The Resources & Scientific Environment booklet provides general information on the comprehensive research environment at MUSC, including facilities & resources, scientific environment, early stage investigators, biohazards, and a brief synopsis of the institution.
Facilities and Resources

Research and Development Laboratories

Research buildings at MUSC include the Basic Sciences Building, a 7-story, 332,000 ft$^2$ laboratory complex that houses MUSC’s basic science departments; Darby Children’s Research Institute, a 7-story, 122,000 ft$^2$ building housing 14 multidisciplinary lab-based research programs, adjoining the Basic Science Building; the Thurmond Biomedical Research Building (STB), a 7-story, 180,000 ft$^2$ building that contains the Gazes Cardiac Research Institute as well as MUSC and VA research labs and shared facilities; and Walton Research Building, an 8-story, 56,600 ft$^2$ building housing research laboratories for Pathology, Otolaryngology-Head & Neck Surgery and Pharmaceutical Sciences. Two new research buildings opened in Fall 2011. Connected to the Basic Science Building via a pedestrian sky-bridge, the Drug Discovery and Bioengineering Buildings add 220,000 ft$^2$ for translational research, research training and in vivo experimentation. Buildings that include significant research laboratory space as well as clinical facilities include the Institute of Psychiatry with 9 basic science laboratories for alcohol and substance abuse research and a behavioral animal model facility; the Storm Eye Institute with a 40,000 ft$^2$ Vision Research Center; and the Hollings Cancer Center with a total of >200,000 ft$^2$ including 98,000 ft$^2$ dedicated to laboratory-based research. All laboratory investigators have well equipped modern laboratories with suitable space for students. Appropriate glassware and sterilization facilities are provided. All researchers at MUSC have access to shared equipment and standard resources such as ultra-low freezers, centrifuges, scintillation counters, and cold, warm, light-controlled and tissue culture rooms.

Darby Children’s Research Institute
The Darby Children’s Research Institute (DCRI), the most comprehensive pediatric research facility in the Carolinas, provides 122,000 ft$^2$ of wet laboratory research space. The Institute is home to research teams in eleven multidisciplinary programs that represent cardiobiology, neurosciences, cancer biology, pharmacogenetics, addiction research, pulmonary biology, proteomics, vitamin D metabolism, osteoclast biology, autoimmune and rheumatic diseases, and renal biology.

Gazes Cardiac Research Institute
The Gazes Cardiac Research Institute (GCRI) and the Strom Thurmond Research Building provides 113,416 ft$^2$ of research space and is a joint research building with the Ralph H. Johnson Veterans Administration Medical Center. The GCRI brings together a multidisciplinary group of investigators dedicated to understanding the biology of heart disease at the molecular level in order to promote the successful development of new therapies for heart disease. The shared facility houses a range of talented physician scientists and translational investigators conducting a wide spectrum of research that includes cellular and molecular investigation, physiological studies in model systems, investigator-initiated clinical research, population studies and large corporate and NIH multicenter clinical trials.
Clinical

MUSC Medical Center

MUSC Medical Center is a 709-bed tertiary and quaternary academic medical center consisting of MUSC University Hospital Authority; Ashley River Tower, a cardiovascular, gastrointestinal, and cancer specialty hospital; the Institute of Psychiatry; the Storm Eye Institute; and Children's Hospital. The Medical Center is supported by respected research-based medical and nursing schools, which deliver both routine inpatient care and highly specialized medical treatment and surgical procedures. Home to the region’s only Level 1 trauma center, the state’s most comprehensive neonatal intensive care unit, and the Transplant Center, MUSC serves as the principal referral center for physicians and patients of the region. The Medical Center is fully licensed by the South Carolina Department of Health and Environmental Control and has JCAHO accreditation with the “Gold Seal of Approval.” The Gold Seal of Approval™ attests that the accredited organization has demonstrated compliance to the most stringent standards of performance.

Medical Center data for the year ending June 30, 2015 include:

<table>
<thead>
<tr>
<th>Number of Licensed Beds (plus 50 Neonatal Special Care)</th>
<th>709</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Daily Census Rate</td>
<td>627</td>
</tr>
<tr>
<td>Annual Admissions</td>
<td>36,660</td>
</tr>
<tr>
<td>Number of Births</td>
<td>2,992</td>
</tr>
<tr>
<td>Number of Outpatient Visits</td>
<td>1,051,874</td>
</tr>
<tr>
<td>Number of Inpatient Surgical Procedures</td>
<td>19,981</td>
</tr>
<tr>
<td>Number of Outpatient Surgical Procedures</td>
<td>8,383</td>
</tr>
</tbody>
</table>

U.S. News & World Report ranked MUSC the top hospital in South Carolina for 2015 and among the best in the country when it comes to the treatment of ear, nose, and throat disorders. In addition to the national ranking for ENT, MUSC was categorized as a “high-performing” facility for the treatment of nephrology, neurology and neurosurgery, orthopedics, pulmonology and urology.

MUSC achieved Magnet Recognition by the American Nurses Credentialing Center in September 2015. Magnet Recognition, ultimate credential for high quality nursing, is a status held by only 7% of hospitals across the United States, and less than 1% of hospitals globally. The Magnet Recognition Program recognizes healthcare organizations for quality patient care, nursing excellence and innovations in professional nursing practice.

Medical Center Research Mission. The Medical Center mission is to provide excellence in patient care, teaching, and research in an environment that is respectful of others, adaptive to change, and accountable for outcomes. The Medical Center advances biomedical knowledge by serving as a setting for clinical and translational research, providing resources to conduct research, and offering opportunities for patients to participate appropriately in research and treatment protocols.

Hospital Accreditation. The most recent Joint Commission on Accreditation of Healthcare Organizations (JCAHO) survey in September 2006 resulted in full re-accreditation. MUSC Medical Center is fully licensed by the South Carolina Department of Health and Environmental Control (SC DHEC).

Access to Patients. The MUSC Medical Center has managed care contracts with all major commercial payers in its area. The tri-county Charleston area is the state’s fastest growing region with a population of 665,000 in the primary area and another ~500,000 in the secondary market. A quarter of the state’s senior population lives in these catchment areas. As South Carolina’s premier health care center, MUSC receives statewide and regional referrals through consortium hospitals, satellite clinics, and an extensive network of referring physicians. Data regarding inpatient and outpatient activity are provided above.
Clinical Trials. The South Carolina Research Studies Directory, SCResearch.org, enables South Carolinians to participate in research opportunities and novel treatment options available at MUSC as well as many of the other state’s hospitals. Participation in these treatment options (i.e., clinical trials) allows individuals to play an active role in their own health care and access new treatments before they become widely available. It also allows individuals to help others that may benefit in the future from their contribution to medical research.

Clinical Data Management System
MUSC has an integrated electronic health record (EHR) system that aligns patient access, patient management, revenue cycle, clinical systems and research. Our integrated EHR optimizes process efficiency and improves quality at each step of the continuum of care across the entire health-care system. In addition to in-house applications, there is now an active patient portal and a new portal for referring physicians. The system also provides additional levels of security and authentication for users and follows the Health Insurance Portability and Accountability Act for privacy and compliance.

Ashley River Tower
Ashley River Tower is a 641,000 square-foot facility that opened in 2008. The 156-bed hospital houses the inpatient units for Hollings Cancer Center, the Digestive Disease Center and the Heart and Vascular Center service lines. The facility includes three intensive care units; laboratories; interventional radiology and endoscopy suites; a specialized chest pain center; and nine operating rooms with integrated IT systems and specialized equipment for vascular surgery.

Hollings Cancer Center
The Hollings Cancer Center at the Medical University of South Carolina is the largest academic cancer center in South Carolina. It is the state’s only National Cancer Institute (NCI) - designated cancer center and one of fewer than 70 in the U.S. As the state’s foremost cancer treatment and research center, Hollings Cancer Center unites more than 200 experts in treatment, research, education, prevention and control, and outreach to address South Carolina’s significant cancer problem. The Center’s resources extend throughout South Carolina via partnerships with other healthcare organizations, ensuring that all patients in the state have access to our innovative and compassionate care. For the 27,000 South Carolinians who will be diagnosed with cancer this year, the Hollings Cancer Center is leading the way in changing what is possible in cancer care.

MUSC Children’s Hospital
MUSC Children’s Hospital is the largest and most comprehensive pediatric medical center in South Carolina. Our health system covers the state with an extensive network of physicians, health care professionals and services – all dedicated to children. MUSC Children’s Hospital has again been ranked as a “best hospital” for children’s heart and nephrology programs in U.S. News & World Report’s 2015-16 edition of America’s Best Children’s Hospitals.

The MUSC Children’s Hospital is dedicated to enhancing the health of children throughout South Carolina and to providing an environment that supports excellence in pediatric patient care, teaching, and research. The Children’s Hospital offers a full range of age-specific care. It is South Carolina’s largest and most comprehensive pediatric healthcare center, offering the only Level III neonatal intensive care unit in the region and the only Children’s Emergency Department in South Carolina. MUSC Children’s Hospital consistently earns high rankings from American Health Magazine and Best Doctors of America. The health system consists of a comprehensive network of primary care physicians, specialists, surgeons, and service providers who provide a variety of services and programs, including the Child Life Program, Community Outreach, Emergency and Transport Services, Pediatric Burn Center, Prenatal Wellness Center, Transplant Programs, and Trident Area SAFE KIDS, as well as specialty care in more than two dozen medical, surgical and psychiatric areas.

Ralph H. Johnson Veteran’s Administration Medical Center
The Ralph H. Johnson VA Medical Center, opened in 1966, is a leading primary, secondary, and tertiary care facility located in Charleston, SC, serving over 55,000 Veterans along the coast of South Carolina and Georgia. The 117-
The VA Research Program contributes significantly to the recruitment and retention of highly specialized clinical staff, many of whom are involved in research studies. Charleston VAMC’s Research and Development Service has a rich and sustained portfolio of innovative basic and clinical projects with an emphasis on translating research findings into cutting edge clinical practices for Veterans. In FY 2015, Charleston VAMC received over $11 million in VA funding and over $10.9 of non-VA funding. Currently, there are 100+ research investigators involved in more than 300 research projects concerned with a broad range of health problems, most of which are prevalent in the Veteran patient population. The Council on Accreditation of the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) commended the work of the Charleston VAMC for providing and maintaining an excellent program of laboratory animal care and use and renewed full accreditation. This station has a VA non-profit research corporation, Charleston Research Institute, for accepting gifts, donations and grants to be used for VA research.

