, including implementation of new or existing computational workflows and the development of new methods or algorithms on a fee-for-service basis. They also provide guidance on experimental design, help with manuscript preparation, and enable the submission of data to public repositories in accordance with the NIH Data Sharing Policy. The BCS growing team comprises 5 members with extensive experience in analysis of next-generation sequencing data including variant calling from whole genome sequencing and whole exome sequencing data, expression quantification and differential gene expression analysis from RNA-seq data, pathway and gene-set enrichment analysis, characterization of protein-DNA interactions using ChIP-seq, chromatin accessibility from ATAC-seq and DNase-seq data, and epigenetic analysis using Methyl-seq and histone modification ChIP-seq data. We also provide comprehensive analysis of single-cell data from the Chromium platform from 10x Genomics and the C1 platform from Fluidigm including guided and unsupervised cell type clustering, merging and harmonization of multiple datasets, and visualization of gene expression programs.

The BCS has access to wealth of resources, both locally and in the cloud. Local resources include a high-performance computing cluster (with 1000+ CPUs, 3000+ GPU cores and an Illumina DRAGEN Bio-IT Platform), petabyte-scale data storage, licenses for software, technology support and a robust and secure Research IT infrastructure. For cloud-based projects, the BCS utilizes the DNAnexus managed analysis platform backed by the Amazon AWS infrastructure. Importantly, CCHMC has a signed Business Associate Agreement with Amazon, guaranteeing that we can technically, legally, and ethically store protected health information with AWS/DNAnexus.

Software: The bioinformatics group is actively involved in extensive software development, primarily using Java, Eclipse and the Struts framework with statistical and mathematical functions carried out using the R-Server application programming interface. Jakarta Project's Struts Framework allows for the use of Servlets, JSP, custom Struts tag libraries and other components using a unified framework that helps rapid design and deployment of web applications. The value of frameworks is realized in the ordered and componentized nature of code that facilitates maintenance, update, and reuse and Tomcat deployments. Centralized authentication (LDAP) servers, serving unique usernames and passwords to all investigators Advanced programming developer tools (Eclipse, IDE, CVS, Ant, compilers, debuggers,) and parallel computing software (MPI, PVM) are also used extensively.

Genomics Software: We use a combination of CCHMC provided software tools, commercially available software package, public freeware resources and our own working scripts to do our bioinformatics data mining. For expression and genomics analyses: GeneSpringNGS (Agilent), Genomatix, BRB-ArrayTools, AltAnalyze and R Packages (Bioconductor, open resource) are commonly used software tools. For Genomic Sequence analysis, GCG (Genetics Computer Group, Inc), MacVevtor, NCBI, Ensembl (<http://www.ensembl.org/>), UCSC (<http://genome.ucsc.edu/>) sequence analysis tools are available to use. For mathematical/statistical analysis, we have SAS, Splus, JMP (SAS Institute), an Matlab (The MathWorks). For promoter mining, we have internally developed web tools GenomeTraFac, CisMols Analyzer together with GenomatixSuite (Genomatix), and many public open resources such as TRANSFAC, TOUCAN, oPOSSUM, Clover, Cluster-Buster, MEME/MAST (UCSD Computer Science and Engineering) motif discovery systems. For functional annotation, classification, pathway mapping and literature mining, we use our internally developed TOPPGENE suites and GO-Elite as well as public freeware such as DAVID and BABELOMICS. Gene set enrichment analysis and pathway exploration are additionally carried out using freeware GSEA, PathVisio as well as commercial software such as Ingenuity Pathway Analysis (Ingenuity) and Pathway Studio 6.0 (Ariadne Genomics). Human PPI resources include HPRD, BIND, DIP and BioGRID. We will download these datasets to our local workstation and search them using the scripts written by our group. Protein interaction networks can be

visualized with Cytoscape and tYNA. Internally developed web tools such as LOOPP, MINNOU, Polyview and SPPIDER can be used for protein domain prediction and visualization.

Data Security: All data collection systems incorporate a multi-layered data security approach through the use of roles, user accounts, and passwords. To access data, users must be assigned to one or more research projects (role) and have a unique login (account) and password. This is important since the nature of the DPI is to provide informatic support to multiple research initiatives. Using this methodology, individual investigators will only have access to their own data (roles) accessible only with a login account and password. Since the principal investigators are considered the owners of the data, they must authorize all roles, and user accounts. In addition to standard authentication, secure data are protected by a dual Atheon firewalls system. These firewalls are placed between the “outside-world” and the CHRf network and prohibit unauthorized external computing protocols and users. All data will be stored and accessed in accordance with the HCFA’s Internet Security Policy (<http://aspe.os.dhhs.gov/admnsimp/nprm/sec09.htm>) and other state and local requirements. A critical aspect of the proposed system is data security and confidentiality. We also intend to follow the Health Insurance Portability and Accountability Act of 1996 (HIPPA) guidelines for handling clinical data. All data within the DPI will or already do meet these guidelines.

