

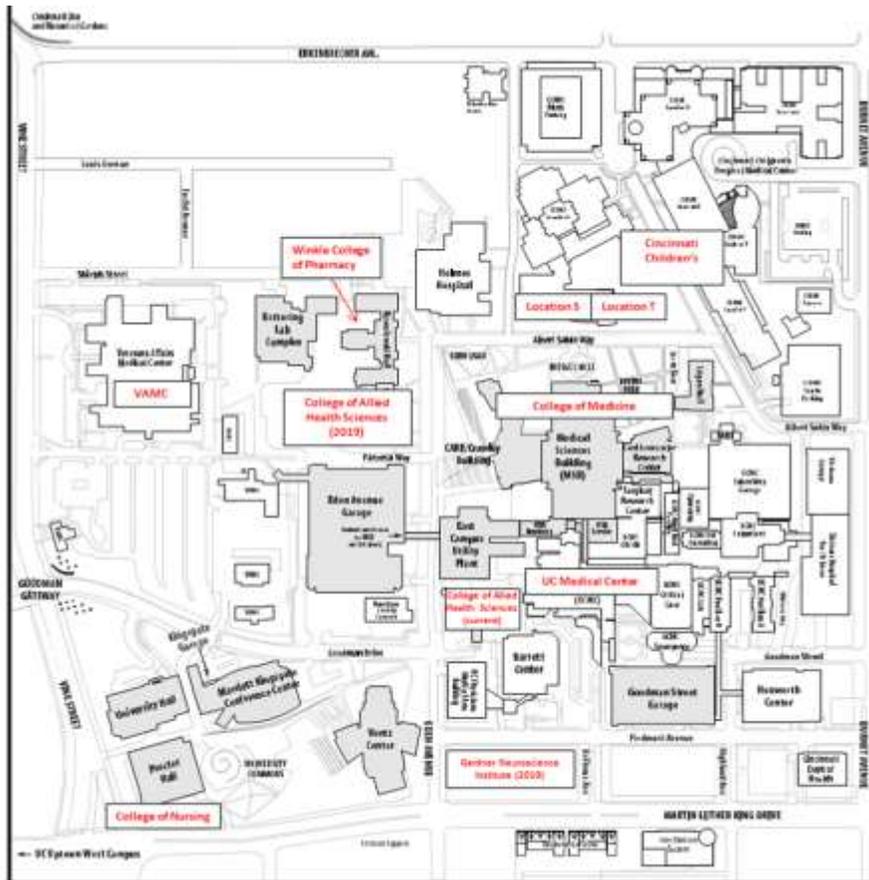
## RESOURCES AND ENVIRONMENT

### 1. University of Cincinnati Academic Health Center and its affiliates

The University of Cincinnati (UC) Academic Health Center (AHC) traces its origins to the Medical College of Ohio, the first medical school west of the Alleghenies, founded in 1819 in Cincinnati through the efforts of Dr. Daniel Drake. Dr. Drake originated the academic health center concept of a single organization encompassing a medical school, other health professional colleges, and teaching hospitals. The Medical College of

#### Key to Abbreviations

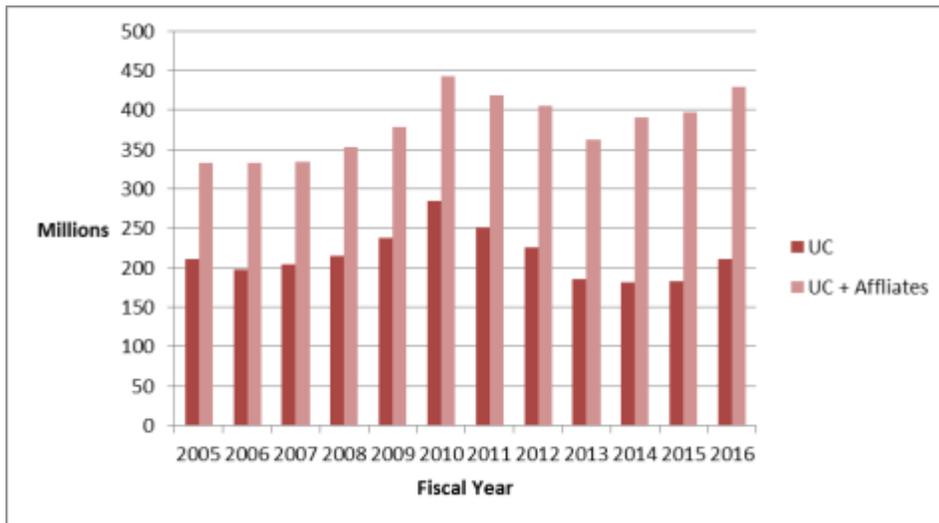
**AHC** Academic Health Center  
**BERD** Biostatistics, Epidemiology & Research Design  
**CCC** Cincinnati Cancer Center  
**CCHMC** Cincinnati Children's Hospital Medical Center  
**CCRF** Cincinnati Children's Research Foundation  
**CCTST** Center for Clinical and Translational Science and Training  
**CIS** Center for Improvement Science  
**CoM** College of Medicine  
**CTRC** Clinical Translational Research Center  
**CTSA** Clinical and Translational Science Award  
**MSB** Medical Sciences Building  
**PCI** Participant and Clinical Interactions  
**PCS** Pilot Translational and Clinical Studies  
**RPAC** Research Participant Advisory Council  
**TWD** Translational Workforce Development  
**UC** University of Cincinnati  
**UCMC** UC Medical Center (formerly University Hospital)  
**VAMC** US Dept. of Veterans Affairs Medical Center



Ohio joined UC in 1896, merged with the Miami Medical College in 1908, and was renamed the College of Medicine (CoM) in 1919. UC became a state-supported institution in 1977. The UC AHC includes the Colleges of Medicine, Nursing, Pharmacy, and Allied Health Sciences, Hoxworth Blood Center, UC Cancer Institute, UC Gardner Neuroscience Institute, Cincinnati Diabetes and Obesity Center, and Metabolic Diseases

Institute. Teaching, research and patient care affiliates include UC Health (encompassing UC Medical Center [formerly University Hospital], West Chester Hospital, Daniel Drake Center for Post-Acute Care, Lindner Center of HOPE, Bridgeway Pointe, and UC Physicians), Cincinnati Children's Hospital Medical Center (CCHMC), Cincinnati Veterans Affairs Medical Center (VAMC), Shriners Hospital for Children–Cincinnati, Christ Hospital, and Jewish Hospital. The University is classified as a “highest research activity” institution by the Carnegie Commission (2015), and is ranked 28<sup>th</sup> in federally-financed R&D expenditures among all public institutions by the National Science Foundation (2015). From all sources, UC and its affiliates received \$429.1 million in sponsored program funding in 2016, the third straight year for an increase and 8.1% more than 2015. Excluding affiliates, UC's sponsored program funding increased 15.5% to \$211.3 million in 2016 including \$175.1 million from federal sources, an increase of 8.4%. The largest source of federal support to UC (44.6%) was the National Institutes of Health (NIH), awarding \$78.1 million in 304 grants.

The CoM received \$115.5 million in sponsored awards in 2016, a dramatic increase of 32.6% over 2015. Federal funding of \$94.0 million comprised 81.4% of the total, \$73.4 million of which (78.1%) was from NIH.



The top 10 NIH institutes and amounts (in millions) awarded to UC in 2016 were:

- National Institute of Neurological Disorders and Stroke (\$12.8)
- National Heart, Lung and Blood Institute (\$10.3)
- National Center for Advancing Translational Sciences (\$8.3)
- National Institute of Environmental Health Sciences (\$7.4)
- National Cancer Institute (\$6.7)
- National Institute of Diabetes and Digestive and Kidney Diseases (\$6.3)
- National Institute of Allergy and Infectious Diseases (\$6.2)
- National Institute on Drug Abuse (\$5.7)
- National Institute of Mental Health (\$5.4)
- National Institute of General Medical Sciences (\$3.3)

Industry support of UC research in 2016 was \$7.5 million. The UC Center for Clinical and Translational Science and Training (CCTST) received a 4 year, \$16.7 million renewal of its Institutional Clinical and Translational Science Award (CTSA; James Heubi, MD, PI) in 2015 from the National Center for Advancing Translational Sciences (NCATS). Cincinnati is one of more than 60 members of the national CTSA Consortium (<https://www.ctsacentral.org/>).

Sponsored program awards for the Cincinnati Children’s Research Foundation (CCRF), home to faculty of the UC Department of Pediatrics, totaled \$207.2 million in 2016, an increase of 3.5% over 2015. Of this total, 63.1% (\$130.8 million) was NIH funded. Overall, 72% of sponsored CCRF research (\$149.2 million) was federally funded. A highlight of 2016 was the NHLBI award of \$32.5 million to establish the Bench to Bassinet national data coordinating center for cardiac genomic research, Cincinnati Children’s single largest research grant ever. Industry, foundation and other non-federal support was 28% of total sponsored funding, or \$30.5 million. Cincinnati Children’s raised \$42 million through philanthropy in 2016, 34% of which (\$14.5 million) supported research endeavors. The CCRF has 48 research divisions and 951 faculty, 872 of whom have full-time appointments. The Department of Pediatrics accounts for 733 of the faculty total (691 are full-time). In 2016, CCHMC trained 254 clinical fellows, covering nearly all of the sub-specialty areas; 181 research post-doctoral fellows; and 502 residents. All told, CCRF research resulted in the publication of 2,236 journal articles (up 21.7%), 8 books and 93 book chapters in 2016. Summer research programs attracted 186 medical students, undergraduates and high school interns.

