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| FACILITIES & OTHER RESOURCES |

**The University of Tennessee Health Science Center (UTHSC) Institutional Core Facilities:**

There are nine institutionally supported and subsidized core facilities located on the UTHSC campus: the Laboratory Animal Care Unit (LACU), the Regional Biocontainment Laboratory (RBL), the Molecular Resource Center (MRC), the Molecular Bioinformatics (mBIO) core, the Flow Cytometry and Cell Sorting (FCCS) core, the Proteomics and Metabolomics Core (PMC), the Research Histology Core (RHC), the Medicinal Chemistry (MedChem), and the Advanced Imaging Core (AIC). An overview of core facilities may be found at the UTHSC Office of Research institutional cores webpage. Institutional core facilities at UTHSC are defined as widely used facilities managed by the Office of Research. Core service fees are very competitive and currently rank in the bottom-third to bottom-half of pricing for similar services offered by peer academic institutions in the Southeast U.S. Institutional core facilities serve investigators based at UTHSC, LeBonheur Children’s Hospital, Regional One Medical Center, and the University of Memphis (the greater Memphis area), as well as several external customers from around the U.S. and the world.

**Laboratory Animal Care Unit (LACU); David Hamilton, DVM, Director:**

The LACU administers the facilities and the program of animal care resources for the campus. The LACU is responsible for all animal care resources and the purchase and care of all animals on the UTHSC campus. It also provides consultation for experimental design, and trains investigators and other personnel in the humane and responsible use of animals. The facilities are comprised of >64,000 net SF of animal space located in six buildings, and office spaces in the Coleman Building. The entire centralized animal care program has been fully accredited by the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) since 1993 and maintains an active Animal Welfare Assurance with the NIH Office of Laboratory Animal Welfare (OLAW). The LACU maintains a 42-person staff, including 3 veterinarians, 2 veterinary residents, 2 veterinary technicians, 3 supervisors, 18 husbandry technicians and 11 cage wash technicians, along with additional business and operations support staff. With the exception of recent hires, 100% of the animal husbandry technicians are certified by the American Association for Laboratory Animal Science (AALAS). Emergency call is rotated among the veterinary faculty and residents. One veterinarian and one animal care supervisor are always on call and available for emergency care, 24/7, 365 days a year. The LACU offers small equipment available for investigator use, including several isoflurane anesthesia units and temperature-controlled circulating water pads. Larger equipment available includes the Visual Sonics Vevo 2100 ultrasound system, the CODA Tail-Cuff Blood Pressure Monitoring system, Sedecal Vet-Ray digital radiography, a Perkin-Elmer (Xenogen) IVIS Lumina XMRS animal bio-imager with luminescent, fluorescent and x-ray imaging capabilities, and an Abaxis VetScan HM5 blood analyzer.

**Regional Biocontainment Laboratory (RBL); Colleen Jonsson, PhD, Director:**

The RBL Core’s mission is to provide state-of-the-art Biosafety Level 3 (BSL-3) and Animal BSL-3 (ABSL-3) containment laboratories in support of basic and translational research on infectious agents. The UTHSC RBL is one of 11 such facilities throughout the country constructed with funds secured by an extramural (NIH/NIAID) award with a match by the university. Operational since 2010, the RBL is approved for Risk Group 3 pathogens and select agents through the Centers for Disease Control and Prevention and USDA and has AAALAC accreditation. The RBL is a 30,000 SF facility housing six ABSL-3 suites, eight BSL-3 laboratories, and one large BSL-2 multi-suite laboratory. The BSL-3 and ABSL-3 laboratories have recirculated air with HEPA filtration, pass-through autoclaves, and personal protective equipment (PPE) protocols to meet the CDC BMBL. Each *in vitro* lab has CO2 incubators, a centrifuge, a microscope, a -80C freezer, a +4C refrigerator, and water bath. The *in vitro* suites in the RBL (~2500 SF) have exhaust HEPA filtration, BSCs, four pass-through autoclaves, and PPE protocols to meet the BMBL based on risk assessment for agents. The RBL BSL-3 facilities support work with Risk Group 3 and CDC and/or USDA select agents. All animals are housed in Allentown BioContainment Units (BCU); the BCU racks are monitored remotely using a WiCom Vantage server, which sends text notification of any alarms directly to the animal facility supervisor and facility manager. The entire ABSL-3 facility, including HVAC and other support systems, is monitored by daily physical observation, and via the building automation system (Johnson Controls Metasys) for continuous systems monitoring with notification of any alarms through email and auto-dialer to designated RBL facilities personnel.