Significant areas of research include:

- Basic Research in Cardiology, Endocrinology, Diabetes Mellitus, Hematology/Oncology, Regeneration Medicine, Rheumatology, Nephrology and Alcohol-Related Disorders.
- Clinical Research in Mental Health, tele-mental health, PTSD, Hypertension and Aging
- Health Services Research in rural health and health disparities
- Rehabilitation research in stroke injury and tele-rehabilitation

The research program has also obtained and maintained accreditation of their animal program through the Association for the Assessment and Accreditation of Laboratory Animal Care (AAALAC), with re-accreditation accomplished in 2014.

Charleston VAMC’s research program is respected for the volume of VA and NIH funded research and its history of obtaining prestigious recognition such as the recently-awarded Charleston Health Equity and Rural Outreach Innovation Center (HEROIC) from the Health Services Research program. The Center of Innovation research focuses on disease prevention and health interventions for diverse populations. Outpatient clinical/translational research activities are housed in a dedicated 2,800 square foot Clinical Research Unit (CRU) on the 2nd floor of the VAMC. The CRU has 10 examination rooms, a 4-station transfusion room, a 3-station physician workroom, a waiting room and a general laboratory with, centrifuge, several refrigerators, and a microscope. The CRU also includes a sterile specimen storage facility, staff offices, and break- and workrooms. Construction for a new mental health research building broke ground in 2013 and was recently completed in the summer of 2015. The final design reflects 14,929 of useable square footage of research space including: 5 wet labs, 27 exam rooms at 120 SF each, 9 office at 120 SF, record storage at 350 SF and miscellaneous other space. The Mental Health Research building was designed to have 4 additional levels in the near future. Numerous VA investigators have also received national awards for excellence such as the Wigger’s Award from the American Physiological Association, the Life time Achievement Award from the American Diabetes Association and most recently an award from the NIH.
Protection of Human Subjects

Participation of human subjects in research is under the jurisdiction of federal regulations (45 CFR 46 and 21 CFR 50 and 56). MUSC investigators are granted the privilege of working with human subjects under normal assurance to the government that such research complies with regulations protecting human subjects. The university has a federal-wide assurance for research with human subjects (FWA 00001888, expires 07/21/2019), and is in compliance with federal policy governing use of human subjects. Individuals involved in human subject research at MUSC are required to complete the Collaborative IRB Training Initiative (CITI) offered on-line by the University of Miami. All human subject protocols are reviewed through an academic Institutional Review Board (IRB) process that has been accredited by the Association for Accreditation of Human Research Protection Programs (AAHRPP). The MUSC Office of Research Integrity (ORI) coordinates the activities of three IRB committees, involving faculty members as well as representatives of the business, legal, ethical, religious, and civic communities. These committees are registered at: http://ohrp.cit.nih.gov/search/search.aspx. The MUSC IRB serves as the university affiliate for the Ralph H. Johnson VA Medical Center, which is accredited by the National Committee for Quality Assurance.

Compliance

The MUSC University Compliance Program is a proactive program designed to promote full compliance with all applicable policies, procedures, laws and regulations. This involves a confidential Compliance Helpline to encourage all members of the MUSC community to ask questions or voice concerns about laws and regulations on such topics as coding and billing, research integrity, professional ethics, human subject/animal research, biological safety, conflict of interests, and patient/subject confidentiality. The Compliance Office proactively trains employees, monitors high-risk activities, and facilitates discovery of concerns, followed by appropriate investigation and corrective action where appropriate. This program directly assists MUSC’s management at all levels in maintaining and enhancing an environment where ethics are paramount considerations in strategic and operational decisions throughout the organization.

Animal

Care and Use of Vertebrate Animals in Research

The Division of Laboratory Animal Resources (DLAR) centrally manages the University's animal care program. The Institutional Animal Care and Use Committee (IACUC) is independently chartered and appointed by the President and is fully independent of DLAR. The IACUC reports to the Vice President for Academic Affairs & Provost. Committee functions are staffed by the Office of Research Integrity under the direction of the Associate Provost for Research. The IACUC is responsible for review of all proposals using lab animals at the university as well as oversight of the programs and policies associated with animal use. The committee meets monthly to review and approve animal protocols and address other issues. It performs semiannual inspections and review of the DLAR programs and facilities for compliance with PHS, USDA and Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) regulations. To help the IACUC in monitoring the conduct of animal-based research and proactively assist investigators in establishing and maintaining good practices, MUSC also has a program for Post-Approval Monitoring of Animal Use (PAMA). A designated Animal Research Compliance Liaison works with the MUSC investigators and the individuals who handle animals in their laboratories to ensure that the highest level of animal care is maintained and that all research involving animals is conducted with appropriate IACUC review and approval.

MUSC has been fully accredited by the AAALAC International since 1987, with an unbroken record of compliance with regulatory inspections by the U.S. Department of Agriculture (USDA). MUSC’s Animal Welfare Assurance number is A3428-01 (expires 04/30/16).
Computer

Office of the Chief Information Officer – Information Services (OCIO-IS)

MUSC Information Services, a division of the Office of the Chief Information Officer, manages the campus-wide data and voice communication network as well as other core infrastructure systems and applications, with high-speed Ethernet network and Internet support with wireless access throughout the campus. Main infrastructure systems include Microsoft Exchange email, file storage, web servers, calendars, network identification and account maintenance, network time protocol, domain name system, and directory services. Core academic applications include the MUSC Library System, OVID, WebCT, SYBYL (molecular modeling), and GCG (gene sequence research). Core financial and administrative applications include GL, AP, financial reporting, purchasing, payroll, and human resources.

Access outside the MUSC firewall requires a VPN with two-factor verification. Free encryption service is provided for all laptops. Other data security elements include enterprise Public Key Infrastructure (PKI) service, advanced intrusion detection systems (IDS), Security Information and Event Management system (SIEM), and virtual machines (VMs) for research data management and analysis. Enterprise-wide process improvements include network access control, technical vulnerability management program and Data Center physical security. The MUSC Data Center is manned 24x7 by operations staff who monitor all servers, environmental conditions, and notify appropriate personnel as needed.

A card access system and 24-hr security cameras at each door entering and within the center protect the entire Data Center. Weekly full-verified backup, daily differential verified backup and every-6-hr transaction log backup are captured by IBM® TSM system, Microsoft® Volume Shadow Copy service and Microsoft® SQL server, so that a new system can be restored using the backup tapes/files with minimal data loss in case of a catastrophic failure to a web or database server. The university system is backed up on a nightly basis, data files are written initially to disk and staged to tape. Copies of the tapes are rotated offsite to vital records (3 months of taped backups are available at any given time). In the event of hurricanes or other natural disasters, two forms of backups will be performed to ensure that data are not lost: 1) the OCIO-IS system will keep timely backups available at the remote site, and 2) project personnel will be instructed to bring updated copies of their data on external hard-drives if evacuated.

Office

Office areas at MUSC are well lighted ventilated and appointed for scholarly activities, paperwork, and modes of communication (voice, data, analog, digital, etc.) that are common and appropriate at a contemporary health professional university and academic medical center. Competent support staff and all standard office services and software are readily available to facilitate the academic and scientific activities of faculty, trainees, and technical staff.
Other Resources - Cores & Facilities

The Medical University of South Carolina has more than 35 state-of-the-art shared research facilities physically housed in and administered by its departments, centers, and institutes. Clinical research faculty basic scientists, and students all benefit from the shared access to and cost of these research laboratories. Through these diverse resources, MUSC provides access to equipment and instrumentation, technical expertise and training and education all designed to support innovative, cutting edge research.

- Antibody Facility
- Biomedical Imaging
- Biorepository & Tissue Analysis Shared Resource
- Biostatistics & Epidemiology Collaborative Unit
- Biostatistics Shared Resource (HCC)
- Brain Stimulation Core
- Cell Evaluation & Therapy Shared Resource
- Cell & Molecular Imaging Shared Resource
- Cell Growth & Therapy Unit
- Clinical Trials Office
- Computational Biology Resource Center
- Confocal & Multiphoton Microscopy Unit
- Data Coordination Unit
- Flow Cytometry Facility
- Flow Cytometry & Cell Sorting Unit
- Fluorescence Imaging Plate Reader Facility
- Gene Function Core
- Genomics Shared Resources
- Gnotobiotic Animal Research Facility
- Irradiator Facility
- Laser Capture Microdissection Facility

- Lipidomics Shared Resources
- Lipidomics Core
- Mass Spectrometry Core
- Mass Spectrometry Facility
- Metabolomics Core Facility
- Mineralized Tissue Facility
- Molecular Modeling
- Molecular, Morphology and Imaging
- Nephrology Proteomics Laboratory
- Nuclear Magnetic Resonance Facility
- Neuroimaging Core
- Oral Preclinical Research Facility
- Protein Science Translation Core
- Proteogenomics Facility
- Proteogenomics and Bioinformatics Core
- Seahorse Bioscience Academic Core Facility
- Quantitative Behavioral Assessment and Rehabilitation Core
- shRNA Shared Technology Resource
- Small Animal Imaging Unit
- X-Ray Crystallography Resource

Antibody Facility

The MUSC Antibody Facility provides monoclonal antibodies to proteins or peptide. Depending on the desire of the requester, the sera, cell line, cell culture supernatants, ascites, purified immunoglobulins or all of the above are provided. Monoclonal antibodies are derived from mice immunized with a particular immunogen or derived from autoimmune mice spontaneously producing antibodies to the antigen of interest. In specific instances of a polyclonal antibody that has been difficult to derive, the facility will aid in this process. Technical assistance in selecting the antigen for injection is also offered. We also provide services to generate phage display libraries for selection of antibodies.
Biomedical Imaging
The Center for Biomedical Imaging (CBI) provides state-of-the-art imaging resources to support clinical and research activities, provide opportunities to advance the imaging field, disseminate new technologies and approaches to the larger community, and train and mentor young investigators interested in developing and applying biomedical imaging to clinical and research problems. The mission of the CBI is to maximize the impact of imaging at MUSC by providing leadership and infrastructure that enables the university to address local and national priorities and developing regional and national collaborations that strengthen capabilities and enhance the university's image. The CBI also provides opportunities for basic and clinical scientists to collaborate and discover new ways to study diseases and disease processes, to develop and apply this knowledge to clinically relevant research, and to translate advances to the community.