The Medical Sciences Building (MSB) is at the center of the AHC campus, which includes 16 buildings spanning over 2.3 million gross sq. ft. on 56 acres in the central Cincinnati neighborhoods of Avondale and Corryville. The MSB contains 917,000 gross sq. ft., with 200 research laboratories totaling over 210,000 sq. ft., as well as all the preclinical and clinical departments of the CoM (except Pediatrics), classrooms, teaching

laboratories, and animal facilities. It is physically joined to the 714-bed UC Medical Center (formerly University Hospital), described below. A comprehensive, multi-year renovation of the MSB, opened in 1974, is nearing completion. Its 9 story, 240,000 gross sq. ft. Center for Academic & Research Excellence (CARE)-Crawley wing, opened in 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, its Cardiovascular Center (1996), the free-standing Vontz Center for Molecular Studies (1999), and the Reading Campus/Metabolic Diseases Institute (2001) have done. The \$60 million Gardner Neuroscience Institute, now under construction on the AHC main campus, will open in 2019. The 114,000 sq. ft. building will consolidate patient care and education and 215 faculty physicians, researchers and staff in a single location. In addition, a new, 117,000 sq. ft. free-standing home for the College of Allied Health Sciences is also under construction, with completion in 2019. A \$34 million renovation of the Winkle College of Pharmacy's home in Kowalewski Hall will be completed in summer 2017. The Reading Campus is located 8 miles north of the AHC and comprised of 10 buildings containing over 382,000 gross sq. ft. of laboratory and office space on a 25-acre campus. It 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.

Faculty at the CoM number 2,333, distributed among 5 basic science and 16 clinical departments, plus departments of biomedical informatics and medical education. As of June 2016, College endowments totaled over \$426 million. Over \$17 million was raised through philanthropic donations in 2016. The economic impact of the CoM was estimated at \$4.6 billion over the 5 year period from 2011-15, according to a study by the UC Economics Center. Patient care activities by clinical faculty were not included in the total.

In 2016, the CoM ranked\* 59th in NIH funding among 139 medical schools (top 42%). UC CoM departments in the top 50 of their peer medical school departments in 2016 NIH research funding were:

- Environmental Health: 14<sup>th</sup> of 45
- Anesthesiology: 21<sup>st</sup> of 46
- Otolaryngology: 26<sup>th</sup> of 41
- Emergency Medicine: 27<sup>th</sup> of 35
- Neurology: 27<sup>th</sup> of 70
- Cancer & Cell Biology: 29<sup>th</sup> of 76
- Pathology: 31<sup>st</sup> of 88
- Dermatology: 32<sup>nd</sup> of 36
- Molecular Genetics: 33<sup>rd</sup> of 46
- Psychiatry: 34<sup>th</sup> of 79
- Pharmacology and Cell Biophysics: 46<sup>th</sup> of 93
- Surgery: 49<sup>th</sup> of 75

*\*rankings in this section compiled from NIH data by the Blue Ridge Institute for Medical Research, [http://www.brimr.org/NIH\\_Awards/2016/NIH\\_Awards\\_2016.htm](http://www.brimr.org/NIH_Awards/2016/NIH_Awards_2016.htm)*

**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.

The **James L. Winkle College of Pharmacy**, the first college of pharmacy west of the Alleghenies, 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 55 faculty members. The College's research-intensive MS/PhD program has 36 students across 6 disciplines: Biopharmaceutics, Pharmacokinetics, Cosmetic Science (including an online degree

program option, one of only 2 nationally), Drug Development, Pharmacology, and Social and Administrative Sciences. The College has 389 students in its 4-year PharmD program, and 144 graduate students. Extramural faculty research funding was \$8.9 million in 2016. Areas of interest include health outcomes research, cancer, dermatology, drug penetration, drug delivery technology, cosmetic science, cardiovascular disease, infectious disease, and neuropharmacology. The research faculty moved into renovated research labs in the Medical Sciences Building in 2015 and 2016. A \$34 million renovation of the College's home in Kowalewski Hall will be completed in summer 2017.

Founded in 1889, the **College of Nursing** is ranked among the top U.S. Nursing schools 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 in which 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 University of Cincinnati Medical Center and CCHMC. The College's 70 faculty received over \$3.9 million in extramural funding in 2016, a nearly 206% increase from 2015. 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 2,653 undergraduate and graduate students. The 26 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 the advanced practice of nursing, utilizing best evidence in the delivery of nursing practice and leadership in complex healthcare 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.

Formed in 1998, the **College of Allied Health Sciences** has 264 faculty and 2,993 students, including Master's and doctoral students. The College houses the Departments of Analytical and Diagnostic Sciences, Communication Sciences and Disorders, Health Informatics, Nutritional Sciences, and Rehabilitation Sciences, as well as 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 FY2016 was nearly \$1.6 million, an increase of over 14% from the previous year. 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 as well as skills in research design and implementation. A new, 117,000 sq. ft. free-standing home for the College of Allied Health Sciences is under construction, with completion in 2019.

**Commitment to Diversity:** UC recognizes a very broad and inclusive concept of diversity that includes commonly recognized considerations such as race, ethnicity, gender, age, disability status, socioeconomic status, gender identity and expression, sexual identity, sexual orientation, religion, and regional or national origin. A 5-year diversity plan was adopted in 2011 which included as major goals: 1) attract, retain and graduate academically prepared, diverse students; 2) attract, retain and promote an increased number of historically underrepresented and other diverse faculty in tenure and clinical track positions; and 3) develop/strengthen partnerships with diverse communities and groups locally, nationally and internationally. A university-wide system of accountability and assessment will evaluate and quantify institutional progress. The diversity plan may be viewed at [http://www.uc.edu/content/dam/uc/sas/docs/div\\_plan\\_7\\_5\\_11\\_final.pdf](http://www.uc.edu/content/dam/uc/sas/docs/div_plan_7_5_11_final.pdf).

The **Center for Clinical and Translational Science and Training (CCTST)** was established in 2005 as the University of Cincinnati (UC) academic home for clinical and translational research, providing "one-stop shopping" for investigators across the AHC and beyond in need of guidance, information, support, resources and training. The CCTST spearheaded the AHC's submission of an NIH Clinical and Translational Science Award (CTSA) application, which in April 2009 received funding of \$22.8 million over 5 years. Following a one year extension, the National Center for Advancing Translational Sciences (NCATS) granted the CCTST a 4 year, \$16.7 million renewal in August 2015. UC and its partner institutions CCHMC, UC Health, and Cincinnati VAMC comprise the 39<sup>th</sup> member of the CTSA Consortium, which now includes over 60 sites. Its offices are

centrally located in the CCHMC “Location S” research building, directly across the street from the UC MSB.

Investigators request methodologist consultation services through the CCTST’s online “**Research Central**” portal at <http://cctst.uc.edu> and may qualify for a renewable voucher for more intensive support, described in the Biostatistics, Epidemiology and Research Design section below. The CCTST website also features service descriptions, a searchable database of intramural funding opportunities, events archive, news, and a comprehensive AHC calendar of on-campus workshops, conferences and lectures of interest to clinical/translational researchers. Faculty and community members can establish free CCTST membership online, required to obtain access to consultation services through Research Central as well as special funding, training and networking opportunities. In return, members help promote CCTST goals and services, collaborate and share expertise with fellow researchers, cite CCTST assistance in publications as appropriate, and provide information for surveys and reports. To date, over 4,000 members have joined the CCTST, including over 400 community representatives. Over the next 3 years, the CCTST will continue its transformation into a highly functioning learning organization in which existing systems (including research) are enhanced by an open, investigator-centric system, founded on the concept of a “**Research Commons.**” Research Commons, building upon the CCTST’s experience with Research Central, will serve as a “virtual mall” for investigators across the AHC and on the undergraduate campus to obtain help with development and completion of clinical and translational research. The principle of a “commons” is one of open-access and bidirectional sharing of resources, expertise, and best practices. Investigators can come to the Commons to get resources (e.g., data, tools, consultations) and the products they generate from those resources are contributed to the Commons for others to use. The Commons Portal, which is currently under development, will allow investigators to access all resources and services in the Commons electronically. When completed, navigation on the Commons will be accomplished via a number of existing services (e.g., triage specialists, electronic faculty portfolio directory, and data warehouses).

