

SCHOOL OF MEDICINE

The mission of the Case Western Reserve University School of Medicine (<http://casemed.case.edu>) is to advance the health of humankind through the four interrelated components of Education, Research, Clinical Care and Public Service.

The School of Medicine provides three programs leading to the MD degree: the School of Medicine program, known as the University program; the Cleveland Clinic Lerner College of Medicine at Case Western Reserve University, known as the College program, which first admitted students in 2004; and the Medical Scientist Training Program, or MSTP, the oldest existing MD-PhD program (since 1956) with NIH MSTP support since 1975. The School of Medicine also partners with the School of Graduate Studies to offer programs leading to PhD and MS degrees, as well as certificates in disciplines in the School of Medicine.

As a research institution, the School of Medicine has a tradition of national leadership. The School of Medicine consistently ranks in the top tier of the nation's medical schools for federal research funding from the National Institutes of Health, and is proud of its Clinical Translational Service Award in partnership with its affiliates. In addition, a 2015 *Academic Medicine* study ranked the School of Medicine in the top 15 schools based on the achievements of its graduates. Faculty and trainee research is routinely reported in the nation's top journals, leading to biomedical discoveries and improved health.

The School of Medicine engages the community in public service in many ways. The School of Medicine's commitment links researchers and medical students to the community. The school's faculty provide 90 percent of the indigent health care in Cuyahoga County and a majority of the care for indigent patients in Ohio. A major economic influence on the northern Ohio area, the School of Medicine and its affiliated hospitals are among the largest employers of personnel in the area and further stimulate the economy by providing concepts for technology transfer to the business sector. On the international level, the School of Medicine has a global health and diseases program focusing on AIDS, tuberculosis, malaria and other diseases that directly threaten world health.

The school is very proud of the contributions made by its educators and graduates but doesn't rest on its laurels. The curriculum constantly responds to the latest findings in education and medicine and sets the pace for other schools with input from gifted and committed scholars.

At least eleven Nobel Prize holders have ties to the School of Medicine:

- John J.R. Macleod, MB, ChB, DPH, physiology professor at Case from 1903 to 1918, shared the 1923 Nobel Prize in Physiology or Medicine for the discovery of insulin. Dr. Macleod completed much of his groundwork on diabetes in Cleveland.
- Corneille J.F. Heymans, MD, who was a visiting scientist in the Department of Physiology in 1927 and 1928, received the Nobel Prize in Physiology or Medicine in 1938 for work on carotid sinus reflexes.
- Frederick C. Robbins, MD, shared the 1954 Nobel Prize in Physiology or Medicine for his work on the polio virus, which led to the development of polio vaccines. He received the award two years after joining the medical school. Dr. Robbins was active at the school until his death in 2003, at which time he held the titles of medical school dean emeritus, University Professor emeritus, and emeritus director of the Center for Adolescent Health.
- Earl W. Sutherland Jr., MD, who had been professor and director of pharmacology from 1953 to 1963, won the 1971 Nobel Prize in

Physiology or Medicine for establishing the identity and importance of cyclic adenosine monophosphate (AMP) in the regulation of cell metabolism.

- Paul Berg, PhD, who earned his biochemistry degree at the university in 1952, received the 1980 Nobel Prize in Chemistry for pioneering research in recombinant DNA technology.
- H. Jack Geiger, MD, a 1958 alumnus of the medical school, is a founding member and past president of Physicians for Social Responsibility, which shared the 1985 Nobel Peace Prize as part of International Physicians for the Prevention of Nuclear War, and Physicians for Human Rights (PHR), which shared the 1997 Nobel Peace Prize as part of the International Campaign to Ban Landmines.
- George H. Hitchings, PhD, who had been a biochemistry instructor from 1939 to 1942, shared the 1988 Nobel Prize in Physiology or Medicine for research leading to the development of drugs to treat leukemia, organ transplant rejection, gout, the herpes virus and AIDS-related bacterial and pulmonary infections.
- Alfred G. Gilman, MD, PhD, a 1969 graduate of the medical school, shared the 1994 Nobel Prize for Physiology or Medicine for identifying the role of G proteins in cell communication.
- Ferid Murad, MD, PhD, a 1965 graduate of the medical school, shared the 1998 Nobel Prize in Physiology or Medicine for discoveries concerning nitric oxide as a signaling molecule in the cardiovascular system.
- Paul C. Lauterbur, PhD, a 1951 graduate of the engineering school and a visiting professor of radiology at Case in 1993, shared the 2003 Nobel Prize in Physiology or Medicine for pioneering work in the development of magnetic resonance imaging.
- Peter C. Agre, MD, who completed a fellowship in hematology at Case while a medical student at Johns Hopkins, shared the 2003 Nobel Prize in Chemistry for discoveries that have clarified how salts and water are transported out of and into the cells of the body, leading to a better understanding of many diseases of the kidneys, heart, muscles and nervous system.

Two other distinguished alumni have served as U.S. surgeon general: Jesse Steinfeld, MD, a 1949 graduate, was surgeon general from 1969 to 1973, and David Satcher, MD, PhD, who graduated in 1970 and was surgeon general from 1998 to 2002.

Dr. Satcher also served as director of the Centers for Disease Control and Prevention from 1993 to 1998, and another medical school graduate, Julie Gerberding, MD, MPH, followed in his footsteps, in 2002 becoming the first woman to be named CDC director.

History

Since its founding in 1843, the Case Western Reserve University School of Medicine has been an innovator in medical education and a leader in pioneering research. Beginning as the Medical Department of Western Reserve College (and popularly known then as the Cleveland Medical College), the school moved into its first permanent home, in downtown Cleveland, in 1846. In 1915, a 20-acre site was secured for a medical center in University Circle, the current home of Case Western Reserve University, its School of Medicine, and two of the school's affiliated hospitals, University Hospitals of Cleveland and the Louis Stokes Cleveland Department of Veterans Affairs Medical Center. University Circle also is home to many of the country's outstanding cultural and educational institutions.

The school was one of the first medical schools in the country to employ instructors devoted to full-time teaching and research. Six of the first

seven women to receive medical degrees from accredited American medical schools graduated from Western Reserve College (as it was called then) between 1850 and 1856.

Already a leading educational institution for more than a century, in 1952 the School of Medicine initiated the most advanced medical curriculum in the country, pioneering integrated education, a focus on organ systems and team teaching in the preclinical curriculum. This curriculum instituted a pass/fail grading system for the first two years of medical school to promote cooperation among students instead of competitiveness, introduced students to clinical work and patients almost as soon as they arrived on campus, and provided free, unscheduled time in an era when doing so seemed unthinkable. Many other medical schools followed suit, and these components remain at the core of the medical school's curriculum today.

In 1924, the School of Medicine moved into the most modern and best-equipped preclinical science building in the country at that time. That building, donated by Cleveland industrialist Samuel Mather, remains an integral part of the medical school complex. It was named the Harland Goff Wood Building in 1993 in honor of the late chair and professor of biochemistry and former provost of the university.

In 1971, the Health Sciences Center was completed to house the university's medical, dental and nursing schools, as well as the Health Center Library. In 1994, the health sciences complex was named for now-retired U.S. Congressman Louis Stokes. The proximity of these excellent research and educational centers to other prestigious university departments, including science, engineering and social sciences, stimulates uniquely creative interaction among researchers and educators.

Another giant leap in research capabilities came in the early 1990s, when the Richard F. Celeste Biomedical Research Building, named for the former Ohio governor, was opened. The \$70 million building, attached to the Wood Building, added 154,000 square feet of research space and includes conference spaces, a lecture hall, public spaces and a cafeteria.

The School of Medicine was the first medical school to provide laptop computers to all its students. Today, students use their laptops to access the entire syllabus as well as numerous electronic resources deemed essential by faculty. Students have access to the WiFi network at the medical school and across campus. Technology is used to enhance, not replace, the faculty-student interaction that occurs in the classroom, the laboratory and small group discussions.