Internet Connectivity: The DPI provides redundant Internet connectivity that includes Internet and Internet2 connectivity through ORNet, Ohio’s academic Internet consortium, with redundancy through Cincinnati Bell at OC3 (155.52 Mbps) to OC48 (2.488 Gbps) bandwidths.

Research IT: The Research IT group is dedicated to supporting the diverse mix of technology and infrastructure needed to sustain the efforts of a dynamic medical and biological research environment. Research IT is comprised of approximately 25 staff and includes systems and database administrators, systems programmers and IT support staff, with Dr. Michal Kouril as faculty advisor. The group provides support for the hardware infrastructure of CCRF (e.g., physical and virtual servers, a high-performance computing cluster, terabyte-scale storage facility, application and database servers, authentication and identity management, etc.). In order to facilitate collaboration with external institutions, BMI has worked over the past several years to build a dedicated research network with separate secure segments for data storage, data management systems, and applications. BMI closely collaborates with Information Security staff in CCHMC Information Services as well as legal and compliance departments to provide an environment compliant with local and federal requirements. Aside from the day-to-day responsibilities needed to maintain the operation and functionality of this infrastructure, the group also handles requests for service from end users. Specific services and infrastructure capacity include:

- Servers running Windows and Linux operating systems for production, testing and development environments as well as to provide backup and redundant services
- A 1000+ CPU Linux cluster for parallel computation, including multi-core AMD Opteron and Intel Xeon based servers, with 4-64 GB or memory per single or aggregated processor
- A VMWare cluster of 150+ virtual machines running Windows and Linux operating systems for testing and development environments as well as to provide backup and redundant services
- Dedicated Oracle, MySQL, MS SQL, Oracle, PostgreSQL, and several NoSQL-based database servers
- A terabyte-scale storage facility, with currently over 1.8 PB usable space, with daily incremental and weekly full backups in designated directories and volumes
- Centralized authentication (LDAP) servers, serving unique usernames and passwords to all investigators
- Basic developer tools (compilers, debuggers, graphical developments environments) and parallel computing software (MPI, PVM)
- Dedicated redundant web servers, principally employing Apache, Tomcat, or JBoss
- A Highly redundant core network for data exchange
- A farm of Microsoft Windows servers and workstations
- Dedicated redundant web servers
- Online tools to facilitate collaborative data authoring and sharing, and data exchange (e.g., Aspera, OneDrive)
- Centralized identity management services providing streamlined access to local investigators as well as external collaborators

- Basic developer tools (e.g., compilers, debuggers, graphical development environments) and parallel computing software

The Research Data Storage (RDS) system in the Data Center was designed to provide data storage for all research divisions. RDS provides centralized, backed-up storage and has staff on-site 24x7. Several types of storage are available: Institutionally supported enterprise storage—i.e., personal, divisional shared and project drives; Web-based storage systems for specific research data types (e.g., genomic, functional genomic, imaging). Other specialized storage includes the mega-i2b2 Clinical Research Data Warehouse hosted on Oracle, storage for VMWare and VDI clusters, High Performance Cluster storage space, project and home directories for segregated research network systems.

BMI offers centralized administration of >100 software packages, licensed and open-source. Examples include:

- *Data capture and storage.* InfoPath/SharePoint, REDCap, OpenClinica, Oracle, FileMaker Pro, MS SQL Server, PostgreSQL, MySQL, Toad, Hadoop, SPARK, MongoDB, hbase, Phoenix
- *Statistical computing and numerical analysis.* SAS, PSPP, JMP, JMP Genomics, Matlab, Nquery, SPSS, R, SUDAAN, GraphPad Prism, SigmaPlot
- *Genome analysis tools.* dprime, snpgwa, dandelion, IMPUTE and other GWA tools, Plink/gPlink, Progeny, SOLAR,
- *RNA sequence analysis tools.* STAR, Bowtie2, BWA, DESeq2, AltAnalyze, BioWardrobe, Kallisto, RSEM, Cell Ranger, ICGS, Seurat, Sincera, SLICE, SIMLR, Monocle2, ToppGene, GO-Elite, Cytoscape
- Machine learning: ILOG/CPLEX, Weka
- Bioinformatics research software: GeneSpringTM; GCG, Affymetrix MicroArray Suite, Vector NTI, DNASTar, MacVector, Ingenuity, Golden Helix
- Additional general software: Adobe Acrobat, Adobe Photoshop Elements, Adobe LifeCycle Designer, BTM Biomaterials Tracking and Management, CERF, Prism