The **Center for Improvement Science (CIS)**. The CCTST’s CIS has developed the infrastructure that will support an interprofessional team focused on learning and utilizing the principles of team science for translational research. It has taken steps to be a focal point in the institutions and started implementation of a comprehensive, tiered education program on team science principles for everyone involved in research. In 2016, the CIS initiated a series of workshops, in collaboration with UC Office of Research, to help investigators be more effective in teams. Plans have been developed to implement a course within the MS in Clinical and Translational Research related to the science of team science. When fully functional, the CIS will provide team science consultants to help teams form and function, and they are now working with academic units to integrate multi-disciplinary research and team science into the promotion and tenure criteria for faculty. The mission, structure, and model of operations were developed by an interprofessional and multi-institutional task force and are being fine-tuned by a Council representing multiple disciplines from multiple campuses, which has been meeting on a regular basis to help inform leadership of the CIS in the right directions to realize its aims. Two other initiatives are being championed by CIS: 1) developing a more comprehensive database of internally-funded grant opportunities and encouraging groups to utilize CCAPS, the CCTST’s grant management software program adapted from Northwestern University; and 2) creating an institution-wide research seminar calendar to foster collaborations between investigators.

The CCTST has promoted multi-disciplinary collaboration through **Integration Committee** consultations and topic-based studios, and by making multi-disciplinary teams a funding priority in CCTST grant programs. Since its inception in January 2013, the Committee has met with over 75 faculty and investigators/groups from across the AHC, UC undergraduate campus and the community to help define solutions for problems encountered during the course of their research efforts. One of the major strengths of the program is its longitudinal nature, which ensures that faculty on the Integration Committee serve as the “primary care doctor” for the participant, with frequent follow-up to ensure that solutions to any encountered obstacles can be developed and to encourage progress on projects and career development. There is interest at the UC leadership level to develop this program across the university and extend to the Colleges on the undergraduate campus (Engineering; Design, Art, Architecture and Planning; Arts and Sciences; Education and Criminal Justice).

The CTSA funding renewal included support for 2 optional modules which will advance clinical and translational research across the AHC:

- The **Acute Care Research Module** has been developed to encourage and support research studies in the acute care setting. Potential subjects for these studies are eligible because of an acute illness, injury or other traumatic event. These studies do not allow for elective planning of visits or admissions to research units, but rather require an on-site, boots on the ground work force capable of rapid enrollments, research procedures and interventions, and data/specimen collection during a time of intense clinical interactions. While many acute phenomena can only be studied through this mechanism, these studies bring unique regulatory concerns and institutional obstacles that must be overcome. To direct the work of the Acute Care Research Module, the CCTST created an Acute Care Research Council (ACRC) consisting of successful investigators conducting research in acute care settings across the AHC, including investigators from UC, CCHMC, VAMC, and the community. The ACRC has begun meeting monthly. Its current activities include conducting an environmental scan to catalog all ongoing acute care studies, including the number of clinical research coordinators (CRCs) involved, identifying barriers to acute care study success and prioritization of the next steps for action to be taken by the Council. Because regulatory issues for acute care research were determined to be critical, the respective IRB Chairs from UC and CCHMC were added to the ACRC and an Acute Care Regulatory Coordinator was hired to provide expertise and support specifically related to research in acute care settings.
- The **Lifespan Data Integration Module** has initiated maternal-infant data linkage among 3 health care systems to establish methods and protocols for inclusion of additional regional systems. This initial linkage includes systems that span UCMC, CCHMC, and local home visitation program Every Child Succeeds (ECS). An IRB protocol for the Data Hub was approved at CCHMC and reliance was granted by the UC IRB. Formalized data sharing agreements have been developed.

With CTSA and institutional funding, the CCTST provides resources in the major program areas described below:

1) **Pilot Translational and Clinical Studies (PCS)** Since inception of CCTST funding (2009), 224 pilot translational research grants have been awarded to investigators at UC/CCHMC for \$7.9 million, resulting in 676 publications and 179 extramural grants worth \$115 million (ROI of 14:1). Forty-five Community Health Grants have been awarded to community partners with faculty at UC or CCHMC for \$614,652, which resulted in 7 publications and 13 extramural grants valued at \$6.8 million (ROI of 11:1). For the 2016-2017 cycle, the CCTST has continued to adapt and improve the software program created by the Northwestern University CTSA (NUCATS) and has been using it for processing all aspects of the receipt/review of applications. The CCTST has also continued to evaluate and fund Just-in-Time (JIT) grants and Processes and Methods grants. To focus on promoting mentored research by new investigators, application guidelines have been rewritten to include a Mentored Pilot Grant (replacing the Junior T1 pilot grant). In this newly revised category, mentees and mentors are paired to promote research education and help ensure career development. The JIT grant program continues to address the barrier of increasing competition for a shrinking pool of external research funds. For the 2015-2016 award cycle, 11 pilot translational research grants were awarded. For the 2016-2017 award cycle, 10 awards were made, including 2 mentored awards. The JIT program has made 19 awards in 2016-17, totaling \$134,414. The Processes and Methods program has made 21 awards, totaling \$134,030.

2) The **Biostatistics, Epidemiology and Research Design (BERD)** program provides all AHC investigators ready access to experts in research methods. Individualized services include review of IRB protocols; advice on study design, including project implementation and data collection methods; guidance on appropriate statistical methods; development of data safety and monitoring plans; and consultation on clinical research ethics. BERD has successfully implemented a completely restructured investigator support system based on a 1-hour session with a “concierge” methodologist to provide high-level advice to any CCTST member on methods needs (and often, other needs). Meritorious projects are asked to apply for a voucher to support more intensive collaboration. These renewable \$2000 vouchers are awarded to K awardees, investigators developing a grant application (i.e., for preliminary data analysis, research design, and statistical planning), and on occasion, to investigators needing support to generate high-impact publications. To receive a voucher, the investigator must submit an abstract, which is rapidly reviewed by a team of 5 methodologists. As of February 2017, 41 vouchers have been awarded, of which 7 went to junior investigators with K awards. Of the remaining vouchers, 22 have led to extramural grant applications (8 pending review, 3 awarded by NIH). In

addition, the vouchers have led to 10 manuscripts (of which 3 have been published to date). The new Processes and Methods grant program includes funding for BERD methods.

BERD continues to organize methods seminars on topics of high interest among methodologists. In 2016, the core launched a newly designed program focusing on the educational needs of methodologists, reaching out to professionals outside the AHC. Topics have included new methods in finite mixture modeling, generalized linear modeling, discrete survival times, and Bayesian non-parametric testing, as well as applied topics such as modeling the effect of exposure to mixtures of environmental pollutants and predicting rapid decline in cystic fibrosis. Members of BERD have established local special interest groups in Adaptive Trial Designs, Environmental Epidemiology, and Causal Inference. BERD is also developing an Educational Exchange Forum for methodologists. This web-based/virtual forum will provide a central location for continuing methodologist education containing a library of courses, workshops, and presentations. This exchange will also maintain a list of topics that methodologists would like to see as part of the continuing education library, including R-programming, non-traditional study design methodologies, new epidemiologic statistical methods, and agent-based models. BERD members have also contributed lectures to the new MS course in Comparative Effectiveness Research and Patient-Centered Outcomes Research.

3) The **Biomedical Informatics (BMI)** core serves as the hub for research informatics throughout the AHC. Through close collaboration with the UC Department of Biomedical Informatics, which includes the Division of Biomedical Informatics at CCHMC and the Center for Health Informatics (CHI) at UC, a robust infrastructure is being established to improve the conduct of clinical and translational science and training. Informatics services include



analysis of genomics datasets; protein informatics services such as modeling, virtual drug design, screening, and cheminformatics analysis; provision of complex datasets and data warehouse queries; and development of databases and surveys using REDCap (Research Electronic Data Capture), a software toolset and workflow methodology for small/medium research studies developed at Vanderbilt University and currently utilized across a consortium of 2,309 institutional partners in 108 countries, including over 516,000 active researchers and 404,000 projects in use or development (2017). To date, the UC AHC has had over 2,700 projects in use or development and has established nearly 4,700 user accounts. In 2016, BMI staff delivered on 259 requests for data extraction; 700 queries were executed against the i2b2 research data warehouse. With the build-out of a secure Research Network Environment (RNE) at CCHMC, credential federation with UC will allow cross-institutional access to applications like REDCap and e-PAS (IRB protocols). Current development of a SHRINE network by UC and CCHMC will enable sharing of de-identified patient data warehoused at each of the institutions. The BMI core developed a clinical and translational research informatics track in 2009 for the MS in Clinical and Translational Research program offered by the Workforce Development core (see #7 below). Funding from an ARRA supplement allowed 5 courses in the track to be offered online beginning in 2012. With CCTST support, UC began offering a PhD program in Biomedical Informatics in 2016, which has engaged 29 faculty and enrolled 5 students to date. A Graduate Certificate in Biomedical Informatics is also offered. A new residency elective in Clinical Informatics has been created. A BMI lecture series hosted 56 events throughout 2016, with over 2,000 attendees.

4) The **Regulatory Knowledge & Support (RKS)** program coordinates the resources of multiple initiatives centrally supported by the CCTST. The core provides institutional support and efficient and effective avenues for clinical researchers to facilitate regulatory compliance. Services include assistance with protocol development, data management, FDA filings, IRB applications and consent formulation.