In 2002, the School of Medicine became only the third institution in history to receive the best review possible from the body that grants accreditation to U.S. and Canadian medical degree programs, the Liaison Committee on Medical Education. Also in 2002, the school built on its tradition of innovation in education when the university and the Cleveland Clinic entered into an agreement to form the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University, with the first class matriculating in 2004.

Recent boosts in research capabilities came with the spring 2003 dedication of a new, eight-floor addition to the School of Medicine's Wood Building, which added more than 40,000 square feet to the medical school, primarily for research laboratories. Also as part of the project, 30,000 square feet of existing laboratory space in the Wood Building was renovated. And in the fall of 2003, the School of Medicine and University Hospitals of Cleveland dedicated the new, eight-floor Iris S. and Bert L.

Wolstein Research Building, adding 320,000 square feet of space for up to 700 researchers.

Affiliated Hospitals

University Hospitals (<http://www.uhhospitals.org>)

University Hospitals serves the needs of patients through an integrated network of hospitals, outpatient centers and primary care physicians. At the core of the health system is University Hospitals Cleveland Medical Center. University Hospitals Cleveland Medical Center is home to some of the most prestigious clinical centers of excellence in the nation and the world, including cancer, pediatrics, women's health, orthopedics and spine, radiology and radiation oncology, neurosurgery and neuroscience, cardiology and cardiovascular surgery, organ transplantation and human genetics. Its main campus includes the internationally celebrated UH Rainbow Babies & Children's Hospital, ranked among the top children's hospitals in the nation; UH MacDonald Women's Hospital, Ohio's only hospital for women; and UH Seidman Cancer Center, part of the NCI-designated Case Comprehensive Cancer Center. Go here (<http://www.uhhospitals.org>) for more information.

The Cleveland Clinic (<http://my.clevelandclinic.org/default.aspx>)

In 2002, the university and Cleveland Clinic entered into a landmark agreement to form the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University, with the first students matriculating in 2004. The "College Program" is a program within the Case Western Reserve University School of Medicine. Cleveland Clinic serves as an outstanding teaching site for all medical students in the School of Medicine, in addition to being the site for pre-clerkship education in the College Program.

Cleveland Clinic was founded in 1921 by four Case Western Reserve faculty members, three of whom are counted among the alumni of the Case School of Medicine. Cleveland Clinic's main campus, where much of the activity associated with the program occurs, is located on 180 acres near the Case Western Reserve campus.

Occupying 44 buildings on 167 acres, Cleveland Clinic main campus includes a hospital, an outpatient clinic, a children's hospital, specific buildings for cancer, eye, heart and urologic care, a research institute with supporting labs and facilities, and an education institute. To better serve the Cleveland suburbs with quality healthcare, Cleveland Clinic operates 18 family health centers, three health and wellness centers, 10 regional hospitals and numerous urgent care and medical offices. State-of-the-art imaging services are available, and several locations contain pharmacies and outpatient surgery centers.

Cleveland Clinic also has locations in Florida, Nevada, Canada, Abu Dhabi and, beginning in 2020, London.

In 2016, Cleveland Clinic recorded more than 7.14 million outpatient visits and 220,000 hospital admissions. Among them were patients from all 50 states and 185 countries. More than 3,500 physicians and scientists, 11,800 nurses and nearly 2,000 residents and fellows provide high quality care for patients.

Cleveland Clinic is consistently named as one of the nation's top hospitals by *U.S. News & World Report*, and its heart and heart surgery program has been ranked No. 1 by U.S. News since 1995. Learn more about Cleveland Clinic (<http://www.clevelandclinic.org>).

The MetroHealth System (<http://metrohealth.org>)

The MetroHealth System is one of the largest, most comprehensive health care providers in Northeast Ohio, caring for people in and around Greater Cleveland for more than 170 years. This academic health care system is committed to the communities it serves by saving lives, restoring health, promoting wellness, and providing outstanding, lifelong care that is accessible to all.

Affiliated with Case Western Reserve University School of Medicine since 1914, MetroHealth is a center for medical research and education, with all active staff physicians holding CWRU faculty appointments. More than 400 primary care and specialty care physicians practice within The MetroHealth System. At the core of the MetroHealth system, is the MetroHealth Medical Center. The system's main health care provider, research facility and teaching hospital is also home to the region's only Level 1 trauma and burn center. However, The MetroHealth System also serves Greater Cleveland with more than a dozen urban and suburban primary and specialty healthcare centers in Cleveland, Strongsville, Westlake, Lakewood, Pepper Pike and Beachwood.

MetroHealth has received many accolades for its high level of care and the innovation of its physicians. Surgeons at MetroHealth are pioneering new techniques in minimally-invasive surgery for faster recoveries, while its primary care physicians are developing cutting-edge ways to manage common and chronic diseases through the use of electronic medical records and a patient-centered medical home model called Partners in Care. Its maternal-fetal medicine specialists are successfully managing the riskiest of pregnancies and saving the tiniest of lives. In addition, MetroHealth is nationally recognized by the American Heart Association for cardiac and stroke care and the cancer center has earned outstanding achievement awards for the treatment of cancer patients. Every year, MetroHealth provides care to more than 28,000 inpatients and delivers approximately 3,000 newborns. More than 790,000 visits are recorded each year in the medical center's outpatient centers, and patient visits to the emergency department exceed 99,000. To learn more about MetroHealth and its locations and services, go here (<http://metrohealth.org>).

The Louis Stokes Cleveland Department of Veterans Affairs Medical Center (<http://www.cleveland.va.gov>)

The Louis Stokes Cleveland Department of Veterans Affairs Medical Center (VAMC) is a major teaching hospital of the School of Medicine and is an important site for the education of medical students. The Cleveland VAMC also supports more than 100 residency and fellowship training positions in medicine, surgery, and psychiatry and their subspecialties. Most VAMC physicians hold faculty appointments within the School of Medicine. The affiliation is overseen by the Deans Committee, consisting of the dean, department chairpersons from the School of Medicine, and key VAMC officials.

The Cleveland VAMC is a part of the VA Healthcare System of Ohio, linking VA health care facilities in Ohio in an integrated service network. Inpatient care is provided at the Wade Park location and includes medicine, surgery, psychiatry, spinal cord injury, neurology and rehabilitation medicine as well as a nursing home and a domiciliary. Outpatient care is delivered in primary and specialty care clinics located at Wade Park, Akron, Canton, Cleveland, East Liverpool, Lorain, Mansfield, New Philadelphia, Painesville, Ravenna, Sandusky, Warren and Youngstown. The medical center serves more than 100,000 individual veterans annually through approximately 11,600 hospital admissions and 1,884,000 outpatient visits.

An active research program includes activities funded through the Department of Veterans Affairs and other governmental and private funding sources. Total funding of approximately \$21.5 million annually (from all sources) supports more than 50 principal investigators in a broad range of research endeavors. For more information, go here (<http://www.cleveland.va.gov>).

Advanced Platform Technology Research Center of Excellence

216.791.3800 x6003

Ronald J. Triolo, PhD, Executive Director

Gilles Pinault, MD, Medical Director

The Advanced Platform Technology (APT) Center (<https://www.aptcntr.research.va.gov>) at the Louis Stokes Cleveland Veterans Affairs Medical Center (LSCVAMC) is one of 13 designated Centers in the Rehabilitation Research and Development Service. The APT Center focuses on serving veterans with sensorimotor dysfunction, cognitive impairment, or limb-loss using cutting edge technologies and rehabilitation techniques, translating them from proof of concept to viable clinical options. Advances in material science, microfabrication and microsystem design, neural engineering, mechanics, and communications are captured and integrated for applications in prosthetics/orthotics, neural interfacing, wireless health monitoring and maintenance and all forms of enabling and emerging technologies. The APT Center is able to provide or facilitate access to the following resources:

- Neural modeling and analysis of interface designs
- Polymer and bioactive material development
- Microelectromechanical (MEMS) systems design and fabrication
- 3-D and laser printing/prototyping, mechanical testing and dynamic simulation
- Pre-clinical in vitro and in vivo verification of device performance
- Circuit, sensor and software design and fabrication
- System validation and design control documentation
- Professional engineering support and project management
- Administrative support for intellectual property protection, regulatory affairs, and quality systems.