The RBL offers fee for service activities, such as but not limited to: (1) production, characterization, next-generation sequencing of the pathogens studies; (2) determination of optimal route and dose for pathogen challenge in small animal models; (3) natural history of infection in the animal model; (4) determination of the best indicators of infection and correlates of immunity; (5) standardization of non-GLP animal models for use in “Proof-of-Concept” efficacy studies of candidate vaccines, therapeutics and immunotherapeutic agents; and (6) testing of toxicity and efficacy of candidate molecules or vaccines in small animal models of infectious disease.

The RBL provides specialized equipment and technical services to support internal and external research for academic or industrial focused projects including the BioAerosol Nebulizing Generator (BANG) unit for nose-only aerosol delivery (mice), which has the capacity to infect up to 64 mice simultaneously, with the ability to perform several aerosol challenges each day. Additional equipment includes a Xenogen Perkin Elmer Spectrum animal bio-imager with luminescent and fluorescent imaging capabilities, a Miltenyi Tyto cell sorter, Cytek Aurora Spectral Analyzer, a Luminex 100, MagPix, Biotek Synergy and EnVision readers in containment, QuantStudio 6 Flex real-time PCR system, KingFisher Flex Purification system, Agilent BioAnalyzer, Illumina MiSeq, DiaSys response 910Vet chemistry analyzer and X-pedite HEM3 Vet hematology analyzer. The RBL supports high throughput screening labs (1-BSL2, 1-BSL3), equipped with a Perkin Elmer Janus robot, MultiFlo FX and Envision readers.

**Molecular Resource Center (MRC) of Excellence; William Taylor, PhD, Director:**

Established in 1985, the MRC is a Tennessee Higher Education Commission (THEC)-sponsored campus resource consisting of approximately 2,400 SF of laboratory/office/ conference room/computer server space and an additional 280 SF for freezers/storage in the Translational Science Research Building (TSRB), which opened in 2015. The MRC maintains several pieces of equipment available for campus-wide use, including two LC480 Roche LightCycler real-time PCR machines (96- and 384-well blocks), along with the complete Roche Universal Probe Library, one Fluidigm Biomark (96x96) real-time PCR instrument that can also be used for digital PCR, one ND-1000, and one ND-8000 NanoDrop spectrophotometer, a Covaris S2 series sonicator for chromatin and DNA shearing, a Qubit analyzer to quantitate nucleic acids, and two Agilent BioAnalyzers to quantitate DNA/RNA/protein and/or to measure nucleic acid quality. For automated DNA and RNA isolation, a Qiacube robot is available, which is capable of isolating DNA or RNA with onboard DNase treatment from eukaryotic cells on a miniprep scale from tissue, blood and cells (96 samples per day). Sanger sequencing is provided as a fee for service through Azenta (formerly GeneWiz). Genotyping of genetically-modified mice can be obtained through Transnetyx. Large equipment includes a 96-well fluorescence and luminescence plate reader (Biotek Flx80), a multimode colorimetric, luminescent reader (Molecular Devices Spectramax M2e) and a GenePix 4000B microarray scanner for analyzing a variety of custom slide arrays. For high-throughput technologies, an Eppendorf EPmotion liquid handling robot and two MJ Tetrad 4 block thermocyclers are available. The MRC maintains a fluorescence microscope (Zeiss Axiophot) for use at no charge. For large-scale genomic analyses, a full range of Affymetrix microarrays for gene expression and genotyping are available. For next generation sequencing (NGS) applications, a Life Technologies Ion Proton sequencer and one Illumina NextSeq2000 sequencer are available, including sequencing of entire genomes, targeting sequencing, whole exome sequencing (WES), analysis of copy number variants (CNVs) or single nucleotide polymorphism (SNP) genotyping, SNP discovery or detecting mutations, RNA-seq, miRNA-Seq, ChIP-seq and microbiome sequencing. Libraries are prepared by MRC dedicated staff and can be produced in a high-throughput manner using the Hamilton STARlet automated robotics system. For computer resources, the MRC maintains a Dell Precision T7500 server with 2 x 6 core Xeon processors (3.47GHz) and 64GB of RAM. The MRC distributes data to users via a similar instrument with 14TB of internal storage and 32TB of network attached storage. Basic or custom analysis of next generation sequencing (NGS) data may be requested via the Molecular Bioinformatics (mBIO) core, which is also housed in Room 110 TSRB.