Major core accomplishments have included implementation of ClickCommerce® for IRB protocol management at UC and VAMC, which is also in use at CCHMC. This single IRB portal allows researchers to move seamlessly across the AHC, evaluate success, and refine priorities. The core has also developed and implemented CITI research ethics refresher training that is utilized and accepted across the AHC and region. UC Health's Clinical Trials Office (CTO) has begun to provide services for UC faculty, including the development of recruitment strategies and materials; study budget development; and improved contract processing. Importantly, this CTO shares leadership with that at CCHMC, building on the strengths of CCHMC's established program and ensuring continuity between institutions. With the Community Engagement core, RKS spearheaded the development of the Consortium of Greater Cincinnati IRBs (CGCI), a subgroup of the Greater Cincinnati Health Council focused on improving the quality of research and facilitating

clinical research regionally. Together with CTSA sites in Cleveland and Columbus, the core has developed and implemented a memorandum of understanding for IRB review that allows all Ohio CTSA sites to rely on each other, and is written to allow expansion to other sites.

RKS implemented a 3 credit hour course on research ethics and compliance for undergraduates in fall 2016, complementing responsible conduct of research training for graduates. The core has also created and provided training on electronic submissions for investigational new drugs/device exemptions (INDs/IDEs).

To increase capacity, RKS established a position dedicated to supporting FDA-regulated research across the AHC, and has implemented extended approval times for minimal risk research as allowed by regulations. RKS is working with the Research Participant Advisory Council on topics such as improving informed consent, waiving informed consent, returning research results, and compensating research subjects for participating in research. RKS continues working with UC's College of Design, Architecture, Art, and Planning to develop non-traditional informed consent templates. A new emphasis on Global Bioethics continues to expand collaboration locally; the working group includes members from 3 colleges at UC, Cincinnati Children's, the Cincinnati VAMC, and Xavier University. Three Global Bioethics Seminars were staged in 2015-16. RKS created a Regulatory Sciences Certificate curriculum (opening for enrollment in Fall 2017), complementing the existing certificate and Masters programs in Clinical and Translational Research. RKS also hosted a regulatory forum entitled *Navigating New Mandates: Seeking Safe Harbor* in May 2016, and the annual regional Human Subjects' Protection Conference in Fall 2016.

**5) Participant and Clinical Interactions (PCI).** The **Clinical Translational Research Center (CTRC)** provides the resources to perform high-quality, patient-oriented research at various venues across the AHC and in the community. The CTRC now encompasses the Schubert Research Clinic, which is located on the first floor of the new (2015) Clinical Sciences Pavilion (T Building) on the CCHMC main campus. The clinic is a welcoming and bright space conveniently located between the main hospital and the research buildings. This space brings together all services supporting clinical trials in one location, making the process of planning and conducting trials convenient for both investigator and participant. The Schubert Research Clinic includes 28 exam rooms, one preparatory lab with equipment for processing samples, a packaging and shipping room, a metabolic kitchen, a body composition laboratory with DXA scanners, and a vascular research laboratory. The Clinic can accommodate visits of less than ½ hour to greater than 10 hours and is equipped for subjects from infants to seniors. The clinic is fully staffed with highly trained and skilled nurses, medical assistants, research assistants, and registration staff to help with study visit needs. Access to the Schubert Research Clinic is open to any clinical researcher with a current IRB-approved study. During the last year, the appointment scheduling process has been fully automated, and a facile application within Epic has been implemented to capture information regarding research visits.

The CTRC nursing core also provides nursing services for inpatient and "scatterbed" studies. Four research nurses are credentialed at the UC Medical Center to assist investigators with studies at that location. Additional outpatient studies are performed in the CCHMC Oak Campus facility (approximately 6 blocks from the Medical Center) in a unit called the Cincinnati Center for Clinical Research. This facility is also the site for vaccine trials in children and adults. There is a 3000 sq. ft. satellite center at the Cincinnati VAMC for adults and other adult patients not medically suitable for the CCHMC facility. The current facilities at UC/CCHMC provide a generous and diversified set of options for AHC investigators needing specialized research space for human studies. CTRC core services are offered in biochemistry, body composition, bionutrition and vascular studies. In 2016, the CTRC and affiliates supported 316 study protocols (+4%), 361 investigators from 62 specialty areas, and 23,144 hours of outpatient visits. One hundred nine journal articles published in the last year directly benefited from CTRC resources. Junior faculty and clinical fellows utilizing CTRC services are eligible to apply for the Clinical Research Feasibility Fund (CReFF), a 1-year pilot award of up to \$20,000. A request for applications is offered once annually. One CReFF award was made in each of the last 3 years. Clinical trial recruitment efforts are bolstered by the efforts of marketing specialists working through the CCHMC and UC Health clinical trials offices, who are available to help investigators develop effective strategies and materials. The recruitment of research participants is proactively tracked across active projects.

**Research Participant Advisory Council.** Established in January 2015, the AHC's first research-focused patient and family advisory council, the Research Participant Advisory Council (RPAC), meets monthly. The 30

member council provides a platform for research participants to engage with and advise CCHMC administration, faculty, and staff on research and its conduct at the AHC. The age range of RPAC participants is 13-62 years, including children and parents/caregivers of research participants. The RPAC has staff representatives from a diverse group of work areas in both research and clinical operations at the AHC. In June 2016, a second advisory group was established in partnership with Seven Hills Neighborhood Houses to create a community-based advisory board in the West End, an urban Cincinnati neighborhood. The West End Community Research Advisory Board has 16 members from the West End community, ages 14-73 years, who have mostly not participated in research. The Advisory Board meets monthly and provides community perspective and feedback on research issues. The group is currently working on gauging their community's familiarity and opinion of research, gaining experience in participating in research, and building their understanding of the various aspects of research. A third RPAC is being developed at UC/UC Health.

6) The **Community Engagement** core is broadening and strengthening collaborations between the AHC and community. Over the last year, core efforts with a more traditional approach to community engagement (largely focusing on communities of Greater Cincinnati) have been expanded to include more direct interactions with the Anderson Center at CCHMC, including work related to Learning Health Networks and enfranchising efforts with the RPAC. The Anderson Center has a broader range of stakeholders including patients, clinicians, healthcare systems, and federal agencies such as PCORI, NIH, and FDA. Other core-driven resources include the Community Partner Council, comprised of community members, neighborhood activists and AHC members who facilitate connections through advice, education and action. Practice-based research networks (PBRNs) developed and supported by the core, the Cincinnati Pediatric Research Group and an adult PBRN, the Cincinnati Area Research Interest Group (CARInG) Network, had a total of 5 active grants, 3 pending grants, and 8 publications in 2016. The core hosted the annual conference of the Appalachian Translational Research Network of regional universities (including UC, OSU, WVU, UK, Marshall, E. Tn. St., OU) in fall 2016, with record attendance of 154 registrants from 7 states and over 40 institutions from the Appalachian region, and assumed leadership of the organization (Erin Haynes, DrPH). Over the last 6 years, more than 120 students have graduated from the Community Leaders Institute (CLI), a 6-week leadership development training program designed to enhance community research and capacity building competencies in community leaders. The 2017 CLI graduated 23 students, including 14 representatives of community agencies, 4 health advocates, and 5 fellows/staff from UC and CCHMC. CLI participants develop health-related pilot research projects and receive grants of up to \$1,500 each to complete them on behalf of their community organizations over a 12 month period. Collectively to date, CLI grads have leveraged their training to obtain over \$5 million in new grants, a ROI >28:1.

The 15<sup>th</sup> Community Engagement Speaker Series was completed in 2016, focusing on toxic stress in children and mental and behavioral health intervention. Training in community-based participatory research is offered through an online module that was revamped in 2014. To date, 45 Community Health Grants of up to \$20,000 each have been awarded to community-academic partnerships focusing on health promotion and research in community settings such as clinics and schools. For 2016, the program was redesigned to support community-academic partnerships focused on research translation. The core has been instrumental in creating the Consortium of Greater Cincinnati IRBs (CGCI), which focuses on creating cross-institutional collaborations and meets quarterly to discuss topics of interest such as access to the electronic health record (EHR), common informed consent language, and biobanking. To enhance community efforts to enfranchise stakeholders, a Research Participant Advisory Council has been formed that focuses on research subject specific issues and concerns (see description above).

The Community Engagement Core continues to provide consultations for investigators seeking advice regarding identification of partners in the community or academic side and implementation and completion of community-based studies. The Core has developed community engagement criteria for the Reappointment, Promotion, and Tenure (RPT) committee at CCHMC, with an RPT toolkit, with plans to expand to other departments in the UC COM.