The CBI includes approximately 4500 square feet of space at 30 Bee Street, as well as approximately 9000 square feet in the Bioengineering Building. Space at 30 Bee Street is the main facility for human imaging research and houses a Siemens 3T TIM Trio MRI scanner equipped with integrated fMRI paradigm presentation equipment. The scanner operates with a 100% mandate for research use and is covered by a master research agreement with Siemens Medical. The site also contains an image analysis laboratory and bioengineering facility along with subject interview and changing rooms. Researchers also have access to clinical Siemens 1.5T and 3T Verio MR scanners, located within the Radiology Department in the Clinical Sciences Building. The space at the Bioengineering Building house offices, wet and dry labs, classrooms, an auditorium, a Bruker 7T/30 animal MRI system, a bioluminescence imager, and a Siemens micro PET/CT scanner. There is also an animal quarantine room within the imaging center itself dedicated to holding animals that have been imaged.

Biorepository & Tissue Analysis Shared Resource
The Biorepository & Tissue Analysis Shared Resource at MUSC and the Hollings Cancer Center provides investigators with access to meticulously collected and annotated human specimens as well as advanced human and animal tissue analyses that require state-of-the-art instrumentation and expertise. The shared resource is comprised of several integrated components: biospecimen and data repository, customized and readily available tissue microarrays, laser capture microdissection, matrix-assisted laser desorption/ionization tissue imaging, and research pathology services such as histologic analysis of fixed, frozen, and stained tissues and analysis of experimental results.

Biostatistics & Epidemiology Collaborative Unit
The Collaborative Unit, housed within the Department of Public Health Sciences, is a university-wide resource facility providing expert consultation in biostatistics, bioinformatics, and epidemiology. Services include assistance in design of observational studies and experiments; selection of data collection instruments and data management systems; selection, application, interpretation, and reporting of epidemiological, bio-mathematical, environmental risk assessment, and statistical methods; graphical analysis of data; sample size estimation; and selection of statistical, graphical and database software packages. The unit assists in preparing the biostatistical and epidemiological narratives associated with grant proposals, and with presentations and publications following the research. The unit supports faculty across campus to develop competitive grant applications, and it also provides a training experience for DPHS trainees interested in developing skills in applying quantitative tools.

Biostatistics Shared Resource
The Biostatistics Shared Resource at the Hollings Cancer Center provides biostatistical support to cancer center investigators. The primary mission includes study design and statistical analysis. Biostatistical support is essential for cancer researchers to develop rigorous study designs to efficiently manage data, and to make maximum use of data collected for informed conclusion. Early statistical input into the design of experiments increases the efficiency of investigations and improves the quality of research. The resource provides services that span all types of cancer research including cancer clinical trials, cancer prevention studies, epidemiologic studies, animal studies, and other laboratory studies. Hollings Cancer Center members are encouraged to utilize Biostatistics Core
resources for development of cancer related grants and protocols (to be submitted to federal as well as private agencies), and help in answering the biostatistical related questions and suggestions of the external reviewers.

**Brain Stimulation Core**

Brain Stimulation Core (BSTIM) provides direct support to the investigators of the South Carolina Research Center for Recovery from Stroke COBRE. The Core supports a unique activity for SCRCRS, building on strengths at MUSC. BSTIM methods are used to measure brain function, excitability and plasticity as well as to induce brain changes to potentially treat damage caused by stroke. Thus, BSTIM tools may be used for quantitative measurement or as plasticity modifying agents, or both. The overall goal is to establish BSTIM as a signature resource to provide essential expertise for SCRCRS investigators and develop unique tools, methods and potential treatments to enhance their research.

**Cell Evaluation & Therapy Shared Resource**

The Cell Evaluation & Therapy Shared Resource offers the Hollings Cancer Center (HCC) investigators comprehensive analytic flow cytometry and high-speed cell sorting services and the capacity to generate human cellular and tissue-based products for use in translational research. The mission of the Shared Resource is to provide an integrated platform where HCC users can evaluate pre-clinical or clinical experimental data in a cell-specific manner and then convert this knowledge using the cell-manufacturing facility to take a cellular product into patients. Immune monitoring services are embedded in this resource and make use of flow cytometry and other technologies that can be used to evaluate the immune response in patients and provide valuable data needed for more basic laboratory investigations in animals or tissue culture. The Shared Resource consists of two synergistic and coordinated units – the Flow Cytometry and Cell Sorting Unit and the Cell Growth & Therapy Unit.

**Cell & Molecular Imaging Shared Resource**

The Cell and Molecular Imaging Shared Resource provides members of the Hollings Cancer Center (HCC) with a fully supported suite of state-of-the-art imaging capabilities. These capabilities include imaging at the cellular, tissue, intravital, and in vivo whole animal levels. The CMI Shared Resource consists of two synergistic and coordinated units – the Confocal & Multiphoton Microscopy Unit and the Small Animal Imaging Unit.

In addition to providing state-of-the-art imaging, the shared resources provides consultation and assistance concerning experimental design, sample preparation, probe selection, data analysis for imaging applications, and transitioning microscopic evaluations to whole animal imaging. Investigators receive in depth training in multiple imaging modalities and education in the fundamentals of imaging technology and its application. The Cell and Molecular Imaging Shared Resource is also a part of the Center for Cell Death, Injury and Regeneration.

**Cell Growth & Therapy Unit**

The Cell Growth & Therapy Unit staff has extensive experience in all aspects of cellular therapy and Good Manufacturing Practice, cGMP, Phase I/II manufacturing of autologous cellular products. These include cGMP handling of blood components; dendritic cells, mesenchymal stem cells, T-cell & immunotherapy expertise; and clinical experience in transplantation and cellular therapies. In addition to technical expertise, extensive QA/QC and regulatory experience are available to ensure FDA compliance during the development of each specific cellular product. The Unit is dedicated to scaling up translational studies within the HCC and supporting investigator-initiated clinical trials involving cellular therapy. Support includes technology transfer from the research laboratory to the clinical setting as well as scale-up and validation studies. Additional services are available for Immune Monitoring.

The Cell Therapy Unit consists of three components: a 200 ft² Process Optimization Lab, a 200 ft² materials Management/QC Laboratory, and a 1000 ft² clean room suite comprised of manufacturing rooms, general processing area, storage, gowning and de-gowning areas. The cGMP clean room suite contains three annually certified ISO 14644-1 compliant Class 6 manufacturing rooms. Each of these is a fully functional processing laboratory. In addition, each room contains at least one Class 5 Biological Safety Cabinet (BSC) for performing open system sterile processing. The largest of these rooms contains two BSCs. Additional processing equipment
includes two COBE 2991 automatic cell processors, a CliniMacs for subset isolation, and centrifuges enabling cell separation. Multiple CO2 incubators and inverted phase microscopes allow all phases of cellular isolation, culture, differentiation, and packaging of final product to be performed inside the clean room environment. An in-lab Accuri C6 flow cytometer is available for cell subset identification and analysis. Sterility testing, including mycoplasma and endotoxin, is performed as required per FDA guidelines. In addition, this laboratory has dedicated refrigerated centrifuges, incubators, microscopes, a Cole Parmer sterile tube welder/sealer, a tabletop autoclave, and controlled rate and cryogenic storage freezers.

Clinical Trials Office
The Hollings Cancer Center (HCC) Clinical Trials Office (CTO) provides a centralized office for the conduct of cancer clinical trials at the MUSC. The purpose of the CTO is to provide an effective and efficient clinical research infrastructure to support investigators and clinicians in developing and implementing clinical research studies. This shared resources provides training and education relevant to all aspects of study management to clinical staff and new investigators. Other services include:

- Assistance for HCC Principal Investigators in the activation and administration of studies
- Centralized support for scientific, ethical, financial and operational reviews and ongoing management
- Communication of the availability of clinical studies to HCC physicians, referring physicians and the public
- Preparation of records for internal and external quality and compliance audits
- Assistance for clinicians in screening and enrolling patients for clinical research studies
- Coordination of the completion of patient-specific study requirements
- Data management support for clinical research studies
- Multi-center management support services for investigator-initiated trials

For a full listing of current clinical trials, please search our Clinical Trials Database.

Collaborative Unit
The Collaborative Unit, housed within the Department of Public Health Sciences, is a university-wide resource facility providing expert consultation in biostatistics, bioinformatics, and epidemiology. Services include assistance in design of observational studies and experiments; selection of data collection instruments and data management systems; selection, application, interpretation, and reporting of epidemiological, bio-mathematical, environmental risk assessment, and statistical methods; graphical analysis of data; sample size estimation; and selection of statistical, graphical and database software packages. The unit assists in preparing the biostatistical and epidemiological narratives associated with grant proposals, and with presentations and publications following the research. The unit supports faculty across campus to develop competitive grant applications, and it also provides a training experience for DPHS trainees interested in developing skills in applying quantitative tools.

Computational Biology Resource Center
The Computational Biology Resource Center (CBRC) is a state-of-the-art computational infrastructure for scientists to apply advanced computer algorithms to biological problems. Toward reaching this goal, the CBRC has purchased and maintains a 16 node 132 CPU computing cluster combined with multi terabit storage capacity. The cluster is a LINUX-based system aimed at supporting a host of biodatabases as well as applications in drug discovery, NMR, x-ray crystallography, DNA microarray analysis, bioinformatics, image analysis and molecular modeling.