The APT Center was established in 2005 as a collaboration between the LSCVAMC and Case Western Reserve University (CWRU). Over 50 Engineers and Clinician Scientists at the LSCVAMC, CWRU, Cleveland Clinic, University Hospitals, Cleveland State University, Kent State University, University of Michigan, and Cornell University are affiliated with the APT Center and contribute to its mission.

Case Comprehensive Cancer Center

216.844.8797

<http://cancer.case.edu>

Stanton L. Gerson, MD, Director, Case Comprehensive Cancer Center

The Case Comprehensive Cancer Center (Case CCC) is one of only 41 National Cancer Institute-designated Comprehensive Cancer Centers in the country. The Case CCC integrates the cancer research activities of the

largest medical collaborative in Ohio, Case Western Reserve University (CWRU), University Hospitals Case Medical Center and Cleveland Clinic - under a single leadership structure. Our researchers dedicate themselves to improving cancer outcomes through basic studies into signaling pathways giving rise to cancer and its genetic and epigenetic causes, pursuing novel therapeutic targets, and analyzing lifestyle interventions to prevent cancer and detect it earlier.

The Case CCC has over 360 collaborating scientists and physicians who have successfully competed for over \$119 million in annual funding. These investigators are organized into eight interdisciplinary scientific programs and have access to 15 Scientific Core Facilities. A unified clinical research effort consisting of 12 multidisciplinary clinical disease teams develop and prioritize clinical trials among the partner institutions.

Located in Cleveland, Ohio, the Case CCC serves a population with higher than average cancer rates. Research programs extend to CWRU affiliates MetroHealth Medical Center (the region's county hospital) and Louis Stokes Veterans Affairs Hospital and to 13 community medical centers operated by University Hospitals and Cleveland Clinic.

As a consortium cancer center, Case CCC has become a powerful example of the potential generated by complementary institutions coming together for the benefit of research and discovery, patient treatments and community impact. Through its partners, Cancer Center programs extend throughout Northeast Ohio to offer residents access to cancer care through participation in community outreach, cancer prevention, cancer survivorship initiatives and a robust clinical trials operational effort coordinated across academic medical centers and community sites.

Case Cardiovascular Center

216.368.3391

Mukesh K. Jain, MD, Director, Case Cardiovascular Research Institute
Daniel I. Simon, MD, Director, University Hospitals Harrington-McLaughlin Heart & Vascular Institute Director, Case Cardiovascular Center

The Case Cardiovascular Center (<http://www.case.edu/cvri>) was established in 2006 with the central mission to develop premier clinical, research, and education programs in heart and vascular disease. The structure of the Center includes clinical (University Hospitals Harrington-McLaughlin Heart & Vascular Institute—UH-HMHVI) and research (Case Cardiovascular Research Institute—CVRI) arms.

The UH-HMHVI (<http://www.uhhospitals.org/services/heart-and-vascular/institute>) is a multi-disciplinary team of nearly 60 full-time faculty members dedicated to (a) the prevention, diagnosis, and treatment of heart and vascular disease to both local and regional patient populations in Northeast Ohio, (b) the education and training of medical students, residents and fellows, and (c) the development of breakthrough medical advancements and practices to deliver superior clinical outcomes. These clinical services range from primary to quaternary levels of expertise and are provided at all the health care facilities within the University Hospitals healthcare system. The clinical programs are organized into 11 program centers that comprise the Institute.

The research activities of the CCC are focused on the development of premier research programs that span the full spectrum of activities from basic bench-side research to translational research (“first-in-man”) and clinical trials. The CVRI is focused on basic and translational studies. The Research & Innovation Center (RIC) of the UH-HMHVI is dedicated to innovative clinical trials and applied technology. The major

areas of research focus in the CVRI include cardiovascular biology, mechanisms of gene regulation, innate immunity & inflammation, and stem cell & regenerative medicine. Investigators in the CVRI have full access to two laboratories for in vivo research in small and large animals. The RIC oversees all clinical research activities within cardiovascular medicine and surgery and is supported by a lead administrator along with nurse coordinators and staff to facilitate patient enrollment as well as regulatory/grant activities. Active areas of clinical research include interventional cardiology, vascular medicine, heart failure, electrophysiology, preventive cardiology & rehabilitative medicine, and cardiovascular imaging.

Case Center for Imaging Research (CCIR)

216.844.8076

James Basilion, PhD, Director - CCIR
Chris Flask, PhD, Director - Imaging Research Core

The CCIR (<http://case.edu/medicine/ccir>) is a joint venture between Case Western Reserve University School of Medicine and University Hospitals Cleveland Medical Center. The CCIR, through its 50 faculty members and state-of-the-art clinical and preclinical imaging capabilities, promotes interdisciplinary and translational imaging research. As the imaging research program at CWRU continues to grow, we strive to make the CCIR imaging capabilities available to the broader research community. This overriding goal has led to a strong collaborative relationship between the CCIR imaging faculty and basic and clinical researchers in many disciplines.

Within the CCIR, the Imaging Research Core provides facilities for both preclinical and clinical imaging studies. The Imaging Research Core serves as a shared resource for CWRU's Cystic Fibrosis Center, the Case Comprehensive Cancer Center, the Clinical and Translational Science Collaborative (CTSC), and the Cleveland Digestive Diseases Research Cores Center. The preclinical facility includes two high resolution MRI scanners, a microPET/CT scanner, an X-ray scanner, and three bioluminescence/fluorescence systems. Magnetic relaxometers are also available for high throughput screening of developmental MRI contrast agents. In addition, a novel cryofluorescence imaging system provides high resolution, 3D optical imaging capabilities. The Core also provides support for quantitative analysis of all imaging data.

A human 3T MRI scanner is also available through the Core for clinical research studies. Other clinical imaging options are also available within the Department of Radiology. The creation of a new radiopharmaceutical facility within the CCIR, together with our existing cyclotron and radioisotope delivery system, now provide the capacity to conduct a variety of molecular PET imaging studies from preclinical animal studies all the way to routine clinical studies.

The Center for AIDS Research

216.368.0271

Jonathan Karn, PhD, Director
Michael Lederman, MD, Associate Director

Since its founding in 1994, the Case Western Reserve University/ University Hospitals Center for AIDS Research (CWRU CFAR (<http://casemed.case.edu/cfar>)) has been a center of excellence for both clinical and basic science AIDS research. Investigators participating in the CWRU CFAR draw on resources from the Case Western Reserve University School of Medicine, University Hospitals Cleveland Medical Center, MetroHealth Medical Center, the Cleveland Clinic Foundation and the Joint Clinical Research Center in Kampala Uganda. As one of only

19 CFARs nationally, the CFAR plays an important role in ensuring that cutting-edge AIDS research and well received community outreach is supported in our region of the country. Major strengths in the CWRU CFAR include international research, especially with respect to research in tuberculosis and HIV malignancy, microbicides, pathogenesis, virology, clinical trials, and training, at the national and international levels. As the first CFAR to make a major investment in international research, we have been able to expand a highly productive and long-standing scientific relationship with Makerere University, Kampala.

The CWRU CFAR shares and supports the mission of the National CFAR program to support a multi-disciplinary environment that promotes basic, clinical, epidemiologic, behavioral, and translational research in the prevention, detection, and treatment of HIV infection and AIDS. The CWRU CFAR provides: Leadership and strategic planning that promotes and supports outstanding HIV/AIDS research at our participating institutions, a vibrant series of seminars and meetings regularly bringing leaders in HIV research to our campus, laboratory cores with expertise, state-of-the-art instrumentation and technologies; pilot grant awards and mentoring to develop junior faculty interested in HIV; educational and training efforts which encompass the whole range of contemporary HIV/AIDS research; community outreach programs, and the promotion of and participation in collaborative research efforts within the national CFAR network and in Uganda.