7) **Translational Workforce Development (TWD)**. The CCTST coordinates the MS in Clinical and Translational Research and Certificate in Clinical and Translational Research programs. Currently, the MS program has 48 students and 155 alumni, and the Certificate program has 46 students and 111 alumni. A new track in the MS program has been developed specifically for clinical research professionals, with plans to

launch it in the next year. Students will be able to select from the following focus areas: clinical trials, clinical research generalist, translational regulatory science, community-engaged research, and nursing research. Several other programs are in the early stages of development as well: a Certificate in Translational Regulatory Science, a Certificate in Community-Engaged Research, and a PhD in Clinical and Translational Research. Three new MS courses were offered in 2016: Methods for Community-Engaged Research, Comparative Effectiveness Research and Patient-Centered Outcomes Research (co-taught with the University of Iowa CTSI), and Statistical Computation and Software. Several other new courses will be launched in 2017: Collaboration and Team Science, Communicating Your Science, and Addressing Epidemiological Challenges with Advanced Statistical Methodology. Tailorable training opportunities in Team Science are being created, and a suite of externship opportunities for K scholars is now available. TWD has connected with administrators at Mother of Mercy High School to offer Women in Science Seminars to students and with Hughes STEM High School to inform students of career opportunities in clinical research. In addition, 20-25 slots per year are supported in the existing pipeline programs for high school, college, and medical students.

The CCTST's KL2 program, which supports 4 Research Scholars annually, is closely linked with our Translational Workforce Development program. As such, KL2 Scholars can easily take courses in the MS in Clinical and Translational Research (MSCTR) program or the Certificate in Clinical and Translational Research program. To date, in order to augment the Scholars' individual coursework, research, and mentoring experiences, we have instituted 2 interdisciplinary activities: K Club and the K Scholars peer mentoring meetings. Anyone with a career development award, or who is planning to apply for a career development award, is invited to join the K Club, an informal forum for discussing topics of interest to attendees related to research, career development, and team science. The K Scholars meetings are required peer mentoring sessions, in which Scholars not only receive invaluable feedback on their current and planned research but also learn to understand and value the perspectives of other clinical and translational researchers not in their field. The K Scholars meetings take place twice monthly.

TWD has developed CTRonline, a repository of (mostly) online modules providing brief, non-degree credit instruction for any interested learner on specific research methodology topics, such as study design, risk estimation, causation, bias, confounding, and public health policy. These modules will be free and open to anyone, available from a new platform on the CCTST website in 2017. TWD is now working with UC Health's Director of Community Strategic Planning, UC Health Human Resources, and UC Human Resources on workforce development needs at UC Health and UC. While existing programs fulfill training requirements for open healthcare system positions at UC Health, efforts now include a focus on training opportunities to prepare both current employees outside of clinical research, as well as community members, to join the clinical research workforce at UC Health. TWD is also offering a new "Research 101" non-credit class for community members to engage them in research subjects most relevant to them; e.g., joining a research study, reading a consent form, and privacy issues.

The AHC has 2 core facilities offering services in epidemiology and biostatistics:

The **Center for Biostatistical Services (CBS)** is housed within the Department of Environmental Health of the CoM. Its mission is to leverage grant funding by providing first-rate biostatistical assistance with proposals during their pre-award and post-award phases. The Center is staffed by biostatistics faculty plus Master's level biostatisticians and graduate students. Services include assistance in formulating and phrasing hypotheses; devising appropriate study designs; calculating sample size and power; and managing and analyzing data. CBS faculty also teach a course in biostatistics consulting.

Services of the **Division of Biostatistics and Epidemiology (DBE)** at CCHMC include guidance and assistance in developing study designs and protocols, creating data collection instruments and databases, developing data management protocols, and crafting analysis plans. The DBE also provides input on grant applications and complete data analysis services. In addition to these core services, DBE faculty conduct their own research, focusing on research methodologies and population-based investigation of disease etiology and prevention strategies.

The **Center for Surgical Innovation (CSI)** was established by the Department of Surgery in 2003 to develop, assess, and disseminate new technologies in biomedical and surgical care through partnerships and

collaborations across the university and nationally with industry, government and other academic health centers. Made possible by philanthropic and industry donations, and operated in partnership with the Departments of Emergency Medicine and Biomedical Engineering and CCHMC, this core facility is a 3,700 square foot state-of-the-art laboratory in the MSB that supports a variety of activities including research, teaching, training, and product evaluation and validation. The Center includes a sterile surgical suite with the latest technology, 7 workstations, videoconferencing and telemedicine capability, and a conferencing facility. Both animate (animal) and inanimate (cadaver) models can be used for teaching, training and research.

The **UC Reading Campus and Metabolic Diseases Institute** were created to foster excellence in biomedical research—from basic science to translational medicine—and facilitate collaboration among academic and industrial researchers. The Campus houses world-class scientists, more than 350,000 square feet of state-of-the-art laboratories, and cutting-edge technology, core laboratories, and animal housing facilities. Formerly known as the Genome Research Institute (GRI), the Reading Campus became part of UC in 2001 through a major property gift from Aventis Pharmaceuticals, which included 10 buildings situated on a 25 acre campus. UC and the State of Ohio provided approximately \$50 million to finance renovation of the research buildings and construction of a new power plant. Funds were also committed for the recruitment of new faculty, facility management and administration, and day-to-day operations. Today, the GRI employs approx. 30 principal investigators and over 300 research and support personnel. The Metabolic Diseases Institute focuses research efforts on diabetes and obesity, lipids and arteriosclerosis, and cancer metabolism. The interdisciplinary research program at GRI features core facilities for drug discovery, proteomics, structural biology, protein production, and animal phenotype analysis.

### **Training Programs:**

**Master of Science and Certificate in Clinical and Translational Research:** Designed for clinical professionals with terminal degrees (MD, PhD, PharmD, etc.) seeking to become independent clinical or translational investigators, the MS in Clinical Research program was established in 2005 to provide training to translate scientific advances into applications for improved clinical practice and human health (<http://www.eh.uc.edu/Clinicalresearch/>). The program combines didactic course work, seminars, and individual mentoring to enable clinicians to develop the analytic and quantitative skills necessary to conduct research within their own specialty area. Students must complete 30 graduate credit hours and thesis research and select one of 5 concentrations: Clinical Epidemiology/Clinical Effectiveness; Molecular Epidemiology; Clinical Trials; Translational Research; or Biomedical Informatics. 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. Currently 48 students are enrolled in the MS program, and 46 in the Certificate.

**Molecular Epidemiology in Children's Environmental Health:** This interdisciplinary training program, funded in part by an NIH T32 training grant (Kim Dietrich, 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 Health, 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 Winkle 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, 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 3<sup>rd</sup> and 4<sup>th</sup> years of medical school. The required master's thesis is completed during the 4<sup>th</sup> 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 included 575 graduate students (including MD/PhD) and 234 postdoctoral fellows in 2016-2017.

**Biomedical Informatics (PhD and Certificate):** The UC Doctor of Philosophy in Biomedical Informatics program is an important cornerstone for a program of academic excellence in informatics at UC and its affiliate hospitals. Leveraging partnerships between the UC CoM, CCHMC, and the UC College of Engineering and Applied Sciences, the program provides an in-depth knowledge of key analytical concepts that underlie applications of informatics and biomedical data science, ranging from the study of molecules to individuals and

populations. The inter-collegiate Biomedical Informatics Graduate Certificate Program offers graduate-level training in the field of biomedical informatics, complementing existing MS and PhD degree programs at the University of Cincinnati. The program is open to both graduate students and to clinicians and professionals with advanced degrees.

**Cancer and Cell Biology:** The Graduate Program in Cancer and Cell Biology is an interdepartmental graduate program with expertise in many critical areas of modern Cancer and Cell Biology research. The mission of the CCB Graduate Program is to train the next generation of scientists and educators in basic mechanisms of molecular and cellular function with an emphasis on understanding mechanisms of cancers. Its philosophy is that PhD training must be intellectually stimulating, scientifically rigorous, and geared toward developing the lifelong learning and critical thinking skills that will prepare graduates to be successful as research scientists, educators, and/or professionals in a variety of other fields. Program faculty are concentrated in the UC Department of Cancer Biology, which administers the Program, and in the Division of Experimental Hematology and Cancer Biology at CCHMC, with additional faculty drawn from more than 10 other departments/divisions at the UC CoM and CCHMC.

**Environmental Health:** For decades one of the top-funded academic units of its type in the country, the Department of Environmental Health (DEH) has the largest graduate program in the CoM, offering doctoral training in epidemiology, biostatistics, environmental genetics and molecular toxicology, and environmental and industrial hygiene. Masters programs are offered in public health, biostatistics, environmental and industrial hygiene, epidemiology, and clinical and translational research. 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 programs in Clinical and Translational Research described above, which require 30 and 10 semester credit hours respectively, offered in multiple tracks.

**Immunology:** 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 a well-rounded immunology training experience and preparedness for future post-graduate career path in immunology. Students in the Immunology Graduate Program have 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.