**Molecular Bioinformatics (mBIO) Core; Daniel Johnson, PhD, Director:**

The mBIO core was established in early 2015 with the mission to provide access to the latest technologies, workflows, and standards for analyzing molecular data. The mBIO Core is adjacent to the MRC and to the Proteomics and Metabolomics Core (PMC) in Suite 110 of the TSRB. Services include sequence assembly, sequence alignment, differential expression analysis, SNP variance, single cell analysis, and custom software designs. Expertise is also available related to protein structure/function prediction and proteomics/metabolomics. A PhD-level trained bioinformatics analyst with a statistics and molecular biology background, Dr. Daniel Johnson is available for PI consultation on pre-experimental design and for data analysis. All analysis services are based on a flat fee. Dr. Johnson is also available as a collaborator to create custom scripts and programming as needed. Data mining and transformation services are offered at an hourly rate. Long-term storage of raw data on a local server cluster is also available as a fee for service. Dr. Johnson maintains four custom servers to support computational analysis (4 AMD 16-core blade servers). The blade servers consist of two 16 core 4.0 GHz processors, 512 GB RAM, and 16 TB storage for each machine. The current server cluster can analyze up to 128 NGS samples simultaneously. The core offers UTHSC investigators long term mirrored storage for omics and other large data projects, with 90 TB of storage. The current server cluster can analyze up to 128 NGS samples simultaneously. The mBIO core provides access to software such as iPathway Guide, Broad Gene Set Enrichment Analysis, StringDB and institutional licenses for Prism 9.0 software. The mBIO Core also provides frequent workshops and hands-on training opportunities for PIs, postdocs, and UTHSC students interested in learning the software, analysis pipelines, and statistics needed to perform bioinformatics analysis independently.

**Flow Cytometry and Flow Sorting (FCCS) Core; Deidre Daria, PhD, Director:**

Established in 2003, the FCCS Core’s mission is to provide investigators at UTHSC and in the Memphis area with access to state-of-the-art flow cytometry and cell sorting technology, instrumentation and training in flow cytometry principles. Located in the Molecular Sciences Building on Madison Avenue, the core provides access to state-of-the-art instruments expertise, instruction, and assistance with experimental design and data analysis for multicolor flow cytometry and cell sorting, including indexed single-cell sorting. The FCCS Core Flow Cytometry specialist and core director are highly experienced in immunology, flow cytometry, and cell sorting. Services include classes on the theory and fundamentals of flow cytometry (no-cost), one-on-one consultation for experimental design (no-cost), training in FCCS Core instrumentation (hourly rate), data analysis (hourly rate), and software resources, including Diva (BD Biosciences), SpectroFlo (Cytek), Everest (Bio-Rad), ModFit (Verity) and FlowJo (BD Biosciences). The FCCS Core maintains a high-performance Bio-Rad ZE5 flow cytometer with four lasers and 21-fluorescence parameter detection in a 4-7-7-3 configuration for blue, green, violet, and red lasers, respectively. The ZE5 cytometer is highly automated with programmable sample collection and includes a small particle FALS detector for exosomes, subcellular particles, and bacteria off the violet laser in addition to standard FSC and SSC light detection off the blue laser. The core also maintains a BD Biosciences FACSAria IIucell sorter equipped with four lasers and 12 fluorescence detectors in a 5-2-3-2 configuration for blue, violet, red, and UV lasers, respectively, in addition to forward (FSC) and side (SSC) scatter detectors off the blue laser. The sorter has two-and four-way sort capability into tubes or microtubes. The sorter is also equipped for indexed, single-cell sorting or multiple cell sorting into microwell plates or onto microscope slides. The sorter has temperature-controlled sample injection and collection chambers and aerosol (BSL2) containment. An S10 award for a new Cytek Aurora CS spectral sorter (5 laser, 64 fluorescence and 3 scatter detectors, 6-way sorting) is currently in the negotiation phase, with an estimated onboarding in fall 2023. The FCCS Core also assists with BSL2/BSL3 flow cytometry and cell sorting services in the Regional Biocontainment Laboratory (RBL). The RBL maintains a Miltenyi Tyto low pressure, disposable, chip-based cell sorter and a Cytek Aurora Spectral Analyzer.