Center for Antimicrobial Resistance and Epidemiology

216.791.3800, ext. 4788

Louis Stokes Cleveland Department of Veterans Affairs Medical Center (VAMC)

Robert A. Bonomo (robert.bonomo@va.gov), MD Chief, Medical Service

As antibiotic resistance has become a national and global public-health problem, top academic centers are preparing to launch ambitious programs addressing research on the basic, translational and clinical aspects of antibiotic resistance. The CWRU-Cleveland VAMC Center for Antimicrobial Resistance and Epidemiology (Case VA CARES) aims to translate research findings into clinically useful tools for the diagnosis and treatment of patients infected with multidrug-resistant (MOR) Gram negative organisms and mycobacteria. The center's long term goals are: 1) to continue and expand this dynamic research program directed at understanding the mechanistic bases of resistance in order to develop innovative clinical and therapeutic approaches to deal with MOR organisms; 2) to develop a strong clinical research program of translational medicine on antibiotic resistance; 3) to incorporate drug discovery, whole genomic sequencing and other rapid diagnostic technologies into the management of patients infected with MOR organisms and mycobacterial pathogens, including tracking of outbreaks and molecular epidemiology of these organisms; 4) to enhance educational activities of trainees in aspects related with antibiotic resistance; and 5) work with existing services available at the School of Medicine, University Hospitals, and the Clinical and Translational Science Collaborative to disseminate research and educational activities both nationally and internationally.

Center for Bio-Nanotechnology

216.368.4377

www.bio-nano.com (<http://www.bio-nano.com>)

Nicole F. Steinmetz, PhD, Director

Sourabh Shukla, PhD, Assistant Director

The Bio-Nano Center was established in 2017 with a central mission of revolutionizing medicine and biotechnology by facilitating communication and providing key resources to faculty to accelerate discovery and development of bio-nanotechnologies across the Case Western Reserve University School of Medicine and the Cleveland research community.

The Bio-Nano Center provides a platform for interdisciplinary collaboration, bringing together scientists, engineers and clinicians studying and developing bio-nanotechnologies in diverse disciplines and from across the CWRU campus and the Cleveland area and beyond. In a boundary-free setting of modern science and engineering, where diverse scientific fields merge and new ones are born, team science is an essential requirement to make new discoveries and breakthroughs. The Bio-Nano Center's mission includes the training and education of tomorrow's researchers in an interdisciplinary and collaborative environment, bridging nanosciences, biomedical engineering, polymer science and engineering, imaging research, cardiovascular medicine, cancer biology and oncology.

The Bio-Nano Center focuses on 4 research thrusts: 1) immunotherapy and vaccines, 2) Novel therapeutics and drug delivery, 3) Molecular contrast agents and imaging, and 4) Advanced Materials. (Bio-)Nanomaterials have unique properties and abilities to navigate interactions with cells and the circulatory system (blood and lymph); these nanoscale objects can be engineered and programmed to selectively interact with specific molecular targets, cells, and tissues – molecular zip codes of the body – to deliver payloads. Targeted to the immune system, these bio-nanotechnologies can mobilize antigen-specific humoral and cellular immune responses to eliminate and prevent onset of cancer, infection and chronic disease. Engineered to carry contrast agents and/or therapeutic molecules, bio-nanotechnologies open the door for molecular diagnosis, longitudinal imaging of disease progression or response to therapy, while enabling disease-targeted treatment strategies thus overcoming systemic toxicities. Lastly, bio-nanotechnologies enable the manufacture of novel materials for tissue engineering and regenerative medicine. Applications of bio-nanotechnology are not limited to human medicine, having possible impacts on such fields as veterinary medicine, pesticide delivery, agriculture, and beyond.

The Center for Child Health and Policy at Rainbow Babies & Children's Hospital

216.844.6253

Ann Nevar, MPA, Manager

Established in 2007, the Center for Child Health and Policy at Rainbow (<http://www.uhhospitals.org/rainbow/for-clinicians/child-health-policy>) focuses on major health policy issues that are central to the well-being of children and youth. The Center recognizes that health policy forms a framework for all health care delivery, and that health policy is therefore essential to improving children's health. In this way, the Center focuses on the nexus between policy and practice of pediatric medicine.

The Center fills the need to amalgamate expertise in pediatric medicine and research with expertise in health policy. Operating as a think tank, the Center brings together experts in child health, health finance, law and policy to perform policy analyses, consultations, research, educational programming, and community outreach to advance child health through policy. Work is focused on several areas including: Maternal/Fetal/Newborn Health; Chronic Illness; Quality; and Care Delivery Systems. The

Center is the only program devoted to child health policy in Cleveland and one of few nationwide.

To date, the Center has accrued many products and achievements including: Ohio Health Policy Researcher of the Year in 2006; Ohio Health Policy Researcher of the Year for Independent Research in 2009; programs designated Centers of Excellence; multiple white papers, reports, and peer-reviewed publications; grants and awards from the National Institutes of Health, The Centers for Disease Control and Prevention, the Ohio Department of Health, the Ohio Department of Job and Family Services, and numerous foundations; and invited/elected memberships in state and national policy committees.

Center for Clinical Investigation

216.368.3286

http://cci.case.edu/cci/index.php/Main_Page

James Spilsbury, PhD, Academic Development Core Director

The Center for Clinical Investigation (CCI) was founded in 2007 and is part of Case Western Reserve University School of Medicine's Division of General Medical Sciences. The CCI serves as the academic home of Cleveland's Clinical & Translational Science Collaborative, a partnership of 4 local institutions (Case Western Reserve University, the Cleveland Clinic Foundation, the MetroHealth System, and University Hospitals) and member of a national consortium of approximately 66 institutions funded by the National Institutes of Health to increase the efficiency and speed of clinical and translational research across the country.

The CCI's mission is to enhance clinical and translational research efforts across the Cleveland area by: (1) spurring advances in knowledge of risk factors, outcomes and treatment effectiveness in the population; (2) facilitating the transfer of scientific advances to the community; and (3) developing a new generation of clinical researchers equipped with the skills needed to efficiently design, implement and interpret novel studies that address important public health questions. To accomplish its mission, the CCI provides computer systems and applications support for basic science and clinical research activities and works closely with basic science and clinical investigators in the CWRU Schools of Medicine, Nursing, and Dental Medicine, as well as the University Hospitals Case Medical Center, Cleveland Clinic, and MetroHealth System. The CCI has supported hundreds of clinical research and epidemiology projects, including local and national multicenter, longitudinal studies. The CCI has two cores that provide research support to all investigators: the Academic Development Core and Statistical Sciences Core.

The Academic Development Core manages the newly created PhD Program in Clinical Translational Science, the Master's Degree Program in Clinical Research (Clinical Research Scholars Program - see "Clinical Research MS" tab above), and the Graduate Certificate Program in Clinical Research. The Academic Development Core also delivers seminars and short courses in clinical research and works to coordinate educational activities in interdisciplinary clinical research across the CTSC's institutional members. The programs target investigators and other key members of the research team, including data managers and study coordinators. Training efforts in research design, research data management, statistical sciences, statistical software, and scientific communication are emphasized.

The Statistical Sciences Core provides data management and statistical support on study design and data analysis. Members who provide data management consist of skilled data managers and programmers who consult and collaborate with investigators on data collection instrument development and coding, database development and administration,

data cleaning and quality assurance, statistical programming, and dataset preparation. Members providing statistical support collaborate and consult with clinical investigators on proposal development, study design, study monitoring, and data analysis. "The Statistical Sciences Core currently consists of 1 PhD biostatistician and 1 MS biostatistician. Statistical software packages that are supported by the CCI Statistical Sciences Core include SAS, SPSS, R/S-Plus, NCSS PASS and Minitab. In addition, the Statistical Science core serves as a gateway for connecting investigators with the broad expertise available through the biostatistics faculty in the Department of Population and Quantitative Health Sciences.