**Medical Physics:** The UC CoM offers an exciting graduate program in medical physics with a strong clinical emphasis, awarding a Doctorate of Medical Physics (DMP) degree and preparing students for the American Board of Radiology Physics exam. Founded in 1959, UC's program is well established and ideally suited to those with a solid undergraduate background in physics and desire to serve others as part of a health care team. The 4 year program curriculum incorporates 3 components: didactic course and laboratory work, clinical practicum and applied research project. The 4 year DMP program is accredited by the Commission for the Accreditation of Medical Physics Educational Programs (CAMPEP) and thus graduates of the program will qualify for entry into the American Board of Radiology (ABR) Board Examination. The program will offer students the opportunity to train in therapeutic radiation oncology physics, with plans to implement appropriate CAMPEP accredited training to qualify for certification in diagnostic and nuclear medical physics in the near future. As a medical physicist, graduates will contribute to the effectiveness of radiological imaging procedures by assuring radiation safety and helping to develop improved imaging techniques (e.g., mammography CT, MR, ultrasound). Graduates also contribute to development of therapeutic techniques (e.g., prostate implants, stereotactic radiosurgery, and proton therapy), and collaborate with radiation oncologists to design treatment plans, monitoring equipment and procedures to ensure that cancer patients receive the prescribed dose of radiation to the correct location.

**Molecular and Developmental Biology:** The Molecular & Developmental Biology Graduate Program at CCHMC offers a unique opportunity to participate in cutting-edge research while being embedded in one of the top 3 pediatric hospitals in the nation. The major emphasis of the over 60 laboratories at Cincinnati Children's is the study of human development and childhood diseases. Faculty represent some of the world's most respected pediatric researchers and CCHMC has been the home of major breakthroughs in both pediatric and adult medicine. The program includes over 100 faculty representing 25 divisions at Cincinnati Children's. Students have the opportunity to conduct research across a broad spectrum of biomedical disciplines, ranging from basic studies of embryonic development to the development of diagnostics and therapeutics for a range of pediatric and adult diseases. Close links between clinicians and researchers allow constant reciprocity – bench-to-bedside translation of research findings into better treatments, and bedside-to-bench transfer of novel clinical observations to the research laboratory.

**Molecular, Cellular and Biochemical Pharmacology Program:** Based in the Department of Pharmacology and Cell Biophysics, the PhD Program is designed to provide training for 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, which offer students a wide array of choices involving mechanistic and quantitative aspects of potential and established drug targets and development of new biotechnologies for high-impact disease interventions through the use of state-of-the-art biotechnology and pharmacological methods. Student thesis projects may include mechanistic and quantitative analyses of: cardiovascular pharmacology; neuropharmacology; immunopharmacology; molecular pharmacology of proteins/enzymes; molecular biology of hormones and drug receptors; molecular biology and pathophysiology of ion channels, pumps and exchangers; contractile and regulatory proteins; cancer pharmacology; environmental toxicology; translational pharmacology; protein chemistry and structural biology; gene therapy; stem cell therapy, etc. A variety of approaches from single molecules to entire organisms are used to study pharmacological mechanisms in health and disease. Students conduct thesis research supported by faculty, and by departmental and institutional state-of-the-art biotechnology laboratory resources, including research core facilities, genomics, proteomics, gene array, bioinformatics, transgenics, MRI, ultrasound and confocal, imaging and fluorescent cell sorting.

Graduates have become principal basic and clinical scientists and professors with outstanding research programs in pharmacology: some in drug discovery, translational medicine, and science education; others in government agencies (e.g., National Institutes of Health, Food and Drug Administration) as research scientists and program managers; and still others in internationally recognized pharmaceutical corporations (e.g., Eli Lilly) as directors of global research and development, clinical research programs and translation of basic research discoveries leading to new product development and licensing.

**Molecular Genetics, Biochemistry and Microbiology:** With the future of medicine and medical practice firmly rooted in recent advances in biochemical and genetic technologies, the graduate program in Molecular Genetics, Biochemistry and Microbiology at the UC CoM is ideally placed to provide the challenge, intellectual excitement and high-level training necessary to jump-start a career in molecular biology and medicine. In addition to the traditional PhD program in Molecular Genetics, an exciting new PhD program in Human Genetics is now available to incoming students. The Human Genetics track will focus on quantitative genomics, cytogenetics, molecular genetics, and clinical genetics. The objective of this track is to provide the student with applied skills enabling a rewarding career in human genetics and genomics. The department's mission is to achieve excellence in training the next generation of scientists and physicians, and to carry out research at the cutting edge of biomedical technology. The 18 full-time faculty have a variety of interests ranging from cancer biology to cardiovascular science to microbial pathogenesis. Faculty use a number of state-of-the-art approaches including molecular genetics and structural biology in their quest to answer today's most pertinent medical questions.

**Neuroscience:** The Neuroscience Graduate Program at UC was established in 1988 as an interdisciplinary program offering the PhD degree and now has more than 80 participating faculty members from 22 departments in the Colleges of Medicine, Pharmacy, and Arts & Sciences. The program encourages a focus on clinical translation and offers multiple areas of concentration: Stress & Neuropsychiatric Disorders, Developmental Neurobiology, Pain, Sensory Neuroscience, Stroke & Neural Trauma, Metabolism & Obesity,

Epilepsy, Cognitive Development, and Motivation & Drugs of Abuse. In addition to scholarship and laboratory training in high impact research within state-of-the-art facilities, the Neuroscience Graduate Program offers guidance and support for a wide range of professional careers.

**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. This is 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 2-3 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 2nd year, students select a laboratory and begin work on their independent research project. A student may choose from approximately 40 participating laboratories directed by faculty members that conduct research in the following general focus areas: Cardiovascular & Lipid Disorders, Digestive & Kidney Disease, Endocrine, Metabolic, & Bone Disorders, Hematology/Oncology and Immunology & Infectious Diseases. Since an individual research project may span more than one focus area, the student's thesis committee will also recommend attendance at select clinical and research seminars in the focus area(s) which are likely to complement the student's research activities. The completion of all requirements for the Ph.D. degree generally takes 5 years.

**Systems Biology and Physiology:** Systems Biology and Physiology at UC is an interdisciplinary graduate program comprising faculty and staff from 19 departments within the Colleges of Medicine, Engineering, and Arts and Sciences. The Program's graduate students are a diverse group of international scholars focusing their research efforts on a wide array of biomedical topics from trying to understand normal and pathological function to development of new experimental tools and technologies. Program participants are encouraged to embrace multi-faceted experimental approaches, making full use of the world class laboratory, computational, and clinical infrastructure available at UC. The intellectual and physical resources of the program are specifically focused on 5 interrelated areas of excellence: biocomplexity, dynamic function, intravital imaging, model systems, and translational physiology. Program faculty and scientists frequently engage in research spanning several of these groups. Coursework, seminars, laboratory rotations and other activities are tailored to the particular needs of each student and are designed to support the Program's mission to develop talented scientists capable of advancing biomedical discovery in the "post-genomic" era.

**Physician Scientist Training Program:** The Physician Scientist Training Program (PSTP) is the combined MD/PhD program of the 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 8 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. PSTP students are recruited from a national pool of outstanding individuals at top undergraduate schools. About 120 applications are accepted annually for 6 positions. PSTP 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.

## **AFFILIATES**

**University of Cincinnati Medical Center (UCMC)** 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 2012. The hospital was recognized as one of "America's Best Regional Hospitals" by *U.S. News and World Report* for 2012-13, and noted in 2014 for 9 high-performing specialties including cancer;

cardiology and heart surgery; geriatrics; and pulmonology. Its 714 licensed beds make it the largest hospital in the Cincinnati region. UCMC has 1,086 medical staff and had 83,279 emergency department visits in FY2016. 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 Level I Trauma Center. Its residency program in emergency medicine was the nation's first, established in 1970. UCMC's Transplant Center performs heart, 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)** was founded in 1883 and, in 1926, relocated to its present site across the street from the CoM. Subsequently, William Cooper Procter, a benefactor of the hospital, funded a building devoted to research in children's diseases (the Children's Hospital Research Foundation, opened in 1931) and a \$2.5 million endowment. Research breakthroughs have included the Sabin oral polio vaccine, rotavirus vaccine (Rotarix®), the first practical heart-lung machine, and the surfactant preparation used worldwide to prevent premature infant deaths.

Today, CCHMC is a 673-bed non-profit organization serving as the AHC's major teaching facility for pediatrics and as the only children's hospital in the Cincinnati metropolitan area (population 2.3 million). Of about 180 pediatric institutions surveyed nationally, CCHMC was ranked 3rd for the 6<sup>th</sup> straight year in the 2016-17 Honor Roll of America's Best Children's Hospitals compiled by *U.S. News & World Report*. CCHMC was in the top 12 for all 10 ranked specialties, including #2 in gastroenterology/GI surgery and nephrology; #3 in diabetes/endocrinology, orthopaedics, pulmonology, and urology; #4 in neurology/neurosurgery; and #8 in cardiology/heart surgery. *US News* also ranked UC CoM pediatrics training (staffed by CCHMC faculty) 3rd among US medical schools in a 2016 survey of the best graduate schools. 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 (College Hill) providing acute inpatient, outpatient and residential psychiatric services. In FY2016, CCHMC had 1,304,776 total patient encounters (+5.4%), 19,684 admissions, 92,528 emergency department visits, and 33,903 surgical procedures, serving patients from all 50 states and 61 countries. A total of 197 transplants were performed, including 26 kidney, 28 liver, 125 stem cell, 12 heart, 5 lung, and 1 multi-visceral procedures. Employment increased 1.1% to 15,429, including 1,891 active medical staff.