Confocal & Multiphoton Microscopy Unit
The Confocal & Multiphoton Microscopy Unit of the Cell & Molecular Imaging Shared Resource provides live cell imaging of parameter-sensitive fluorophores, high resolution imaging of tissue sections for immunocytochemistry and fluorescent protein distribution, fluorescence resonance energy transfer (FRET) and fluorescence recovery after photobleaching (FRAP) to characterize and quantify interactions between specific molecules and their mobility, and intravital microscopy to monitor microcirculation. This resource is equipped with the following instruments:
• Zeiss LSM 510 NLO META multi-photon laser scanning confocal/multiphoton microscope
• Zeiss LSM 510 META: Similar to the above microscope with the exception of the multiphoton capability
• Olympus Fluoview FV10i LIV
• Olympus FV1200 MPE
• Leica TCS SP2 AOBS
• Fluorescence Plate Reader

Data Coordination Unit (DCU)
The Data Coordination Unit (DCU), housed within the Department of Public Health Sciences provides assistance with the design of clinical trials and analysis of their data and in establishing, implementing and maintaining data and project management systems for multicenter clinical trials. The DCU has expertise in the design and conduct of Phase I through III trials in a variety of therapeutic areas including neurology, digestive diseases, psychiatry, and diabetes, as well as trials conducted under FDA Investigational New Drug/New Device applications. All trial management activities are conducted using the DCU’s internally developed Clinical Trials Management System (CTMS) referred to as the WebDCU™ system. The WebDCU™ offers a full collection of web-enabled modules for central randomization, protocol and site management (e.g., drug accounting and shipping, automated SAE reporting, regulatory document tracking), study monitoring, safety reporting, data entry and validation, and report generation. The system provides a web-based collaborative environment for study team members across all participating clinical sites and provides all the required tools for site coordination and data management in one efficient and easy to use system.

Flow Cytometry Facility
Flow Cytometry Facility serves to provide information and encourage individual researchers to bring their expertise in cell proliferation, extracellular signaling, intracellular signaling, cell adhesion, cell migration, or gene regulation to bear on studying the biological properties of stem cells. This facility offers technical information and training to guide investigators in using stem cells to enhance their individual research interests or scientific expertise. Through this facility, investigators can arrange training and tutorials in procedures to isolate, clone, store, and culture stem cells from adult bone marrow, cord blood, or established cell lines.

Equipment available to the facility includes: Becton Dickinson FACSVerage flow cytometers with five fluorescent detectors for use in complex cell sorting; tissue culture hoods and incubators; a Cryomed Programmatic Cell Freezing system with an MVE Cryogenic Liquid Nitrogen Freezer for keeping cells long-term; and computer workstations for visiting faculty and students.

Flow Cytometry & Cell Sorting Unit
The Flow Cytometry & Cell Sorting Unit of the Cell Evaluation and Therapy Shared provides comprehensive analytic flow cytometry and high-speed cell sorting services to Hollings Cancer Center (HCC) investigators. The facility staff members have considerable expertise in high-speed sorting of rare populations of cells including stem/progenitor cells and epitope-specific T cells and are continually expanding the repertoire of available techniques to meet the needs of the innovative research within the HCC.

This resource offers a wide range of services from access to routine flow cytometric analysis to expertise in high-speed cell sorting to the development of novel assays. Examples of assays available include, but are not limited to: immunophenotyping, cell cycle analysis, DNA ploidy analysis, apoptosis, cell proliferation (BrdU incorporation), intracellular antigen/protein and membrane potential measurement, as well as cytokine detection (bead assay). High-speed cell sorting based on cell surface marker immunostaining and/or side-population staining is also available.

Facility supports the following equipment:
• Becton Dickinson FACSVerage
• Becton Dickinson FACSCalibur Analytical Flow Cytometer
• Becton Dickinson LSRFortessa Analytical Flow Cytometer
- Becton Dickinson FACSAria IIU Cell Sorter
- Beckman Coulter MoFlo XDP High-Speed Cell Sorter

**Fluorescence Imaging Plate Reader Facility - (FLIPRTETRA®)**

The FLIPRTETRA® purchased through a shared instrumentation award obtained from NIH under the American recovery and Reinvestment Act of 2009 (NCRR 1S10RR027777-01) is an industry-renowned instrument for monitoring GPCRs and ion channels. The system provides a reliable and flexible high throughput screening solution for identifying early leads in the drug discovery process. FLIPRTETRA®, features 96, 384 and optional 1536 well configurations, multi-wavelength kinetic readings, LED modules and user configurable excitation and emission filters, and enhanced luminescence sensitivity with the aequorin luminescence camera. With the user configurable LED excitation modules, the FLIPRTETRA® has been used for the following assays: membrane potential, intracellular pH, sodium and calcium, reactive oxygen species, nitric oxide, c-AMP (utilizing GLO-sensor cells; Promega, Inc) and others. The FLIPRTETRA® is optimized for use with both fluorescent and luminescent assays, including assaequorin and Molecular Devices’ no- wash FLIPR® calcium and ion channel assays.

Experiments must be pre-consulted with Dr. Tom Morinelli, facility manager, to assure that they are feasible and that the proper dyes are available. All disposables are provided by user (plates, dyes, buffers). Subsequent to initial training session, reservations can be made utilizing the on-line calendar. The FLIPRTETRA® facility is located in room 519 Strom Thurmond Biomedical Research Center.

**Gene Function Core**

The Gene Function Core (GFC) mission is to support investigators in the application of genetically modified mice or rats by providing the following services: (1) Expertise and technology required to generate DNA constructs for the production of genetically modified mice or rats; (2) Generation of genetically modified mice/rats by both “typical” transgenic and ES approaches, or CRISPR/Cas; (3) Sperm cryopreservation and strain rescue; and (4) Xenograft experiments for cancer researchers. This Core integrates two existing state-of-the-art intramural core facilities, the Transgenic Facility and the Gene Targeting Facility, with mentoring and training to facilitate the application of mouse models. The Gene Function Core generates genetically modified mice by pronuclear injection of the fertilized zygotes and offers gene "knockout", Cre-conditional knockout mice, and production of genetically mutant mice containing site-specific mutations (ranging in size from 1bp to over 100 Kbp). The Core now offers the possibility of making genetically modified mice in the C57BL/6 strain to eliminate the time-consuming process of genetic backcrosses and to facilitate assessment of genetic modifier effects.

**Genomics Shared Resource**

The Hollings Cancer Center Genomics Core Facility at MUSC offers state of the art next generation sequencing (NGS) including DNA-Seq, RNA-Seq, ChIP-Seq, Methyl-Seq, Targeted sequencing utilizing Illumina HiScanSQ and Ion Torrent instrumentation. In addition to NGS, Bead-Array analyses for GWAS, RNA expression and other analyses are available.

This Shared Resource supports the following equipment:

- Illumina HiScanSQ micro-array scanner and HiSeq sequencer
- Illumina cBot Cluster Generation System
- Ion Torrent PGM sequencer
- Ion One Touch System
- Agilent ® 2200 TapeStation
- Sage Science Pippin Prep
- Diagenode Bioruptor UCD-600 TS
- QuBit Fluorometer
- IBM compute analysis, storage cluster

**Gnotobiotic Animal Research Facility**

The Gnotobiotic Animal Research Facility provides MUSC investigators and others a unique opportunity to conduct research with germfree or "gnotobiotic" animal models, in addition to more widely available specific-
pathogen-free animal models. Located in the Darby Children's Research Institute, the facility is a joint initiative of
the College of Dental Medicine, Center for Oral Health Research (COHR), University Research Resource Facilities
program, and the Division of Laboratory Animal Resources (DLAR). A range of services are provided including: 1) derivation of new strains of mice into the germfree state; 2) germfree colony maintenance and management; and 3) production of germfree and defined flora mice.

**Irradiator Facility**
The Irradiator Facility serves as a shared resource for the MUSC and under the direction of the Radiation Safety Office. The facility contains a JL Shepherd Model 143 137 Cesium irradiator. This equipment is designed to irradiate biological samples at variable doses. Adapters allow exposure for both tissue culture samples and small rodents.

**Laser Capture Microdissection Facility**
The state-of-the-art technology of Laser Capture Microdissection (LCM) Facility provides researchers with the ability to accurately analyze DNA, RNA and protein from pure populations of cells, such as tumor cells that are captured from complex heterogeneous tissue samples. Protocols have been developed and optimized for acquisition of high-quality RNA and DNA from both frozen and formalin-fixed, paraffin-embedded tissue. Care is taken to preserve the integrity of the samples at all times, ensuring high quality retrieval of molecular targets.

Services provided in the LCM facility include:
- Laser Capture Microdissection of pure populations of cells
- DNA/RNA/protein extraction and QA/QC from microdissected samples
- RNA/cDNA Amplification from microdissected, frozen, and FFPE tissues
- Support for grant applications by providing LCM budgets and support letters

The establishment of the LCM shared resource is a combined effort of the College of Dental Medicine Center for Oral Health Research and the Hollings Cancer Center Tissue Biorepository. The Center for Oral Health Research provided significant support such as LCM equipment and partial salary support for LCM personnel. The LCM shared resource is housed in the Tissue Biorepository at Hollings Cancer Center, and is equipped with an ArcturusXT LCM system, Agilent Bioanalyzer, Leica CM 1850 Cryostat, and a Microm HM340E Microtome, which are available for a wide range of applications. Viability of the IR laser-enabled LCM technique has been shown for a variety of different cell types.

The LCM procedure is remarkably simple and robust. The method is extraordinarily gentle and ideal for microdissection of single cells or small numbers of cells. The LCM system utilizes a laser microbeam that melts a thermoplastic membrane that sticks to the selected cells, which can then be lifted and secured in a microfuge tube containing the appropriate extraction solutions. The transferred tissue on the film retains its original morphology, thereby allowing microscopic verification of the specificity of the captured material. Using this strategy, a single small cluster up to thousands of cells can be procured safely and without contamination. The Agilent 2100 Bioanalyzer and Nanodrop ND1000 monitor the quality and quantity of extracted RNA, DNA, as well as proteins from the LCM sample.