Center for Global Health and Diseases

216.368.6321

<http://www.case.edu/orgs/cghd/>

James W. Kazura, MD, Director

The Center for Global Health and Diseases links the numerous international health resources of the University, its affiliated institutions, and the northern Ohio community in transdisciplinary programs of research and education related to global health. The scope of the Center's activities also includes education and service as these are related to molecular, clinical and population studies of human health and disease.

The Center is currently a national leader in National Institutes of Health-supported studies of the major infectious diseases of developing countries. Cutting-edge approaches are implemented in order to examine the molecular, genetic and immunologic basis of susceptibility to infectious diseases of public health significance - malaria, river blindness, lymphatic filariasis, schistosomiasis, HIV and other viral diseases such as Rift Valley fever. Clinical research in endemic countries is concerned with testing and implementing cost-effective public health interventions that are aimed at the control of malaria and Neglected Tropical Diseases (worm infections of children, elimination of lymphatic filariasis). The Center has ongoing research and educational collaborations with academic and governmental institutions in Papua New Guinea, Brazil, Kenya, Uganda, and several other countries in Sub-Saharan Africa. Educational programs sponsored by the Center include electives in international health, population biology, and genetics of infectious diseases (available to undergraduate, graduate and professional school students), a weekly World Health Interest Group (WHIG) seminar series, overseas rotations for graduate and professional school students, and training programs at the university and abroad for scholars from developing countries (with support from the Fogarty International Center at NIH).

A certificate in Global Health is available (see Certificates).

Center for Health Care Research & Policy

216.778.3902

Randall D. Cebul, MD, Director

The mission of the Center for Health Care Research & Policy (<http://www.chrp.org>) is to: 1) improve the health of the public by conducting research that improves access to health care, increases the quality and value of health care services, and informs health policy and practice; and 2) lead education and training programs that promote these goals.

Formally established in 1994, the Center's mission is carried out by a cross-disciplinary faculty who both lead and collaborate with other scholars in Northeast Ohio and beyond. A core faculty of 17 is extended by affiliated Senior Scholars throughout the university, assisted by an able staff and over 30 grant-supported research associates. The Center's home at MetroHealth's Rammelkamp Research and Education Building is

an outstanding venue for collaborative research, mentoring of students and junior faculty, and cross-disciplinary seminars.

The Center's research and training focuses in programmatic areas that reflect national health care priorities as well as high impact problems in adults. Center Programs pertain to chronic conditions, especially stroke, obesity and diabetes, and kidney disease. Programs are supported by methods units, including biostatistics and evaluation, health care decision making, and health economics and health policy. Research using clinical informatics capitalizes on growing institutional capacities in electronic medical records (EMR) and clinical decision support. Center faculty view Northeast Ohio as a laboratory for research, recognizing the national relevance of regional challenges and opportunities. For over four years, the Center has served as the administrative home for Better Health Greater Cleveland, an EMR-catalyzed initiative to measure, publicly report, and improve health outcomes for the region's residents with chronic medical problems. Center faculty also assume leadership roles in federally-supported degree programs in Health Services Research and Clinical Investigation and teach in the core curriculum of the School of Medicine.

Center for Medical Education

216.368.1948

Patricia A. Thomas, MD, FACP, Director

Klara Papp, PhD, Director, CAML

The Center for Medical Education, established in 2010, provides an organizational home for teaching and learning programs in the School of Medicine and a supportive environment for those who want to develop special skills in medical education.

The Center also sponsors faculty appointments, both full- and part-time, for faculty whose roles are predominantly focused on teaching medical students and physician assistant students. These include community clinicians who welcome medical students into their clinics and practices.

The Center for the Advancement of Medical Learning ("CAML") operates its programs under the auspices of the CMEd. CAML supports and promotes the development of teaching and lifelong-learning skills among students, faculty, staff, residents, and alumni. CAML pursues research into educational innovations to advance our knowledge of medical learning and teaching. The Center offers workshops to faculty locally, regionally, and nationally to enhance faculty teaching, research and evaluation skills.

Center for Proteomics and Bioinformatics

216.368.0291

<http://proteomics.case.edu/index.html>

Biomedical Research Building, Ninth Floor

Mark R. Chance, PhD, Director

The Case Center for Proteomics and Bioinformatics was created, in part, to strengthen Cleveland's presence in modern proteomics and bioinformatics research to make the region a leader in the field. The vision for the Center has been shaped over the past several years by the leadership of the Center's Director, Mark Chance, PhD, with over \$120 million in grants awarded to the Center and its collaborators since its inception in February 2006. One of the primary goals of the CPB is to develop an infrastructure of sophisticated equipment that facilitates and maximizes shared equipment usage, as well as to offer a wide array of proteomics and bioinformatics services including mass spectrometry,

protein expression/interactions, systems biology, and biostatistical analyses.

The CPB has expanded its vision to include education of graduate students in systems biology and bioinformatics. The Center for Proteomics and Bioinformatics developed a graduate program in Systems Biology and Bioinformatics in collaboration with Schools and Departments across the campus. For more information regarding the SYBB graduate program please see "Systems/Bioinformatics" tab above. You may also visit <http://bioinformatics.case.edu/>.

Proteomics entails the in depth structural analysis of individual proteins in human and animal cells. In studying proteins and their changes, bioinformatics enables researchers to take an integrated -omics approach for discovering networks involved in human disease. The School of Medicine has established the Center for Proteomics and Bioinformatics to perform research to better understand the genetic and environmental bases of disease as well as provide new technologies to diagnose diseases such as cancer, heart disease, and diabetes.

New technologies in mass spectrometry are also allowing protein expression, localization, structure, post-translational modifications, and interactions to be studied in increasing detail and on a genome wide scale. The Center is also developing and applying state-of-the-art-structural proteomics technologies to understand the function and interactions of macromolecular complexes.

The CPB has three divisions: Proteomics and Genomics, Bioinformatics, and Macromolecular Structure.

Proteomics and Genomics Division

The mission of the Division of Proteomics and Genomics is to support research in protein and gene expression analysis, protein and gene modifications, and protein interactions in a wide variety of biological contexts. The division also develops new tools in Proteomics and Genomics research. This includes multiple Proteomics Cores to support these activities.

Bioinformatics Division

The mission of the Division of Bioinformatics is to support interdisciplinary research and training in many areas of bioinformatics including analysis of DNA and protein sequences, protein interaction networks, linkage and association studies for simple and complex traits, and gene and protein expression profiles. This includes a Bioinformatics Core that provides research support for these activities.

Macromolecular Structure Division

The mission of the Division of Macromolecular Structure is to support interdisciplinary research in new methods of structure determination, the combination of computational and experimental structural biology approaches, and developing and maintaining infrastructure for macromolecular structure determination. The Division will work closely and coordinate their activities with faculty and Departments in the University who use structural information to understand function as well as other Centers that provide leadership in Structural Biology and Biophysics.

The CPB also offers a wide range of seminars, workshops, and possibilities for individual training. These activities are posted on the CPB Web site. For a list of services and to explore opportunities to

collaborate, please visit the Web site: <http://proteomics.case.edu> or e-mail: proteomics@case.edu (//proteomics@case.edu).

Center for Psychoanalytic Child Development

Kimberly Bell, PhD; John A. Hadden Jr. Assistant Professor of Psychoanalytic Child Development
Email: kmb207@case.edu
216.991.4472

The Center for Psychoanalytic Child Development was established in 2001 in memorial to John A. Hadden Jr., past President of the Board of Trustees of the Cleveland Center for Research in Child Development and of the Hanna Perkins School. The mission of the center is to advance the science of psychoanalytic child development at the School of Medicine.

The Center offers medical students and residents who are interested in working with children the opportunity for observational learning in the Hanna Perkins school. In addition, didactic courses, case conferences and supervision are available to deepen students' understanding of the relationship between physical and psychological development in the first 5 years of life.