CCHMC ranks 3rd nationally among pediatric medical centers in NIH-funded research (\$130.8 million in 2016). Its 1.4 million gross sq. ft. of research space includes the new (2015), \$205 million Clinical Sciences Pavilion ("Location T"), a 15 story, 445,000 sq. ft. facility adjacent to and physically integrated with the 415,000 sq. ft., 11 story Location S which opened in 2007 directly across the street from the CoM. Location T includes new laboratories, a research imaging facility, research-focused outpatient clinic, offices, and supporting infrastructure for over 1,500 physicians, scientists and staff. CCHMC housed an NIH-funded General Clinical Research Center (GCRC) from 1963-89, and has co-sponsored a Center with UC since 1993 that is now part of the CCTST and known as the Clinical Translational Research Center (CTRC), based in Location T, which encompasses the Schubert Research Clinic. See description in PCI section above. The new (2016) \$120 million proton therapy center on CCHMC's Liberty Township campus, jointly funded and operated with UC Health, is the only center in the nation to dedicate a gantry (bay) exclusively to research. Separate gantries are dedicated to adult and pediatric cancer treatment, with capacity for a combined 300 patients annually.

Established in 2010, the **James M. Anderson Center for Health Systems Excellence** serves as the catalyst for transformation across Cincinnati Children's and is leading efforts within the hospital to achieve the unprecedented performance in outcomes, experience and value that the organization has made core to its mission. The Center works at the system level on strategic initiatives while also looking broadly across the organization to ensure that work within meso- and microsystems has maximum institutional impact. One of its key roles is to provide leadership, content expertise and research and infrastructure support for strategic areas that are not only system-level priorities but which also serve as hubs for accelerating organizational

transformation: safety, capacity management, chronic diseases, community/population health, learning networks, health policy, health services research, evidence-based decision making, and improvement science education.

In 2007, UC, CCHMC and UC Health agreed to establish a Joint Cancer Center, together committing \$60 million to build and upgrade facilities and new clinical programs, attract world-class faculty and accelerate research findings. The development of shared clinical facilities allows continuous monitoring of pediatric cancer survivors into adulthood and beyond. Now known as the **Cincinnati Cancer Center (CCC)**, the collaboration's long-term goal is National Cancer Institute (NCI) designation as a Comprehensive Cancer Center. Shuk-Mei Ho, PhD, professor and Jacob G. Schmidlapp Chair of Environmental Health and an expert on the role of epigenetics, hormones and endocrine disruptors in cancer development, was named director of the Center in 2013. She works closely with an administrative team and research program leaders to develop cross-institutional and cross-departmental research teams and to ensure alignment with the NCI's guidelines for research programs and initiatives. The Center's mission is to reduce the burden of cancer in the US, with a particular focus on southern Ohio and northern Kentucky, which will be attained through a seamless integration of discovery science, translational research, clinical trials and prevention strategies. More than 800 individuals, including faculty, research professionals, physicians and staff deliver leading edge cancer research, clinical care and effective cancer prevention and control measures to the region and across the nation through 3 programmatic areas: Molecular and Cellular Basis of Cancer, Molecular Therapeutics and Diagnosis, and Cancer Etiology, Control and Prevention. The Center is also involved in an initiative to enhance research on the links between obesity and cancer, which involves faculty affiliated with the Cincinnati Diabetes and Obesity Center, UC Cancer Institute and UC Metabolic Diseases Institute.

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 in order 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 Veterans Affairs Medical Center (VAMC)**, located within the AHC complex, has 117 general medical and surgical beds and serves veterans within a 50-mile radius of Cincinnati and beyond, encompassing 15 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. During FY 2016, the hospital provided 66,815 in-patient bed days of care, and had 580,788 outpatient visits. The VAMC also supports 6 community-based outpatient clinics and 1 healthcare access site in Fort Thomas, Kentucky.

The Research Service supports a variety of research projects that are funded by the VA Central Office, Department of Defense (DOD), NIH, private foundations, and the pharmaceutical industry. In FY 2016, Cincinnati VAMC investigators received \$3,298,943 in VA funding and \$548,931 in extramural federal funding (\$241,118 from NIH), which supported 26 active investigators in 94 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, as well as a satellite location of the UC AHC's CTSA-funded Clinical Research Unit (CRU) are based at the VAMC. The CRU satellite consists of 3,000 sq. ft. of dedicated research space, and contains both inpatient and outpatient rooms as well as a lab and an investigational drug pharmacy.

**The Center for Closing the Health Gap in Greater Cincinnati** was established in 2003 with the vision of "a healthier region for all." A non-profit corporation, its mission is to lead efforts to eliminate racial and ethnic health disparities in Greater Cincinnati through advocacy, education, and community outreach. Led by President & CEO Dwight Tillery, a former Cincinnati Mayor, the Center also works collaboratively with health

institutions and other stakeholders to promote health and disease prevention.

**Hoxworth Blood Center**, located on the Academic Health Center campus, is the only facility of its kind for the Greater Cincinnati region. Its mission is to enhance the well-being of patients in its service area by assuring a reliable and economical supply of the safest, most efficient possible blood, by combining effectiveness and providing innovative hematotherapy and cell therapy services, as well as by promoting research and education programs in transfusion and transplantation medicine.

Serving a 17-county area in Ohio, Kentucky and Indiana, Hoxworth collects, tests, processes, and distributes over 140,000 blood components annually to 31 hospitals and medical centers. Hoxworth, 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, American Society of Histocompatibility and Immunogenetics and the Foundation for the Accreditation in Cellular Therapies. Founded by Dr. Paul I. Hoxworth in 1938, the Blood Center has grown to be an internationally recognized leader in transfusion medicine. The Center has 7 neighborhood donor centers, multiple mobile collecting units, more than 250 full- and part-time employees in 26 divisions (including therapeutic apheresis, transplantation immunology, cellular therapy/regenerative medicine, immunohematology reference laboratory and research), and a complement of over 300 volunteers. Since their inception, Hoxworth Blood Center has provided Transfusion Medicine Compatibility Laboratory Services to Cincinnati Children's Hospital Medical Center and medical oversight of the University Hospital Compatibility Laboratory.

Hoxworth's Research Laboratory is a leader in coordinating research projects in transfusion medicine and cell therapies, including clinical trials for transfusion medicine/cell therapy-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 was nearly \$2.0M in 2016. In education, the Center offers an ACGME-accredited fellowship program in Blood Banking and Transfusion Medicine and provides Transfusion Medicine training to Adult and Pediatric Hematology/Oncology fellows, Anesthesiology fellows and Pathology medical residents.

**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 Barrett 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. Cancer Institute physicians, who are faculty of the 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 active protocols sponsored by cooperative programs through the NCI and pharmaceutical companies. In 2007, the Barrett 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 UC Medical Center, 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 18 centers nationally to gain this distinction. The Center was reaccredited in 2016.

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's research efforts span multiple departments within the UC CoM as well as the James L. Winkle College of Pharmacy, College of Nursing, College of Engineering and McMicken College of Arts and Sciences. The Institute's infrastructure was designed to complement efforts of the Cincinnati Cancer Center, a collaborative initiative of the UC CoM, UC Health and CCHMC (see description above). Inter-departmental, disease-based research teams collaborate on basic, translational and clinical research projects. Researchers

have access to robust core research facilities, including a preclinical imaging center, comprehensive tissue and blood bank, high-throughput screening capabilities and compound library for drug target screening, proteomics, bioinformatics and more.

The **UC Heart, Lung and Vascular Institute** pursues a mission to provide optimal and affordable care to patients with complex diseases, disorders and conditions affecting the heart, lungs and vascular system. The Institute is committed to educating and training clinicians and scientists who will become future leaders, conducting cutting-edge basic science, translational and clinical research and establishing a “learning hospital” environment that assures quality, safety and reliability to each patient under our care. Strengthening bridges between basic science and clinical research accelerates discovery of safe, new treatments for heart, lung and vascular diseases and disorders. The Institute strives to support cutting-edge research that leads to novel technologies and therapeutics, expand current research in promising new areas, translate and commercialize new discoveries into products that can be used by clinicians to provide care to patients, and recruit prominent faculty to enhance research strengths. The Institute was the first in the nation to show that:

- Sarcoplasmic reticulum calcium cycling and contractility is linked to cell death.
- A multimeric complex of several gene products mediates cross-talk between heart function and cell death or survival.
- There are human mutations in calcium cycling genes linked to heart failure or arrhythmias that can be used as prognostic or diagnostic markers in heart failure progression or arrhythmia development.
- Specific genes may serve as excellent new therapeutic targets for heart failure.
- Peripheral nociceptor stimulation can improve muscle survival after heart attack.
- Ultrasound can enhance thrombolysis for stroke treatment.
- A new calcium channel, TRPV2, is implicated in the regulation of myocardial function.