**Lipidomics Shared Resource**
The Lipidomics Shared Resource represents a novel scientific service that is unique to the Medical University of South Carolina and the Hollings Cancer Center. The Lipidomics Shared Resource builds on unique expertise at MUSC in sphingolipid biology, chemistry and analysis and their role in signal transduction and cell regulation. Sphingolipid metabolism assumes a key role in the complex mechanisms regulating cellular stress responses to environmental changes. Several sphingolipid metabolites act as bioactive molecules, and their individual contribution to the regulatory pathways that govern cell growth are being established. This offers promises for new molecular insights into tumor growth and metastasis and emphasizes the needs to analyze sphingolipid components, examine sphingolipid chemistry and regulation of sphingolipid metabolic pathways. Monitoring
changes in sphingolipid composition in normal and cancer environments will provide one of the missing links in
the search for a novel and effective therapy.

The Lipidomics Shared Resource includes analytical and synthetic units. Resource personnel provide conceptual
and practical training in various aspects of lipidology, qualitative and quantitative analysis of lipid components
from different biological materials (cells, tissue, biological fluids), synthetic molecular tools to study lipid
metabolism (functionalized and fluorescent ceramides, site-specific radioactive sphingolipids), diversified
synthetic lipids and analogs for cellular, in vitro, and in vivo studies (organelle-targeting sphingolipids and
organelle-targeting inhibitors of sphingolipid metabolizing enzymes). Resource personnel also assist investigators
in experimental design, selection of lipid of interest and interpretation of the analytical results. Analytical
approaches are based on High Performance Liquid Chromatography-Tandem Mass Spectrometry (LC/MS)
technology. This sensitive and specific analytical methodology can be applicable to a broad spectrum of diversified
chemical compositions of sphingolipids and glycerolipids.

The Lipidomics Shared Resource has five functional chromatography/MS units that all use dual ionization modes:
electrospray ionization (ESI) and atmospheric pressure chemical ionization (APCI).

- Four ThermoFisher TSQ Quantum triple-stage quadrupole mass spectrometers with super high pressure
  HPLC systems.
- A SCIEX 2000 Q-Trap triple quadrupole/ion trap combination instrument with outstanding sensitivity for
  improved detection limit and mass resolution connected to supercritical fluid chromatograph that allows
  separation and analysis of molecular species of GluCer and GalCer.
- Instrumentation for lipid sample preparation and MS analysis: Atlas nitrogen generator for providing a
  steady supply of high purity nitrogen for optimal performance for both MS instruments, Savant speed-
  vacuum evaporator, two nitrogen evaporators, Beckman centrifuge, and Shimadzu UV-1601
  spectrophotometer.

The Lipidomics Shared Resource supports the COBRE in Lipidomics and Pathobiology and serves as the
Lipidomics Core.

Mass Spectrometry Facility

The Mass Spectrometry Facility, housed within the Department of Pharmacology, provides expertise, services,
education, and training to enhance biomedical research endeavors through mass spectrometry-based proteomics.
Protein analysis includes in-gel or in-solution protease digestion, chromatographic separation and tandem mass
spectrometric analysis of the resulting peptides, and interpretation of MS/MS data using Sequest, Mascot, Protein
Pilot, MaxQuant, and other search algorithms. The facility also assists in the development of customized
applications for the isolation, detection and characterization of posttranslationally modified peptides. The COBRE
in Oxidants, Redox Balance, and Stress Signaling, Mass Spectrometry Core is housed with the Mass Spectrometry
Facility.

The Orbitrap Elite Mass Spectrometer provides services to couple quantitative approaches to modification-
specific experiments. Investigators are developing methodology to analyze alterations in posttranslational
regulation that impact signal transduction, epigenetic modulation, and the response to therapeutics with the goal
of enabling investigators to discover molecular mechanisms underlying disease progression and therapeutic
responses that may not be revealed through genomic studies.

The MALDI-TOF MS, LC-MS, and LC-MS/MS tandem mass spectrometry analyses are offered for protein
analysis. Protein identification services include in-gel or in-solution protease digestion, chromatographic
separation and tandem mass spectrometric analysis of the resulting peptides, and interpretation of MS/MS data
using Sequest® or Mascot® software. The facility will also assist in the development of customized applications
for the isolation, detection and characterization of posttranslationally modified peptides. Sites of modification are
verified by manual inspection of the data. Please consult facility staff for feasibility and pricing of quantitative
proteomic experiments, the implementation of specialized approaches with quantitative proteomics, and MALDI-imaging mass spectrometry for tissue imaging experiments.

Mass spectrometers and associated proteomic applications available include:
- **Bruker Solarix 7T Dual Source MALDI/ESI FT-ICR MS (CID and ECD Fragmentation)**
  MALDI Tissue Imaging, Top-Down Protein Characterization
- **Thermo Orbitrap Elite with VelosPro Ion Trap MS (CID, HCD, ETD Fragmentation)**
  LC-MS/MS for identification, characterization of modifications, quantitation of differential protein expression or posttranslational modification using SILAC, iTRAQ®, TMT®, or label free approaches. Top-Down Protein Characterization.
- **Thermo LTQ XL Linear Ion Trap MS (CID, PQD, ETD fragmentation)**
  LC-MS/MS for protein identification and characterization of fragile modifications.
- **Thermo LTQ Linear Ion Trap MS**
  LC-MS/MS analysis for protein identification and characterization.
- **Applied Biosystems 4800 MALDI-TOF-TOF Proteomics Analyzer**
  LC-MALDI-MS/MS for protein identification and quantitation of differentially expressed protein class="bodytext"using iTRAQ®, or TMT® reagents.
- **Bruker Autoflex III MALDI-TOF-TOF MS**
  MALDI Tissue Imaging
- **Bruker Autoflex III MALDI-TOF MS**
  Molecular weight determination of intact proteins and peptides

**Metabolomics Core Facility**
The Metabolomics Core Facility provides the technology and expertise for the identification and quantification of low molecular weight metabolites related to cellular redox. Because energy metabolism produces both the primary oxidative and reductive species involved in cellular redox reactions, another major focus of the core is on the characterization of energy metabolism in cells, tissues, and whole animals. The facility provides access to traditional, 'gold standard' techniques such as isotopomer, radiometric, and spectroscopic analyses.

In addition to a dedicated Thermo-Finnegan HPLC-hyphenated ion trap mass spectrometer used for basic biochemical metabolite quantifications and quantification of complex mixtures of metabolites obtained from biological samples (cell lysates, plasma, urine). Also provided is access and expertise in state of the art techniques that include hyphenated biosensor-based metabolic flux assays and surface plasmon resonance (SPR) imaging of protein arrays. The core is a development site for an innovative SPR Protein Microarray Imaging Instrument. The microarrays consist of immobilized antibodies that can capture specific proteins for which the level of metabolite modification (i.e., carbonylation, sulfenic acids, etc.) can then be quantified with secondary reagents.

**Mineralized Tissue Facility**
The Mineralized Tissue Facility (MTF) within the Center for Oral Health Research is dedicated to providing MUSC researchers with the equipment, techniques, and technical expertise necessary to study mineralized tissues. MTF services are available to researchers investigating mineralized tissue biology and function at MUSC and other institutions. The facility is equipped with state of the art equipment and experienced staff to assist both new and experienced researchers:
- **The facility provides microCT scanning and analysis with a Scanco uCT40 ex vivo scanner with an analysis workstation and server. The scanner is capable of up to 6 um resolution scanning of samples up to 6 mm in diameter.**
- **Digital image acquisition and analysis services provided by an upright Olympus BX61 automated microscope equipped with a digital color camera and motorized stage, 1.25x-60x magnification, and brightfield and fluorescent illumination.**
- **Histological analysis of mineralized samples including the bones and dentition can present unique challenges. The MTF offers several services to assist researchers in the generation and analysis of these samples. The facility operates specialized equipment; including a Microm HM360 motorized rotary**
microtome equipped with a tungsten carbide blade, Buehler diamond saw and grinder for generation of plastic and ground sections.

**Molecular Modeling**
A number of molecular modeling software packages are available to MUSC researchers via the Computational Biology Resource Center, which operates a 30 node 244 CPU Linux cluster. These include applications for homology modeling, ligand or protein-protein docking, molecular mechanics or dynamics simulations, electrostatics and in silico drug design.

**Molecular Morphology and Imaging Core**
The Molecular Morphology & Imaging core provides investigators with skilled personnel able to perform highly specialized techniques, such as echocardiography, in situ hybridization, and cell kinetics assays. Services includes are: to assist the research projects perform state-of-the-art image and data analyses; to help design and perform in situ hybridization analyses; and to implement and maintain an online database of the data generated in this project. MUSC investigators have access to core facilities to run their own experiments and are assisted by core staff concerning experimental design; data interpretation and technical information to best utilize facilities and instrumentation. The core falls into eight basic components: (1) basic microscopy (light, electron, and video); (2) confocal microscopy; (3) echocardiography; (4) histology (in situ hybridization, and immunohistology); (5) special techniques (laser capture; apoptosis and proliferation assays; optical mapping); (6) morphology, image analysis and statistics; (7) presentation graphics; and (8) data sharing technology.

**Nephrology Proteomics Laboratory**
The Nephrology Proteomics Laboratory is a state-of-the-art facility capable of separation and identification of proteins in tissue, cells and body fluids. The major interest of our laboratory is biomarker discovery and pathophysiology of renal diseases. To support this interest we perform liquid chromatography/mass spectrometry, 2D gel electrophoresis and other protein separation techniques. The facility is located in the Strom Thurmond Building at MUSC. The laboratory is a sample repository and analytical lab for the Southern Acute Kidney Injury Network (SAKInet) and the Southeastern Kidney Disease Consortium (SEKDC).