The Center for RNA Science and Therapeutics

216.368.0299
<http://www.case.edu/med/rnacenter/home.htm>
Jeffery M. Collier, PhD, Director

The Center for RNA Science and Therapeutics is a free standing academic unit in the basic sciences within the School of Medicine at Case Western Reserve University. The RNA Center was established in the mid-nineties as a core entity in recognition of the strong cadre of research laboratories devoted to studying post-transcriptional mechanisms of gene expression focusing on various aspects of RNA Biology. The current mission of the RNA Center is to parlay the strengths of RNA Center scientists towards the development of unique therapeutic initiatives. The RNA Center is combining the usage of nanoparticle technology with RNA science to develop new classes of drugs, leading towards the amelioration of a variety of diseases. Current efforts are focused on metabolic disorders, cancer immunotherapies, immunity, and protein replacement. In addition, we are developing new technologies that promise to improve diagnostics, allowing for earlier detection of a variety of human diseases, especially cancer.

The RNA Center contains one of the largest concentrations of RNA scientists in the nation. The faculty of the RNA Center cover nearly every aspect of RNA research. Current research in the Center focuses on several problems ranging from extremely basic questions such as the mechanism of RNA catalysis and how proteins interact with RNA to the roles of RNA processing in disease. Specific research interests include splicing and its regulation, RNA editing, tRNA maturation, mechanisms of translation regulation, RNA degradation, RNA trafficking, RNA interference and regulation of gene expression by microRNAs and non-coding RNAs.

Collectively, the RNA Center provides a valuable resource for collaborative efforts within the University and its affiliated institutions: the Cleveland Clinic Foundation, MetroHealth Medical Center, the Cleveland VA Medical Center, and University Hospitals Cleveland Medical Center. In addition, the official journal of the RNA Society "RNA" was founded and continues

to be housed in the RNA Center. The members of the RNA Center have an excellent funding record and the research performed is regularly published in highly visible journals such as Science, Nature, Molecular Cell, NSMB, Molecular Cell, etc.

Center for Science, Health and Society

216.368.2059
<http://casemed.case.edu/cshs/>
Nathan A. Berger, MD, Director

Recognizing that the successful futures of Case Western Reserve University, the City of Cleveland, and Cuyahoga County are integrally related, the Center for Science, Health and Society (CSHS) was created in 2002 to focus the efforts of the University and the community in a significant new collaboration to impact the areas of health and healthcare delivery systems through community outreach, education, and health policy. The Center, based in the School of Medicine, with university wide associations, is engaging the many strengths of the University and the community to improve the health of the community.

The Center has engaged the community at the level of the individual and the neighborhood, in public and private schools, at civic and faith-based organizations, and at the level of governmental agencies and community leadership to identify community problems, perceptions, assets and resources; advise the community of faculty skills, assets and expertise; and, catalyze that community service based scholarship that benefits community interests and promotes mutual enhancement. The Center coordinates the Scientific Enrichment Opportunity outreach program that brings Cleveland high school students on to the medical school campus in the summer to work along with our distinguished faculty in their research labs, to introduce and stimulate the students and help prepare them to enter careers in the health career professions and biomedical workforce. The Center also coordinates the Mini Medical School Program presented every Spring and Fall to educate the community in the latest developments in healthcare, particularly those developed at CWRU. The overall goal of these programs is to educate and empower the community to become better consumers of healthcare and more informed and stronger advocates for healthcare policy and legislation in their own interests.

Center for the Study of Kidney Biology and Disease

216.444.8415
John R. Sedor, MD, Director
Thomas H. Hostetter, MD, Co-director
Jeffrey Garvin, MD, PhD, Co-director
Jeffrey Schelling, MD, Co-director

Chronic Kidney Disease (CKD) is a growing public health problem in the United States. More than seventeen percent of US adults—more than 30 million Americans—have CKD. CKD generally progresses over time, and can cause cardiovascular disease, anemia, bone disease, fluid overload, and eventually end-stage kidney disease (ESKD). Patients with ESKD need renal replacement therapy, either from dialysis or a kidney transplant, to live. The risk of death for patients receiving dialysis is nearly eight times higher than the non-ESRD population, leading to a 20% annual probability of death. Kidney disease disproportionately affects minorities and vulnerable populations. Kidney disease treatment is expensive and uniquely tied to federal expenditures through the Medicare entitlement program. The cost of care for ~ 550,000 ESKD patients is nearly \$34 billion annually, exceeding the total NIH budget. Treating all

health conditions of CKD and ESRD patients consumes nearly 25% of the Medicare's budget.

The Center's mission is to accelerate discovery and its translation for treatment and cure of kidney diseases in an interdisciplinary environment within the rich, research environment of the CWRU School of Medicine. The faculty is an accomplished and highly interactive group of investigators, based in the adult or pediatric Divisions of Nephrology in CWRU-affiliated hospitals as well as other clinical and basic science departments. Research interests of the faculty include digital pathology image analysis, glomerular diseases, diabetic and other chronic kidney diseases, epithelial cell biology and ion transport, tubular physiology, genetic epidemiology, health services research, renal transplantation, health disparities research and clinical trials. Center faculty are members of the NIDDK-funded Kidney Precision Medicine Project. Research projects use cellular, molecular biological, computational, genetic, genomic and epidemiological methods to study in vitro and animal models and/or patients. Many projects by Center investigators use health data, culled from electronic health records, and biological samples from patients with kidney diseases in order to generate novel hypotheses, which can then tested with animal models and cell lines. Training opportunities are available for undergraduate, pre- and post-doctoral students.

The Center for Translational Neuroscience

216.368.6116

David M. Katz, PhD, Director

The goals of the Center for Translational Neuroscience are to develop scientific interactions that promote understanding of the pathology of neurological diseases and to develop novel therapeutic strategies for the treatment of those diseases. The Center pursues these goals through Translational Interest Group meetings and events, and through the Neurological Institute, in the University Hospitals Case Medical Center, where clinicians and investigators have a direct conduit between research and developing treatments.

Cleveland Functional Electrical Stimulation (FES) Center

216.231.3257

Robert F. Kirsch, PhD, Executive Director

Robert Ruff, MD, PhD, Medical Director

The Cleveland Functional Electrical Stimulation (FES) Center (<http://fescenter.org>) is a consortium of three nationally recognized institutions: Department of Veterans Affairs, MetroHealth Medical Center and Case Western Reserve University. Through the support of these partners, the Cleveland FES Center is able to provide a continuum of advancement. Created in 1991 with a grant from the Department of Veterans Affairs, the FES Center currently has research funding at the federal, state and local levels and additional industry and foundation funding in excess of \$17M in order to achieve its mission.

The Center focuses on the application of electrical currents to either generate or suppress activity in the nervous system. This technique is known as functional electrical stimulation (FES). FES can produce and control the movement of otherwise paralyzed limbs for standing and hand grasp, activate visceral bodily functions such as bladder control or respiration, create perceptions such as skin sensibility, arrest undesired activity such as pain or spasm, and facilitate natural recovery and accelerate motor relearning.

Founded to introduce FES into clinical practice, the Center provides innovative options for restoring neurological health and function by developing advanced technologies and integrating them into clinical care.

Institute for Transformative Molecular Medicine

216.368.5725

Jonathan S. Stamler, MD, Director

The Institute for Transformative Molecular Medicine (ITMM), which operates under the combined aegis of Case Western Reserve University and University Hospitals, is composed of physician-scientists and basic discovery researchers who work to acquire fundamental scientific knowledge within the field of molecular medicine. Founded in 2010, the ITMM provides physician-scientists with the opportunity for professional advancement based on their contributions to life sciences, protected from demanding clinical schedules or administrative responsibilities. The mission of the ITMM is to foster the unrestricted pursuit of new knowledge that can be cultivated as the basis for therapeutic innovation, and to inspire new generations of physician-scientists.

The operation of the ITMM is based on a new model that unites academic medical centers, physician- and discovery-scientists and commercial partners to maximize the conversion of basic science discoveries into novel, high-value therapeutics. Thus, the ITMM facilitates connectivity between medical disciplines and the basic research community in order to catalyze fundamental discovery and its transformation into therapies that benefit humankind. Creativity and innovation are highly valued in the culture fostered by the ITMM. Expertise in interdisciplinary science is prioritized, including signal transduction, receptor biology, regenerative medicine, RNA biology and chemical biology, in the pursuit of cutting-edge advances that can impact human disease.