To facilitate collaboration with external institutions, BMI has built a dedicated research network with separate segments for data storage, data management systems, and applications. BMI closely collaborates with CCHMC IS as well as legal and compliance departments to provide an environment compliant with local and federal requirements, including HIPAA (the Health Insurance Portability and Accountability Act), FISMA (the Federal Information Security Management Act), and 21 CFR Part 11 (U.S. Food and Drug Administration regulations on electronic records and electronic signatures). BMI provides consultations for faculty and staff on best IT practices and help facilitate data use agreements with partner institutions for a wide range of projects. BMI has developed annual System Security Plans and data use agreements as required by a number of regulations, including through its role as a FISMA-compliant data coordinating center for several NIH consortia.

UC and CCHMC Information Services maintain 7 x 24 x 365 Data Center operations with operators continually onsite. All servers are backed up with daily incremental backups, weekly full backups, and monthly offsite vaults as needed. In the event of a power outage, the Data Centers rely on redundant power systems, distributed power distribution units, and several backup generators.

The Research Data Center for high-performance computing and virtualized servers that is available to all CCTST investigator projects is operated by BMI and is housed in a portion of CCHMC's state-of-the-art 15,000 square foot, highly secure, institutional data center that meets Tier 4 standards for reliability (redundant power and cooling systems, remote site backup, etc.) and provides redundant, high bandwidth, fiber connectivity between the University of Cincinnati and CCHMC networks, as well as with Internet2. The secure environment permits compliance with numerous federal and state regulations (e.g., FISMA, HIPAA, NIH, DOD) as well as with security requirements attached to many data access agreements. It has scalable storage capacity, which is essential because of the regulatory requirements governing the length of time data must be retained/archived. State of the art firewalls and systems for identity management and access control are incorporated into management of the Data Center, including interfaces between Hospital and Research IT networks and equipment.

Technology Development. BMI's Technology Development group is a faculty-supported collaborative service

and development unit with expertise in a number of different areas. Staff members include experts in web- and mobile-based software development, networking, system administration and maintenance, and database programming. Staff are accustomed to working within a unique environment that facilitates realization of complex projects with significant programming and outreach extensions. Services offered include:

- Developing customized software applications in a wide variety of programming languages, (e.g., Python, Perl, Java/J2EE, iOS, and .NET)
- Evaluating, hosting and customizing licensed and open-source research software
- Designing and hosting research databases, datamarts, and registries
- Developing customized research web sites and web services compliant with industry and corporate standards
- Hosting content management systems and web portals based on SharePoint and Drupal

BMI application developers have extensive experience in designing and implementing web servers for prediction and analytical methods developed in BMI investigator laboratories. In addition to interactive web-interfaces involving JavaScript, Java applets, PHP, Perl, and HTML5 graphics, the following web and computing technologies have been acquired and are frequently utilized by BMI application developers for ongoing projects: asynchronous JavaScript and XML (AJAX) client-server communication; automated queries to both local (MySQL- and SQLite-based) and external databases (with HTML, FTP, or REST interfaces); scheduling jobs on the BMI computational cluster; dynamic data analysis and visualization; automated email communication and data file exchange. BMI application developers have experience handling large user request traffic, integration of servers and databases, and creating automated workflows for data distribution and analysis.

Data Services. BMI Data Services is a group of approximately 30 staff members who operate both at UC and CCHMC. This group specializes in complex extractions of data from the electronic health record (EHR) and other primary sources for research purposes, the transformation of these data into common data models for use in distributed research networks, the development and implementation of standards and infrastructure to support learning health systems and other data and improvement networks. BMI Data Services oversees the development and implementation of the respective UC and CCHMC-based research data warehouses and develop data collection and reporting systems to support registries and multicenter learning networks. The research data warehouses are also used to support UC/CCHMC participation in several distributed data sharing networks, including the Electronic Medical Records and Genomics (eMERGE) Network, the National Patient-Centered Clinical Research Network (PCORnet) and the Accrual for Clinical Trials (ACT) Network. CCHMC was involved in three projects during PCORnet Phase 1 (SCILHS and PEDSnet Clinical Data Research Networks (CDRNs) and the PCORnet Patient-Powered Research Network (PPRN)), and is part of two awards in PCORnet Phase 2 (PEDSnet CDRN and ImproveCareNow PPRN). UC and CCHMC share a node on the ACT Network. Through these projects, staff in BMI Data Services have gained tremendous experience extracting data from the EHR and developing transformations into many of the most popular Common Data Models (CDMs), such OHDSI/OMOP, i2b2, and the PCORnet CDM. They have also gained experience with the analytical tools that are associated with each model.