The MUSC nephrology proteomics lab has purchased a state-of-the-art mass spectrometer. The ABSciex 5600 Triple ToF mass spectrometer has brought exciting new capabilities to the lab for biomarker identification because of its extremely high mass accuracy and sensitivity. The instrument was purchased with a combination of funds from a VA grant and MUSC contributions. The mass spectrometer has been used to identify novel biomarkers that predict the development and progression of both diabetic nephropathy and acute kidney injury.

**Neuroimaging Core**
Neuroimaging Core (NI) provides direct support to the investigators of the South Carolina Research Center for Recovery from Stroke COBRE. The Core supports the quantitative measurement of plasticity and structural and functional connectivity; The Neuroimaging Core leverages resources within the Center for Biomedical Imaging (CBI), a designated University Center with the mission of advancing biomedical imaging at MUSC.

**Nuclear Magnetic Resonance Facility (NMR)**
The Nuclear Magnetic Resonance Facility (NMR magnet space total square footage 1,428 ft²) in the Drug Discovery building is designed to the strict stability criteria required for the very highest quality environment for NMR instruments. NMR spectroscopy is a powerful technique that can provide detailed information on the three-dimensional structure of biological molecules in solution.

**Instrumentation**
- Bruker 400: A NanoBay Avance III 400, equipped with a 5 mm dual resonance, broadband inverse probe with an actively shielded single-axis gradient. A complementary Multinuclear Broadband Fluorine Observe
(BBFO) probe exists for exotic X-nuclei observation. The current configuration allows operation in a two-channel setup.

- **Bruker 600**: The Avance II 600 is currently equipped with a Quadruple Resonance (QCI)-Cryoprobe (H/C, N, P) purchased with support from NSF’s Major Research Instrumentation (MRI) Program (Award #1126230). Additional room temperature 5mm triple (H/C, N) and a quadruple (H,F/C,P) resonance inverse probe with actively shielded single- and triple-axis gradients exist as backups. The 600 spectrometer facilitates operations in a four-channel setup and is equipped with a CASE sample changer for automated analysis of up to 24 samples. $^1$H and $^{19}$F can be pulsed independently using two separate, high-band RF-channels.

- **Bruker 850**: The high-field magnet 850 MHz is equipped with a TCI-cryoprobe triple resonance inverse probe. A room temperature Quadruple Resonance (QXI)-RT probe (H,F/C,N,) is available as a backup. The 850 spectrometer facilitates operations in a five-channel setup and is equipped with a CASE sample changer for automated analysis of up to 24 samples. $^1$H and $^{19}$F can be pulsed independently using two separate, high-band RF-channels.

The NMR facility serves as a research resource and shared instrument facility for researchers at MUSC and in the region. The facility offers access to state-of-the-art instrumentation and expert assistance in designing NMR experiment and applications.

In addition, researchers at MUSC have access to NMR instrumentation located at the Hollings Marine Laboratory (HML), a unique collaboration of governmental and academic agencies including NOAA, NIST, SC DNR, CofC and MUSC. Access is based on the scientific merit of a project and relevance to the mission of the NMR facility as determined by the HML NMR council. Potential users are welcome to discuss use of the 700 and 800 MHz spectrometers at HML with the MUSC NMR senior scientist.

**Oral Preclinical Research Facility**

The Oral Preclinical Research Facility provides services to investigators who studying oral related diseases. We offer several animal models, including a xenograft tumor model, 4NQO oral cancer model, periodontitis model, and oral mucositis model. Services include injection of tumor cells, 4NQO delivery, animal health monitoring, and imaging of tumor progression (in vivo), oral injections, animal irradiation, and animal dissection and tissue collection.

**Protein Science Translation Core**

The Protein Science Translation Core provides direct support to investigators of the COBRE in Lipidomics and Pathology program, as well as other investigators at MUSC, in the production of recombinant proteins via prokaryotic and eukaryotic expression systems and in the structural and functional characterizations of proteins. The Core also supports translational research by producing active proteins that are needed for high-throughput screening assays and for determining the mechanisms and efficacy of various synthetic compounds. In addition to service, an important commitment of the Core is to mentor and assist investigators in solving technical problems concerning protein expression, purification, and characterization.

The Core also provides a wide range of protein-related specialty services to suit the needs of the investigator. This includes the determination of the physical state of the protein by circular dichroism (CD), dynamic light scattering (DLS) and protein crystallization. In addition, the Core will assist to investigate protein-protein interactions by immunoprecipitation and Western blotting. Furthermore we will assist to investigate protein-lipid interactions by fat western and HPLC-based enzyme assays.

and web-based archiving of data.

**Proteogenomics and Bioinformatics Core**

The Proteogenomics and Bioinformatics Core mission, component of the South Carolina COBRE for Cardiovascular Disease, is to provide COBRE trainees with a resource for expert consultation, technical training/services, and state-of-the-art instrumentation to enable advancement of their research efforts through the application of DNA
microarray analysis and protein based ('proteomic') approaches. The DNA microarray analysis component permits investigators to use DNA microarray screening technology to perform comprehensive gene expression profiling through application of both commercial and custom microarray screening and advanced computational/statistical analysis methods. The proteomics component provides investigators with technical assistance and instrumentation resources to use conventional and cutting edge protein biochemistry-based technologies to address questions of protein function.

**Instrumentation:**

- Affymetrix DNA Microarray System, comprising a GeneChip® Scanner 3000 7G (with autoloader), hybridization oven and two fluidics workstation.
- MJ Research Dyad PCR Machine is a 3-block thermal cycler capable of gradient PCR amplification.
- BioRad CFX 96 and iCycler iQ real-time PCR detection systems offers users to achieve sensitive target detection in single (or multiplex assays) for a variety of real-time PCR applications. The CFX96 Manager software enables rapid quantitative and built-in gene expression analysis using powerful analysis data tools.
- BioRad BioLogic DuoFlow Chromatography System is specifically designed for the high-resolution purifications of proteins, peptides and other biomolecules where recovery of biological activity is of primary concern.
- BIACore 3000 System is a surface plasmon resonance based system that performs real time biomolecular interaction and kinetic analysis (e.g., receptor-ligand, antibody-antigen, protein-DNA).
- Agilent 2100 Bioanalyzer System utilizes microfluidics technology for sizing and quantification of RNA, DNA and proteins.
- Roche RTS 500 is designed for protein expression in the scale of 100 to 500 mg in a 1 ml reaction volume from cDNA cloned into a pIVEX vector or another vector, designed for prokaryotic in vitro protein expression and containing a T7 promotor. Proteins in the molecular weight range from 10 to 120 kDa have been successfully synthesized using the RTS 500.
- Bio-Rad Protean Isoelectric Focusing System is optimized to use ReadyStrip IPG strips to perform first-dimension isoelectric focusing.

**ProteoGenomics Facility**

The [MUSC ProteoGenomics Facility](#) offers a range of proteomics and genomics services to the MUSC research community as well as to outside academic and corporate researchers. The proteomics component provides investigators with technical assistance and instrumentation resources to use conventional and cutting edge protein biochemistry-based technologies to address questions of protein function.

Proteomics related services include: Luminex bead array based cytokine and phosphoprotein analysis (i.e., Bioplex) and surface plasmon resonance based protein interaction analysis (i.e., BIACore). In addition, the facility provides genomics related services such as Qualitative analysis of RNA (i.e., Agilent Lab-on-a-chip Bioanalyzer), DNA microarray based whole transcriptome and miRNA expression profiling, SNP and ChIP-Chip analysis, Real time PCR, Next generation sequencing (i.e., Ion Torrent PGM) for **RNA-seq**, resequencing and ChIP-seq applications, and bioinformatics services for analysis of DNA microarray and next generation sequencing data and web-based archiving of data.
Quantitative Behavioral Assessment and Rehabilitation Core

Quantitative Behavioral Assessment and Rehabilitation Core (QBAR) provides direct support to the investigators of the South Carolina Research Center for Recovery from Stroke COBRE. The Core supports a standardized experience and quantitative measurement of behavior and function; core services include motion capture and electromyography for precise measures of motion and muscle activity, energetics as measured by oxygen consumption, accelerometer-based devices for measuring activities such as walking and hemi paretic arm use, neuromuscular measures of strength and power of individual joints, clinical measures, and animal behavioral assay equipment. QBAR is located in the CHP research building.

Seahorse Biosciences Academic Core Facility

The Seahorse Biosciences Academic Core Facility is part of the Center for Cell Death, Injury & Regeneration and provides access to the XF Extracellular Flux Analyzer. This equipment is the industry standard for measuring cellular bioenergetics, simultaneously measuring the two major energy producing pathways of the cell – mitochondrial respiration and glycolysis - in a microplate, in real-time. This fast and sensitive measurement of cellular bioenergetics is label free, enabling time-resolved analysis and the reuse of the cells. XF assays provide increased throughput in a drug discovery format that is superior to its single parameter predecessors. This fast and sensitive measurement of cellular bioenergetics is label free, enabling time-resolved analysis and the reuse of the cells. XF assays provide increased throughput in a drug discovery format that is superior to its single parameter predecessors.

shRNA Shared Technology Resource

The shRNA Shared Technology Resource (short hairpin shRNA) will provide investigators at MUSC access to genome wide human and mouse libraries that together encode a total of almost 160,000 shRNA clones against over 41,000 genes. The resource utilizes The RNAi Consortium’s (TRC) genome-wide lentiviral mouse and human libraries and investigators will have the option of ordering shRNA’s targeting single or multiple genes, gene family sets as well as pathway specific pooled libraries. The library will allow access to multiple shRNAs for a single gene, which is important for validation against off target effects. This technology holds tremendous power, and is ready to help investigators at MUSC work toward breakthrough discoveries.