The Mt. Sinai Skills and Simulation Center

216.368.0064

Mark I. Aeder, MD, Medical Director

The Mt. Sinai Skills and Simulations Center (MSSSC) (<http://casemed.case.edu/simcenter>) was initially conceived in response to common concerns over the nationwide increased incidence of medical errors, the rising costs of health care, and the need for improved patient-caregiver communication. Since its founding in 2006, the MSSSC continues to work with an ever expanding list of health care partners to become an integral resource for the education of health care students and professionals in the Northeastern Ohio region and throughout Ohio. The MSSSC and The Institute for Surgical Innovation (ISI) combine to form the Case Western Reserve University Center for Skills and Simulation (CWRU-CSS).

Simulation develops confident practitioners who can significantly contribute to the goal of improved patient outcomes. By providing a variety of simulation tools, such as life-like computerized manikins and standardized professionals performing within carefully crafted scenarios, we can replicate the complex environment of the clinical setting. Participation in these specially designed scenarios allows learners to practice the critical skills needed to provide safe, quality care to patients, including communication, technique development, decision making and data analysis. These models have allowed us to have ongoing research projects in education development and intervention and advanced our partnership for the development of new techniques and materials.

The MSSSC has all the tools available for simulation training, including Standardized patients – individuals trained to portray situations or conditions; Task trainers – devices used to teach individual techniques; High fidelity trainers – manikins with programming capabilities; Virtual reality – real life interactive trainers for surgery, cardiology and other disciplines; Second life – avatar interactions in a computerized world; and Hybrid combinations of the above.

The CWRU-CSS is an American College of Surgeons Level 1 Accredited Educational Institute. During the past five years, the Center has provided educational opportunities and course for learners at all levels from high school students, medical, dental and nursing students at Case Western Reserve University and The Lerner College of Medicine, residents and fellows from training programs at University Hospitals Case Medical Center, The Cleveland Clinic and MetroHealth Medical Center, graduate education for practicing physicians and surgeons, nursing and other health care providers at all levels, first responders including EMS and fire/rescue, flight nurse training and military reserve medical units.

National Center for Regenerative Medicine

216.368.3614

<http://ncrm.us>

Stanton L. Gerson, MD, Director

Jeremy Rich, MD, PhD, Co-Director

Mariesa Malinowski, Executive Director

The Center for Regenerative Medicine (<http://ncrm.us>) is a multi-institutional center composed of investigators from Case Western Reserve University, University Hospitals Case Medical Center, the Cleveland Clinic, Athersys, Inc., and The Ohio State University. Building on over 30 years of experience in adult stem cell research in northeast Ohio, the Center was created in 2003 with a \$19.4 million award from the State of Ohio as a Wright Center of Innovation. An additional \$8M award in 2006 from the State of Ohio's Biomedical Research and Commercialization Program (BRCP) was successfully completed and enabled 3 new clinical trials to enroll patients. In 2009, \$5M was awarded by the Ohio Third Frontier (OTF) Research Commercialization Program (RCP) which further validated the Center's ability to achieve its mission to utilize human stem cell and tissue engineering technologies to treat human disease. In 2010, \$1M was awarded to the NCRM by the OTF Biomedical Program (OTFBP) to advance the clinical treatment of spinal cord injury, and a \$2.1M OTF Wright Program Project (WPP) award was made to create a consortium of quantitative analysis imaging systems for stem cells.

Neural Engineering Center

216.368.3978

Dominique M. Durand, PhD, Director

Kenneth Gustafson, PhD, Associate Director

The Neural Engineering Center (NEC) (<http://www.case.edu/cse/nec>) is a coordinated group of scientists and engineers dedicated to research and education in an area at the interface between neuroscience and engineering. They share the common goal of analyzing the function of the nervous system, developing methods to restore damaged neurological function, and creating artificial neuronal systems by integrating physical, chemical, mathematical, biological and engineering tools.

The center was started in 2001 and replaced the Applied Neural Control Laboratory (ANCL) started in 1972. The center offers breadth and depth in Neural Engineering research and education in a highly ranked biomedical engineering department and medical school. The center is located on the

campus of Case Western Reserve University and its members collaborate with four major hospitals in the Cleveland area.

The center provides core facilities in tissue culture, microscopy and histology. The center facilities also include an electrode fabrication laboratory, surgical suite for acute and sterile surgery, staffed by two full time animal technicians. The center also holds several laboratories in neural regeneration, neural interfacing, neural prosthetics, materials for neural interfacing computer modeling and in-vitro electrophysiology. The students, research associates and faculty can carry out research at many levels starting from cellular and molecular to animal experimentation and into the clinic. Many other facilities such as electronic design, microfabrication and rapid prototyping are also available in collaboration with other closely related centers, the Functional Stimulation Center (FES) and the Advanced Platform development Laboratory (APT). Center members work closely with the partner hospitals and the technology transfer office of CWRU for translation and clinical implementation of solutions restore neural function such as development of electrodes for communication with the nervous system, regenerating neural tissue, restoring function in paralysed patients, preventing seizures, motor disorders, incontinence aspiration or obstructive sleep apnea.

The center provides financial support for students through research and training grants. The graduates of this program have made significant contributions to the development and the growth of this fast growing area of neural engineering in academic, industrial and federal institutions.

Prevention Research Center for Healthy Neighborhoods

216.368.1918

Elaine A. Borawski, PhD, Director

The Prevention Research Center for Healthy Neighborhoods (PRCHN) (<http://casemed.case.edu/ctsc/community/prevention.cfm>) at Case Western Reserve University was established in 2009 with funding from the Centers for Disease Control and Prevention (CDC). Built upon the foundation of two previous centers that merged to become the PRCHN - the Center for Health Promotion Research and the Center for Adolescent Health - the PRCHN seeks to foster partnerships within Cleveland's neighborhoods for developing, testing, and implementing research strategies to prevent and reduce the burden of chronic disease. The PRCHN, midway into its second 5-year cycle of CDC funding, is a highly responsive and collaborative community-based research center that partners with public health agencies, community organizations, neighborhood leaders and residents to address significant environmental and lifestyle issues strongly linked to chronic disease and influenced by the conditions, disparities and resources of the neighborhood itself.

Its faculty and staff have also served as an active partner and leader in the transformative process occurring in Cleveland around the concepts of health equity, collective action, and the understanding of multiple determinants of health.

The PRCHN supports a comprehensive research agenda that centers around food access and community nutrition, tobacco prevention and cessation, environments supporting healthy eating and active living, place-based health and health behavior surveillance, and community-clinical linkages and chronic disease management research. This includes core research project, Freshlink, that aims to increase nutritional food access (NFA) in low income neighborhoods throughout Cleveland.

A goal of the PRCHN is to build capacity for community-based research among University and community partners by offering formal training programs (i.e., PEER Program, PRCHN Student Internship Program)

monthly seminars, workshops and webinars, and by providing technical assistance, evaluation services and subject matter expertise to its community partners.

The PRCHN partners include experienced community based researchers, heads of local boards of health, more than 50 community and health organizations, neighborhood leaders and residents, and Affiliated Faculty from five schools within the University (College of Arts and Sciences, the Frances Payne Bolton School of Nursing, the Mandel School of Applied Social Sciences, and the School of Dental Medicine), to support the mission of the Center. Representatives from these local agencies and organizations serve on the PRCHN's Network of Community Advisors (NOCA), offering guidance to identify emerging issues, set research and programmatic priorities, and ensure that the community's voice informs our work.

Skin Cancer Research Institute

216.368.0324

Kevin D. Cooper, MD, Director

The Skin Cancer Research Institute (<http://mediswww.case.edu/dept/dermatology/Centers/SCRI.html>) engages the foremost experts in dermatology and oncology to work collaboratively across disciplines to identify new ways to treat and prevent skin cancers. The Skin Cancer Research Institute (SCRI) at Case Western Reserve University exists to discover causes of skin cancers, prevent skin cancers more effectively, and to develop new therapies for skin cancer treatment.