BMI supports Honest Broker services for each institution, which allows the creation of an integrated patient record using data from UC Health and CCHMC's clinical information systems as well as select research systems. This information is de-identified and access is made available through the respective institutional Research Data Warehouses, which consist of a suite of software applications as well as a core data repository that is intended to support translational research. The warehouses are designed with the same core infrastructure (e.g., i2b2 and TriNetX) to maximize efficiency and interoperability across institutions. Each warehouse contains much of the data stored in UC Health and CCHMC's electronic health records, including demographics, diagnoses, procedures, laboratory results, medication orders, vital signs and allergies. The CCHMC warehouse is also linked to the institutional biorepository, which allows investigators to include sample-related metadata in their search queries. The primary use case of the warehouses is cohort identification, allowing users to perform an enterprise-wide search on a limited data repository to determine the existence of a set of patients meeting certain inclusion or exclusion criteria. Once a cohort has been identified, investigators at UC COM and Cincinnati Children's are able to work with the Honest Broker service to obtain the data needed to complete their research as specified in their Institutional Review Board (IRB) protocol. Investigators can also work with the Honest Broker service directly to obtain the data they need to complete

their research study. The research data warehouse is also used to support CCTST participation in several distributed data sharing networks. Data from the relevant warehouse(s) is transformed into the appropriate data model and terminology standards and then exposed in a way that preserves privacy and allows queries for aggregate counts or summary statistics to be broadcast from approved investigators to all network participants. The queries are executed against the data and then the results are sent back to the originating investigator, rapidly lowering the time needed to identify cohorts or validate hypotheses among large, diverse patient populations spread among multiple care centers.

H. LIBRARY AND ELECTRONIC RESOURCES

Donald C. Harrison Health Sciences Library (HSL): One of 10 UC libraries, the HSL encompasses nearly 45,000 sq.ft., and is in the Medical Sciences Building (MSB) and atrium of the CARE/Crawley building. It features collaborative and individual study and meeting spaces, interactive tools Sectra Table and zSpace, and over 250,000 print volumes on site. As part of the UC Library system and OhioLINK, it also provides access to over 740 databases, 37 million electronic journal articles, and over 200,000 e-books. The Health Sciences Library serves the research needs of students, faculty, and staff of all AHC Colleges, affiliates including UCMC, CCHMC and VAMC, the Greater Cincinnati community, and investigators/scholars across the country and globe. The Health Sciences Library is ranked 14th among “the 25 most impressive university medical school libraries in the world” according to the website Best Master’s Degrees Reviews and Rankings.



NetWellness: Established in 1995 as one of the first health sites on the internet, NetWellness (www.netwellness.org) is a non-profit service providing health and medical information directly to the public from 3 academic health centers (University of Cincinnati, The Ohio State University, and Case Western Reserve University). NetWellness covers a full range of health topics in an easy-to-understand format with information for all age groups and diverse populations, including minorities and the underserved. NetWellness provides the knowledge needed to increase prevention, enhance provider/patient communication, and reduce health care costs. In NetWellness, these Ohio universities have created the largest expert network of its kind, providing health information and education to consumers directly from experts who are specialists in their field. NetWellness is non-profit and without commercial advertising, serving the public as an unbiased resource. Over its 19 years of operation, its reputation has grown as a leader in free, accurate health information, garnering numerous national awards for the site. NetWellness has also enjoyed considerable growth, now receiving over 13 million visitors per year, 80% from across the US and North America, for its 55,000+ pages of health information. Over 500 faculty members have volunteered their time to provide state-of-the-art health content, including over 600 articles and an “Ask an Expert” feature that has answered over 68,000 questions to date.

HealthBridge: HealthBridge is a not-for-profit health information exchange serving the Greater Cincinnati OH-KY-IN tri-state area. Created through the Greater Cincinnati Health Collaborative, its mission is to improve the quality and efficiency of health care in the community. To do this HealthBridge serves as a trusted third party working with all participating health care stakeholders to facilitate creation of an integrated and interoperable community health care system. This includes the adoption of community standard technologies and work processes. HealthBridge’s Health System participants include 18 hospitals and represent nearly 90% of the community hospital sector activity. HealthBridge also connects thousands of physicians and staff as well as nursing homes, independent labs, radiology centers and others in our health care community. It provides access to over 60 hospital based critical care systems including radiology images, fetal heart monitoring, hospital-based electronic medical records and chart completion, among others. Additionally, it operates the largest community-based secure clinical messaging system in the country. HealthBridge functions as a complete outsourced solution of results reporting for its hospitals and ancillary facilities. Through its clinical messaging system, it delivers over 1.4 million results (laboratory, radiology, transcription, and ADT) to over 4,000 physicians each month.