<table>
<thead>
<tr>
<th>shRNA Library Features</th>
<th>Lentiviral Vector Features</th>
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<tbody>
<tr>
<td>Largest and most validated shRNA collection</td>
<td>shRNA cloned into the pLKO vector developed by the Broad Institute</td>
</tr>
<tr>
<td>Human Library: 20,018 genes, 129,695 clones</td>
<td>Allows for both stable or transient transfection</td>
</tr>
<tr>
<td>Mouse Library: 21,171 genes, 118,062 clones</td>
<td>Self-inactivating replication incompetent viral particles can be produced in packaging cells (HEK293T) by co-transfection with compatible packaging plasmids</td>
</tr>
<tr>
<td>Hairpins comprised of a 21mer base stem and a 6 base loop designed against NCBI REFSEQ</td>
<td>Stable gene silencing is selected using the puromycin selectable marker</td>
</tr>
<tr>
<td>Sequence, specificity &amp; position scoring with the Broad Institute algorithm</td>
<td>Integrates for long-term knockdown</td>
</tr>
<tr>
<td>A minimum of 3-5 shRNA constructs are created for each target gene to provide varying levels of knockdown and to target different regions of mRNA transcript</td>
<td>Transduces virtually any cell type (dividing or non-dividing)</td>
</tr>
<tr>
<td>For any given RefSeq, there is often a shRNA clone targeting the 3'UTR for use in phenotypic rescue studies using cDNA expression constructs.</td>
<td><strong>No interferon response</strong></td>
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<tr>
<td><strong>Lack of recombination issues</strong></td>
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Small Animal Imaging Unit

The Small Animal Imaging Unit of the Cell & Molecular Imaging Shared Resource is a collaborative effort between the Center for Biomedical Imaging and the Hollings Cancer Center. The Small Animal Imaging Unit provides state-of-the-art instrumentation enabling noninvasive anatomical, metabolic, and functional imaging. By leveraging HCC
cancer research experience with the facility's extensive expertise in imaging, this unit is able to monitor cellular events such as tumor progression and metastasis in living animals. In vivo fluorescence and bioluminescence imaging is also used to evaluate tumor metabolism and cell biology in response to genetic manipulations, pharmacologic agents, and cancer chemotherapy drugs. This unit has experience in in vivo imaging of brain, colon, lung, head and neck cancers as well as multiple other tumor types.

The Small Animal Imaging Unit supports the following equipment:

- Bruker 7T Small-Bore MRI
- PerkinElmer Maestro 2 In Vivo Fluorescence Imaging System
- PerkinElmer Xenogen IVIS 200 In Vivo Bioluminescence Imaging System
- Siemens Inveon Micro-PET/CT
- Small Animal Imaging Suites

**X-Ray Crystallography Resource**

MUSC has excellent facilities for X-Ray Crystallography to enable researchers at MUSC to engage in high-resolution structural studies of biological macromolecules. The facility, which operates as a University Shared Research Resource, is located in the Department of Biochemistry & Molecular Biology in the Basic Sciences Building. The facility is supported by an X-ray Manager, who is responsible for maintaining the diffraction equipment and assisting users with X-ray data collection and structure determinations, and a Systems Manager for the computing resources.

It includes three components: X-ray diffraction, crystallization and molecular graphics. X-ray diffraction is a purpose-designed diffraction laboratory containing an RU-H3RHB rotating anode generator fitted with Osmic Blue Confocal Optics, a Raxis-IV++ imaging plate system, and an X-Stream cryostat (Rigaku-MSC). In an adjoining room, the crystallization facility contains two large incubators and a stereomicroscope for setting up and monitoring crystallization experiments. Another adjoining room contains four small-scale incubators to test a wide range of temperatures in crystallization.

Adjacent to the diffraction lab, the molecular graphics suite contains a cluster of Unix/Linux workstations for molecular graphics and crystallographic computing. One of these is configured for remote access to the SER-CAT beamline at the Advanced Photon Source (APS) of Argonne National Lab, allowing synchrotron data to be collected at the home lab. Cluster computing in the form of a 16 node dual-quad core system will be available in Fall 2007. Standard crystallography and modeling software are running on these systems including HKL2000, d*Trek, CCP4, CNS, O, Shake’n’Bake, SHARP, SOLVE, and SYBYL, as well as high-throughput phasing software. Data are stored on a 2.5 TB RAID system, which is backed weekly by tape. An additional 2.5TB of file storage is available on the University’s SAN.
Scientific Environment

MUSC Overview

Founded in 1824 as the first school of medicine in the southeastern U.S., the Medical University of South Carolina (MUSC) is now the core of the state's largest medical complex and the largest employer in the metropolitan Charleston area with nearly 13,000 employees. A freestanding academic health center, MUSC is the only tertiary/quaternary care referral center in South Carolina for a statewide population of about 4.7 million people.

MUSC is a state-assisted institution. The South Carolina General Assembly and Governor appoint the Board of Trustees, who appoints the President. The Vice President for Academic Affairs serves as Provost and Chief Academic Officer. The Dean of the College of Medicine serves as Vice President for Medical Affairs. The Chief Executive Officer of the Medical Center serves as Vice President for Clinical Operations. These dual appointments ensure that strategic planning implementation and oversight are closely and continuously coordinated to provide excellent education, research and patient care in a first-rate academic health center. Although MUSC is a public institution, it receives less than 7% of its total annual budget from the State of South Carolina. The majority of financial resources are generated through patient care fees, tuition, federal grants and contracts, and private contributions.

The university has been at its present site on the Charleston peninsula since 1913, currently occupying 76 acres and 89 buildings. Major construction and renovation in recent years include the 122,000 ft² Darby Children's Research Institute (2004); a major renovation of the Hollings Cancer Center (2006) that expanded the cancer center to >200,000 ft²; an education and research complex for the College of Health Professions involving renovation of a 40,000 ft² historic building adjoining a newly constructed building of similar size (2006); the Ashley River Tower as the first phase of a long-term initiative to construct an entirely new comprehensive teaching and referral hospital on the west side of campus (2008); a 120,500 ft² home for the James B. Edwards College of Dental Medicine (2009); and the new Drug Discovery and Bioengineering Buildings (2011). As key components of the James C. Clyburn Research Center at MUSC, these two newest buildings add ~220,000 ft² for translational research and research training to generate molecular targets, lead compounds, tissue engineering constructs, novel devices and genomic technologies.

MUSC is a partner with the City of Charleston and the South Carolina Research Authority in the SCRA MUSC Innovation Center ~1 mile from the center of campus, providing research incubator and laboratory space to advance the commercialization of knowledge-based on research discoveries and advances in health care.

MUSC's major components are the MUSC Medical Center and six colleges: Medicine, Pharmacy, Nursing, Graduate Studies, Health Professions, and Dental Medicine. The Medical University of South Carolina is fully accredited by the Southern Association of Colleges and Schools (SACS) to award bachelor, master, doctoral and professional degrees. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and numerous national, professional and specialized accrediting bodies provide additional accreditations. The teaching faculty on campus consists of ~1,200 full-time and >200 part-time members. MUSC offers professional education at undergraduate, graduate and postgraduate levels appropriate to the health care disciplines, awarding ~900 degrees annually with enrollment of >2,500 degree-seeking students. In addition, the university coordinates the training of approximately 80 interns, 400 medical/surgical residents and 100 specialty fellows in ACGME-approved programs and dozens of dental and pharmacy residents.
U.S. News & World Report ranked MUSC the top hospital in South Carolina for 2015 and among the best in the country when it comes to the treatment of ear, nose, and throat disorders. In addition to the national ranking for ENT, MUSC was categorized as a “high-performing” facility for the treatment of nephrology, neurology and neurosurgery, orthopedics, pulmonology and urology.

MUSC College of Nursing’s online graduate nursing program has earned the top spot on U.S. News & World Report’s 2015 Best Online Graduate Nursing Programs. The public nursing school received a perfect score of 100 and earned high marks for faculty training and student engagement.

MUSC leads the South Carolina Area Health Education Consortium (AHEC), linking the academic health sciences center in Charleston to community-based health care centers statewide with an emphasis on health disparities, rural health issues and access to health care. South Carolina was among the first 11 states to receive federal funding to establish a model statewide AHEC program in 1972. South Carolina AHEC received the prestigious Eugene S. Mayer Award in 2006, presented every two years to the best model statewide AHEC system in the nation. MUSC has received national recognition from the Association of American Medical Colleges and other professional associations for outstanding community service and leadership in innovative health services delivery, outreach, and emergency preparedness.

MUSC is the leading biomedical research institution in Health Sciences South Carolina (HSSC), a statewide consortium to facilitate and accelerate the development, testing and dissemination of new, more effective health interventions and therapies to improve the health and well being of all residents of the state. Through HSSC, the state’s three research universities and four largest healthcare systems have created a statewide integration of scientists, clinicians and data systems. HSSC has active working groups on science, clinical care, information technology and data interoperability, a statewide IRB, and an integrated Center for Clinical Safety and Effectiveness that develops and coordinates state-of-the-art patient simulation technologies across the state.

Research at MUSC

MUSC has a substantial research enterprise with 1,182 extramural awards totaling more than $247.7M in FY2015. Federal funding constitutes about 48.2% of extramural support, with the National Institutes of Health (NIH) as the primary funding agency. MUSC’s extramural research portfolio continues to diversify: the corporate funding sector increased 45.2% between FY2014 and FY2015 to $76.3 million; funding from public and private foundations increased by 20.7%. MUSC continues to rank in the top 100 in R&D expenditures at higher education institutions [NSF 15-314, February 2015].

The South Carolina SmartState® Program was created by the South Carolina legislature and is funded through South Carolina Education Lottery proceeds. The legislation authorizes the state's three public research institutions, Medical University of South Carolina, Clemson University and the University of South Carolina, to use state funds to create Centers of Economic Excellence in research areas that will advance South Carolina's economy. The SmartState® Program has resulted in more than $400 million dollars in non-state investment into the South Carolina economy and is responsible for the creation of 5,000 jobs. To date, MUSC has initiated 20 SmartState® Centers, bringing the total of MUSC endowed chairs and named professorships to 45 (28 appointed as of January 2016). In addition to the obvious benefit of providing substantial resources to recruit senior research leadership and entrepreneurship, the program has dramatically raised the profile of university-based research in South Carolina — especially biomedical and clinical/translational research — and stimulated significant philanthropy to meet match requirements.