The Department of Dermatology is poised to create a research institute unique in scope on a national scale. Its efforts are validated by generous grant funding from the National Institutes of Health as well as through its continuous stream of groundbreaking discoveries over the past decade. What exists now within this rich infrastructure is an opportunity to transform discovery in skin cancer research. CWRU plans four new centers exclusively dedicated to the study of skin cancer, which will complement existing centers of excellence in the Department. The emerging centers will include a melanoma center, a basal/squamous cell carcinoma center, a photo medicine center, and an environmental agent center.

The Skin Cancer Research Institute has an opportunity to be unique in the nation in its capacity to bring new therapies "from lab to life" by aligning specialized skills and catalyzing new knowledge through these centers.

The Stem Cell Ethics Center

216.368.0881

Insoo Hyun, PhD, Director

The CWRU Stem Cell Ethics Center (<https://case.edu/medicine/bioethics>) serves as a focal point for campus-wide and international interdisciplinary scholarship and education. Housed in the Department of Bioethics, the Stem Cell Ethics Center provides an avenue to educate policy makers, regulators, and the general public about stem cell research of all forms and their translation to clinical practice. The Stem Cell Ethics Center bridges ethics and biotechnology by providing ethical and technical support, as well as a forum for directed application of stem cell ethics in the complex array of cultural, social, political, and economic issues.

The Swetland Center for Environmental Health

216.368.5437

<http://casemed.case.edu/swetland/>

Li Li (li.li@case.edu), MD, PhD, Director

The mission of the Mary Ann Swetland Center for Environmental Health is to study the complex interplay between the environment and health. The center places special emphasis on investigating the environmental determinants of health disparity, and translating the findings into practices and programs that promote community and population health.

The environments in which we live, work and play have a great impact on our health. Environmental health embraces all the physical, psychosocial, and biological factors that affect health. Today, the Swetland Center continues Mary Ann Swetland's legacy, promoting awareness of the environment's disparate impact on disadvantaged populations.

The strategic vision of the Swetland Center is:

- Promoting translational environmental health research
- Integrating environmental health science into medical education
- Engaging the community in environmental health sciences

The Visual Sciences Research Center

216.368.4752

Irina Pikuleva, PhD, Director

Nancy Vitale, Administrative Manager

The Visual Sciences Research Center (VSRC) was founded at Case Western Reserve University in 1996 and its mission is to promote the study of basic and clinical problems of the eye and visual system, expectantly leading to improvements in the prevention and treatment of major blinding disorders. The VSRC now comprises a multidisciplinary and comprehensive research program in vision and ophthalmology, with 30 members in different departments including Ophthalmology and Visual Sciences (<http://case.edu/med/ophthalmology>), Pharmacology (<http://pharmacology.case.edu>), Chemistry (<http://chemistry.case.edu>), Medicine (<http://medicine.case.edu>), Molecular Biology (<http://case.edu/med/microbio>), Population and Quantitative Health Sciences (<http://epbiwww.case.edu>) (formerly Epidemiology & Biostatistics), Neurosciences (<http://case.edu/medicine/neurosciences>), Pathology (<http://case.edu/med/pathology>), Pediatrics (<http://casemed.case.edu/pediatrics>), and Proteomics (<http://proteomics.case.edu>). VSRC scientists study basic and clinical aspects of the eye and focus on Retinal Degeneration, Aging and Diabetes, Biochemistry of Aging Lens, as well Glaucoma. Also, through multidisciplinary and comprehensive research involving both basic and clinical departments, the VSRC seeks to advance the visual sciences at the University and to promote its efforts to the scientific community.

The VSRC is supported by a National Eye Institute (NEI) (<https://www.nei.nih.gov>) funded P30 Core Grant (EY11373) (<http://case.edu/med/ophthalmology/VisualSciencesResearchCenter.html/TheCOREModules.html>) and an NEI T32 Training Grant (EY007157), as well as generous contributions from both the university and University Hospitals.

The P30 grant supports four Core Modules, which enhance research quality in the most efficient and economical manner. The Core Modules are: Molecular Biology (<http://case.edu/>

med/ophthalmology/VisualSciencesResearchCenter.html/MolecularBiologyCore.html), Tissue Culture & Hybridoma (<http://case.edu/med/ophthalmology/VisualSciencesResearchCenter.html/TissueCultureHybridomaCore2.html>), Microscopy, Digital Imaging (<http://case.edu/med/ophthalmology/VisualSciencesResearchCenter.html/MicroscopyDigitalImagingCore2.html>) & Histology (<http://case.edu/med/ophthalmology/VisualSciencesResearchCenter.html/HistologyCore2.html>), and Specialized Animal Resources with a Vision Function submodule (<http://case.edu/med/ophthalmology/VisualSciencesResearchCenter.html/SpecializedAnimalResourcesCore2.html>). The provided services include genotyping, DNA cloning, paraffin or cryostat sections and slides, histological stains, high quality images, microscopy training, image analysis, maintenance and breeding of mice as well as *in vivo* eye imaging and testing. Each Core manager is very knowledgeable in his/her respective field. The P30 grant Core facilities provide first-rate service with quick turnaround times. Individual consultations are also available.

The T32 training grant offers the graduate course 'Biochemical and molecular aspects of vision' facilitated by Dr. Paul Park (<http://case.edu/med/ophthalmology/BasicResearch/PaulParkResearchPage2.html>). This course, listed under the graduate program of three VSRC basic science departments - Pharmacology (PHRM 432), Neurosciences (NEUR 432) and Pathology (PATH 432), is taught by VSRC investigators, and covers the major components of the eye, visual processing and disease conditions. The course is open to all students, although VSTP Training Grant awardees take this course in their first or second year of training. Together with the Core Grant facilities, the T32 Training grant has had the most profound influence on the development and growth of the VSRC by bringing young investigators into the field that have full access to Core Grant facilities for pre- and post-doctoral training.

The VSRC coordinates an annual seminar series (<http://case.edu/med/ophthalmology/Seminars/2016SeminarSeries.html>), which brings to campus renowned vision researchers on a regular basis during the academic year. An all-day annual symposium, held on the Medical School Campus, comprises an external keynote speaker, talks from the faculty, post docs, ophthalmology residents and training grant awardees as well as poster presentations. In addition, monthly VSRC Primary Investigator meetings are a forum for the VSRC members to discuss science on a regular basis. Also, members from each Ophthalmology research lab take turns presenting their research at monthly Departmental Ophthalmology Research meetings. These three seminar series and the symposium foster a multitude of opportunities for collaboration, in addition to bringing non-vision investigators into the field

Willard A. Bernbaum Cystic Fibrosis Research Center

216.368.6896

Mitchell Drumm, PhD and Michael Konstan, MD, Co-Directors
Constance May, Administrative Assistant

The Cystic Fibrosis Research Center is a translational center composed of investigators from Case Western Reserve University and University Hospitals of Cleveland. The Center's research is funded by over \$4 million in grants from the National Institutes of Health, the Cystic Fibrosis Foundation and other sources. The Center provides core facilities and services for investigators carrying out research related to cystic fibrosis, including a Clinical Studies core that provides clinical data for research studies and aids in IRB generation and study design, an Animal Models core that maintains the world's largest assortment of CF mouse models,

a Bioanalyte core that measures a range of biomolecules (proteins, lipids, mRNA) from blood, tissues or cell culture, an Animal Imaging core that uses such technologies as MRI, PET and SECT to generate high resolution images of rodents, a Biostatistical core to carry out complex statistical analyses of CF related studies, a Histology core that generates slide-mounted and stained sections of tissues from animal or human samples and a Cell Culture core that provides facilities and media for cultured cells. These cores facilitate translational, or "bench to bedside" projects that take very mechanistic, basic research on CF-related biochemistry and cell biology to *in vivo* studies in animal models and on to humans. Center members have access to all the cores as well as involvement in the weekly seminar series focused on CF or pediatric pulmonary research.

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