The **UC Gardner Neuroscience Institute**, a collaboration of the UC College of Medicine and UC Health, is a leading treatment, research and teaching center for complex neurological conditions that includes more than 100 faculty members from 15 clinical specialties. Through its centers of excellence and premier programs, the Institute advances compassionate, patient-centered neurologic and psychiatric care, life-changing research, and comprehensive education. Its physicians and researchers have created national models for evidence-based treatment and research of complex neurologic conditions, including ischemic and hemorrhagic stroke, brain aneurysms, brain and spinal cord trauma, brain tumors, Parkinson’s disease, epilepsy and seizure disorders, multiple sclerosis and trigeminal neuralgia. Institute physicians helped discover the only FDA-approved treatment for ischemic stroke, and were also the first to receive FDA approval to use the YAG laser to vaporize inoperable brain tumors. The \$60 million Gardner Neuroscience Institute, now under construction on the AHC main campus, will open in 2019. The 114,000 sq. ft. building will consolidate patient care and education and 215 faculty physicians, researchers and staff in a single location.

**UC Center for Integrative Health and Wellness.** Integrative medicine combines conventional medicine with evidence-based complementary therapies such as mindfulness approaches, nutrition and health coaching, acupuncture, massage therapy, yoga therapy and stress reduction techniques for optimal healing. The Center for Integrative Health and Wellness focuses on promoting integrative medicine principles at the UC Academic Health Center and throughout the community. The Center is working to engage members of all colleges and units across the university, along with its collaborative partners in the community, to develop robust integrative health and wellness initiatives and programs. Center faculty provide education to enrich and cultivate integrative medicine skills for medical students and promote the value of treating the whole person. Using evidence-based perspectives, graduates will be able to address and counsel patients in the use of integrative modalities, improving patient care and satisfaction. Likewise, Center researchers are involved in several federally-funded research projects that focus on integrative care.

**Shriners Hospitals for Children® – Cincinnati** opened in 1968 on the AHC campus, moving about 3 blocks to its present 30-bed facility in 1992. This pediatric burn hospital is well known for treating comprehensive acute and reconstructive/rehabilitative pediatric burn patients and its basic and clinical research programs. It is one of only 4 freestanding hospitals in the country dedicated to the treatment of pediatric burns. In addition to its pediatric burn services, the hospital treats many nonburn and plastic surgery conditions such as: cleft lip and palate, congenital deformities of the face, ear or hands, complex wound and skin conditions, and post

trauma reconstruction. Fully accredited by the Joint Commission, the hospital received re-verification as a burn center by the American Burn Association and the American College of Surgeons. In 2016, the Cincinnati facility admitted 156 acute care patients, performed 832 outpatient surgeries, recorded 4,207 outpatient clinic visits, and coordinated 32 telemedicine visits. It receives referrals from 22 states in a 1,000-mile radius from Cincinnati, and features the nation's only pediatric burn air transport service. All medical care is provided regardless of the patients' ability to pay. Research funding totaled \$3.3 million in 2016.

## **2. Patient Resources Available for Research**

With 714 registered beds and 1,086 medical staff, **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. UCMC, West Chester Hospital, Drake Center for Post-Acute Care, Lindner Center of HOPE (behavioral care), numerous outpatient care facilities throughout the region and UC Physicians (UCP), the practice group for over 750 clinical faculty members at the UC College of Medicine, together comprise UC Health. UCP was integrated into UC Health in 2011. Clinical services are provided in an array of different specialties including family medicine, surgery, internal medicine, emergency medicine, oncology, urology, cardiology, neurology, neurosurgery, otolaryngology, dermatology, rehabilitation, pain management, anesthesiology, orthopedics, obstetrics-gynecology, ophthalmology, radiology, radiation oncology, pathology and psychiatry. A Level 1 trauma center, UCMC logged 83,279 emergency department visits in 2016.

**CCHMC** has 16 patient care locations and 673 registered beds in the Cincinnati metropolitan area, including 102 inpatient psychiatry beds and 30 residential psychiatry beds. In FY2016, CCHMC had 1,304,776 total patient encounters (+5.4%), 19,684 admissions, 92,528 emergency department visits, and 33,903 surgical procedures, serving patients from all 50 states and 61 countries. A total of 197 transplants were performed, including 26 kidney, 28 liver, 125 stem cell, 12 heart, 5 lung, and 1 multi-visceral procedure. Employment increased 1.1% to 15,429, including 1,891 active medical staff. A new, 600,000 sq. ft. building housing 276 critical care beds and related support functions including a roof-top heliport for emergency care and an emergency department are planned for completion in 2021.

## **3. Institutional Assets for Research Training**

The Academic Health Center is the region's center of medical education. The CoM trains 678 medical students, 575 graduate students (including 55 MD/PhD), 664 residents and clinical fellows, and 234 postdoctoral fellows annually. CCHMC has 502 medical residents, 254 clinical fellows and 181 research postdoctoral fellows; 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 533 students, including the PharmD and MS/PhD programs. The College of Nursing has 2,653 undergraduate and graduate students. The College of Allied Health Sciences has 2,993 undergraduate and graduate students.

## **4. Informatics Infrastructure**

**CCHMC Division of Biomedical Informatics:** The Division of Biomedical Informatics provides a variety of computational resources, services and support to investigators at Cincinnati Children's and across the AHC. Available computational resources include the i2b2 research data warehouse for cohort identification, a cluster with more than 300 processing cores for executing computationally intensive jobs, network filers and relational database systems for secure and regulatory compliant data storage, and an array of licensed and open-source scientific software applications including statistical analysis packages. Support services for both basic and clinical research are offered. Service staff can help with the selection, purchase and installation/configuration of basic research tools (e.g., electronic lab notebook software, cluster computing applications), and can provide both formal (grant-funded) and informal assistance in areas such as sequence analysis and microarray data analysis. Staff also specialize in the development of electronic data capture systems using tools such as Microsoft SharePoint Services with InfoPath, in addition to designing/developing informational and collaborative portals, research patient registries and other custom software, including multimedia applications.

**UC Department of Biomedical Informatics:** The Department of Biomedical Informatics was established within the College of Medicine in 2014. Its mission is to use data to effectively create and apply knowledge to improve the understanding, diagnosis, treatment and prevention of health care problems. The department is

the academic home for informatics faculty and assists with collaborations and data sharing among UC, CCHMC and UC Health. UC began offering a PhD program in Biomedical Informatics in 2016, which has engaged 29 faculty and enrolled 5 students to date. A Graduate Certificate in Biomedical Informatics is also offered. The department houses the **Center for Health Informatics (CHI)**, established in 2006, in which experts from the AHC and community organizations address issues in clinical practice, clinical research, and public health to improve the quality and safety of patient care and advance medical science. The Center is affiliated with hospitals and healthcare organizations throughout the region, which provide access to real-world settings for gathering data and testing informatics innovations. While the CHI's primary focus is on the sub-domains of health informatics concerned with clinical care, clinical research and public health, its faculty also collaborate closely with departments and divisions of UC and partner institutions that focus on other sub-domains such as bioinformatics and computational biology.

**Donald C. Harrison Health Sciences Library:** Reopened in 2008 following extensive renovation and expansion, the former Academic Information Technology & Libraries was renamed for benefactor Donald C. Harrison, MD, who served as AHC provost and senior vice president for health affairs from 1986-2002. The Library encompasses nearly 45,000 sq.ft., bridging the existing Medical Sciences Building (MSB) and light-filled atrium of the new CARE/Crawley building. Featuring a 90 seat computer lab, numerous meeting spaces, and over 200,000 print volumes on site, it also provides a full calendar of computing classes and access to over 800 online databases, 110,000 electronic journals, and 149,000 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. In 2014, the Library was ranked 14<sup>th</sup> 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](http://www.netwellness.org)) is a non-profit service providing health and medical information directly to the public from 3 academic health centers (UC, 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. In its 22 years of operation, its reputation has grown as a leader in free, accurate health information, garnering numerous national awards for the site. Over 360 expert 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 nearly 68,000 questions to date.

**The Health Collaborative.** In April 2015, the Health Collaborative, Greater Cincinnati Health Council, and HealthBridge merged into a single organization called The Health Collaborative. These 3 long-standing nonprofit health and health care improvement organizations now work together under a single management structure which more efficiently aligns services and more effectively meets the needs of the communities, stakeholders, and members they serve. Its members are health systems and hospitals (including UC Health, CCHMC, and Cincinnati VAMC), as well as care partners (post-acute and non-acute care providers), and business partners. The Collaborative provides insight into regional health issues, helping catalyze community will around solutions, and measuring progress on shared community aims; expertly manages large-scale improvement initiatives involving multiple stakeholders working together toward a defined common goal; and provides data and value-added solutions to help stakeholders succeed and accelerate innovation to make health and healthcare a competitive advantage for the region. Among its many services is the Health Information Exchange, the secure electronic movement of health-related information among organizations utilizing nationally recognized standards and policies. As patients move from one healthcare setting to another, HIE ensures patient information is available at the point of care where and when it is needed.