South Carolina Clinical & Translational Research (SCTR) Institute

MUSC is one of 62 national centers in the Clinical and Translational Sciences Award (CTSA) Consortium located in 28 states and the District of Columbia. Launched in 2006, the CTSA program creates academic homes for clinical and
translational science at research institutions across the country. This CTSA Consortium works to build national clinical and translational research capability. The CTSA is a component of the South Carolina Clinical & Translational Research Center (SCTR), which serves as a catalyst for research partnership development across the state and region by facilitating interdisciplinary, multi-institutional collaborations spanning the full translational spectrum from drug discovery and target identification through pre-clinical studies, clinical trials, community-based participatory research, and startup company initiatives. Kathleen T. Brady, MD, PhD, serves as the SCTR Institute Director, Distinguished University Professor, and Associate Provost for Research. SCTR works to facilitate sharing of resources and expertise and to streamline research-related processes to assist large-scale clinical and translational research efforts in South Carolina. SCTR’s statewide affiliates include USC, HSSC, Clemson, South Carolina State University, Claflin University, Greenwood Genetics Center, South Carolina Research Authority, and VA Medical Centers.

The **SCTR Research Nexus** is a comprehensive clinical research service line for MUSC investigators that enables and enhances translational and patient-oriented research infrastructure including: a fully-equipped outpatient clinic, blood drawing station, sample preparation laboratory, specialized molecular core laboratory, and FDA-registered HCT/P (human cells, tissues and human cell and tissue based products) facility, and expert clinical research staffing (including research nurses, laboratory personnel, nutritionists, IT specialists, and a research coordinator core). The Nexus works in conjunction with SCTR’s SUCCESS Center, which provides regulatory, navigation, and participant recruitment support.

### Research Training

MUSC offers an outstanding environment for training and career development. The university ranks in the top quartile of domestic educational institutions in number of NIH grants for research training and education. NIH FY2015 award data include 21 NIH institutional training or research education grants (T15, T32, T35, TL1 and R25 types), 21 NRSA individual fellowships (F-types), 32 individual and 4 institutional career development awards (K awards), and 16 center grants (P awards) that include training and career development components for postdoctoral and/or junior faculty. MUSC has three dual degree programs: the NIGMS-funded Medical Scientist Training Program (MD/PhD), the NIDCR-funded Dental Scientist Training Program (DMD/PhD), and PharmD/PhD, plus a well-subscribed Master of Science in Clinical Research (MSCR) program that was initiated with K30 support. Four MUSC training programs focus specifically on diversity in the biomedical sciences: an NIGMS-funded Initiative for Maximizing Student Diversity (IMSD) that supports doctoral training for minorities, two NHLBI R25 grants for short-term research training for minority students, and a Post-Baccalaureate Research Education Program (PREP) that supports minorities in preparation for biomedical research careers.

### Research Development and Administration

The MUSC research infrastructure includes pre- and post-award functions reporting to the Vice President for Academic Affairs & Provost through the Associate Provost for Research. The Office of Research Development (ORD) focuses on program and proposal development, identifies funding opportunities, develops proposal concepts, networks faculty members with complementary interests, provides grant-writing consultation and workshops, offers pre-submission critiques, compiles institutional data, and prepares competitive proposals for research resources and research training.

The Office of Research and Sponsored Programs (ORSP) handles certifications and assurances, ensures that policies and procedures are followed, helps prepare budgets, negotiates terms and conditions, maintains proposal and awards data, administers the program of intramural research grants, and oversees re-budgeting and close-out activities. ORSP is the institutional interface with Grants.gov and coordinates all aspects of electronic research administration. The Office of Research Integrity (ORI) provides oversight and staffing for activities focused on
compliance with regulations for research involving humans, vertebrate animals, and biohazardous agents. It also coordinates management of conflict of interest, financial disclosure, and scientific integrity issues.

**Foundation for Research Development**

The **MUSC Foundation for Research Development (FRD)** is an affiliated, not-for-profit, 501(c)(3) corporation, established in 1995 to manage technology transfer and private sector research relationships for MUSC. MUSC investigators currently submit approximately over 100 new invention disclosures per year, for a total of nearly 1500 disclosures since the FRD’s inception. On behalf of MUSC and its investigators, FRD has filed more than 400 US patent applications on new technologies. Those applications have resulted over 300 domestic and international patents. In addition, FRD has executed more than 150 option and license agreements for MUSC innovations. Over 50 start-up companies have been founded to commercialize MUSC intellectual property. These accomplishments illustrate the quality and practical relevance of MUSC expertise and research findings, setting the pace for future progress.

**Support Services**

**Health Affairs Library**

The **MUSC Library** serves as a database and knowledge center, academic computing support unit, electronic education center, and leader in information planning. Online resources include major biomedical databases (e.g., Scopus, CINAHL, PsycINFO, SciFinder Web, and PubMed). Resources include drug information (Lexicomp Online, the Electronic Orange Book), consumer health (Hands on Health, MedlinePlus, Health Reference Center), clinical decision support systems (DynaMed, UpToDate, DDX), Clinical Practice Guidelines, clinical trials, evidence-based practice (Cochrane, the TRIP database), government resources (Toxnet, Federal Register, Code of Federal Regulations, SC and US Statistical Abstracts), the Computational Biology Resource Center, over 30,000 electronic books (Procedures Consult, Harrison’s Online, Access Medicine) and e-journal packages with over 19,000 individual journals), statewide shared academic databases (Collegiate DISCUS, DISCUS), and other resources that provide a wealth of global information. Service-oriented faculty and staff assist in the use of a variety of informational systems. An active program of individual, class, and group instruction supports teaching, clinical care, research and community outreach. The Library includes the Instructional Technology Lab for web-based instruction and curriculum evaluation, and the Informatics Lab with more than 180 microcomputers and peripheral equipment. In addition to off-campus remote access to collections and information, the Library maintains 250 print journals that are not available electronically. The library serves as a resource library within the National Network of Libraries of Medicine, and is a major health science resource library for the State and the Southeast.
Early Stage Investigators

MUSC is committed to promoting the development and advancement of Early Stage Investigators. Institutional investments to help ESIs achieve success in their academic careers include the following:

**SCTR Resources:** MUSC’s South Carolina Clinical and Translational Research Institute ([SCTR](http://sctr.org)), one of NIH Clinical and Translational Science Award (CTSA) Programs, offers substantial resources for Early Stage Investigators. SCTR’s Society of Clinical Research and Translational Early Scientists ([SOCRATES](http://socrates.org)), a mentoring forum for all mentor and mentee faculty, holds monthly meetings where junior investigators present their research proposals-in-development and get peer review feedback. Other SCTR resources include: (1) a robust Pilot Project Program that awards >$1 million dollars in seed funds for promising multi-disciplinary clinical and translational research, enabling ESIs to form interdisciplinary, interactive and sustainable research networks and teams; (2) extensive support of clinical and translational research at MUSC, including biostatistical assistance and training, database management, an enterprise-wide clinical data warehouse (CDW), a biorepository for ready access to de-identified patient data and human samples, subject recruitment and retention, education and outreach activities, and other training and research opportunities; (3) a voucher program whereby investigators may request research related vouchers at any given time to pay for lab services, participant recruitment, biostatistical and epidemiological consultations, ethics consultations, and other research costs; and (4) internal and external scientific review of extramural grant applications.

**Institutional Resources:** MUSC’s Office of Research Development offers a full array of resources to guide early stage investigators towards research independence. These include: (1) Grantsmanship Workshops focusing on basic principles of good grant writing and strategies for success focusing on the relational issues to proposal writing; (2) Individual and team consultations with external advisors and consultants; (3) Proposal Library, an online repository of recent, successful proposals (e.g., NIH R01, K23, K08, U01) that serve as a resource for MUSC investigators; and (4) Webinars, a series of short training videos that demonstrate proposal development best practices.

**Department Mentoring Plan:** All academic departments are required to have a faculty mentoring plan based on each department’s unique resources and needs of the faculty, as well as mentoring champion(s) who work under the chair’s direction to implement and ensure the plan’s effectiveness. These plans provide junior faculty with a supportive environment encompassing skills, knowledge, and resources to achieve success and career satisfaction.
Biohazards

The University Risk Management has an established Biological Safety Policy. This policy establishes responsibility for the proper use of biohazardous agents, including recombinant DNA, infectious agents and biological toxins in research and other educational activities at the Medical University of South Carolina in order to protect students, faculty, staff, the community and the environment. This policy is intended to ensure compliance with all applicable local, state and federal guidelines and regulations for research involving biohazardous materials.

MUSC’s Institutional Biosafety Committee (IBC) conducts initial and continuing review of all research proposals and projects involving recombinant DNA as outlined in the National Institutes of Health Guidelines for Research Involving Recombinant DNA or Synthetic Nucleic Acid Molecules. The IBC also reviews work with infectious agents and biological toxins. The IBC comprises at least five (5) members with experience and expertise in recombinant DNA technology and microorganisms, microbiological techniques and the potential risk to public health or the environment from these materials. At least two (2) members are not affiliated with the institution (apart from their membership on the IBC) and represent the interest of the surrounding Charleston community with respect to health and protection of the environment. The Associate Provost for Research makes all appointments as recommended by the IBC Chairperson/Vice Chairperson. This committee reports to the Associate Provost for Research.

All Principal Investigators (PIs) assume primary responsibility for the proper use, handling and disposal of all biohazardous agents in research or other educational activities conducted under their supervision ensuring compliance with the governing documents and MUSC policies applicable to their research. To further protect students, faculty, staff, the community and the environment, the Institutional Biosafety Committee (IBC) and the Biosafety Officer are authorized to review and monitor all research and other educational activities involving biohazardous agents, whether such research is funded or not. Failure to comply with this policy results in a review by the IBC and possible suspension or revocation of approval or privileges by the IBC to work with biohazardous agents.