**Proteomics and Metabolomics Core (PMC); David Kakhniashvili, PhD, Director:**

Established in 2015, the PMC’s mission is to provide the UTHSC community with state-of-the-art mass spectral technology and support to facilitate molecular-level discoveries that transform and advance our understanding of biological systems to solve challenging, relevant scientific questions in the life sciences. The PMC is in Suite 110 of the TSRB. The PMC provides consultations to optimize experiment design and to interpret generated data. Services include identification of individual proteins in simple and highly complex protein mixtures, identification and mapping of posttranslational and other modifications of proteins, differential protein expression analysis based on precursor ion quantification (SILAC, dimethyl labelling), reporter ion quantification (iTRAQ/TMT labelling), and precursor ion area detection (label-free analysis), analysis of protein-protein interactions, and determination of the molecular masses of analytes. The core is equipped with a Thermo Fisher Orbitrap Fusion Lumos mass spectrometer - a tribrid mass spectrometer combining a Quadrupole, a Dual Linear Ion Trap, and an Orbitrap mass analyzers able to perform CID, HCD, or ETD fragmentation, operate in parallel mode, and provide excellent resolution (500,000 FWHM @m/z 200), accuracy (1 ppm), sensitivity (quantification of 1 attomole at CV<15%), and high scan rate (20 Hz). The instrument operates in line with an ultra- HPLC system- Ultimate 3000RSLCnano for nano-flow applications or Vanquish for micro-flow applications. The software tools for system operation/data acquisition and post-acquisition analysis of raw MS data include Xcalibur/SII 4.3, FreeStyle 1.6, Proteome Discoverer 2.4, PMI-Preview 3.5, PMI-Byonic 3.5, Compound Discoverer 2.1, TraceFinder 4.1, and others. Metabolomics projects are outsourced to the University of Tennessee Knoxville (UTK) campus, which bills UTHSC at UTK internal rates for services.

**Research Histology Core (RHC); Natasha Jones, Laboratory Manager:**

The Research Histology Core is a partnership between the Office of Research and the Department of Pathology and Laboratory Medicine/University Clinical Health (UCH). The RHC’s mission is to provide high-quality histology services and expert consultation on histopathology to support basic and translational research. Launched in July 2017, the RHC supports processing, embedding, sectioning, H&E-staining and a variety of special stains of tissues for research purposes - primarily tissues derived from rodent models or human specimens xenografted into mice. The RHC also offers expert consultation during the project design phase, and for evaluating histopathology and molecular pathology of processed samples through collaboration with faculty and residents in the Department of Pathology. The core makes referrals for investigators to obtain whole digital slide scanning services on the ThermoFisher Pannoramic FLASH III system, with software bundles for quantification of whole slide images or tumor microarrays. Equipment is maintained by the Department of Pathology and Laboratory Medicine. Special histopathology projects are priced based on the scope of the proposed work in consultation with the laboratory manager. The RHC maintains a Thermo Excelsior Tissue Processor, 2 Sakura VIP Tissue Processors, 1 Sakura DRS2000 Autostainer, 3 Leica microtomes, 2 Benchmark Ultra Immunohistochemistry stainers, 2 Peloris Rapid Tissue Processors, 1 CM1850 cyrostat, 1 H&E AutoStainer XL and 1 CV 5030 Automatic Coverslipper. The RHC is staffed by three experienced, full-time clinical pathology histotechnologists.

**Medicinal Chemistry Core (MedChem); Jiawang Liu, PhD, Director:**

The Medicinal Chemistry Core’s mission is to offer services related to all aspects of small molecule drug development and synthesis, including, but not limited to, target validation, lead optimization, small molecule custom synthesis (milligram scale to multi-gram scale), structural determination, and purity/stability analysis. Since 2020, the core also provides targeted metabolite identification and quantification services. The core is located in the College of Pharmacy building within a standard chemistry laboratory module, including chemical fume hoods, and is equipped with top-of-the-line instruments needed for synthesis and separation, such as an automatic flash/HPLC hybrid column purification system with a 3-way UV detector, a microwave synthesizer, and a pressure adjustable rotavapor with a high performance vacuum pump, and a PerkinElmer Janus liquid handler workstation. There are also several major instruments in the College of Pharmacy Building that are part of a College of Pharmacy-supported shared analytical facility that the MedChem core has full access to, including NMR spectrometers (Varian Inova 500 and Bruker Avance III 400), LC/MS (Waters Xevo G2-S QTOF with Waters Acquity UPLC and SCIEX TQ5500 with Shimadzu Nexera XR HPLC), and other analytical instruments, such as IR spectrometers, UV spectrometers, and a polarimeter. A service center dedicated to the generation of new products and raw data, the core provides one-on-one consultation with internal investigators at no charge, as well as services for literature searches, oral research reports and consulting on experimental design.

**The Advanced Imaging Core (AIC): Rachel E. Helms, PhD, Microscopy Manager**

The AIC is the newest institutional core facility on campus. Its mission is to accelerate research at UTHSC and surrounding institutions by providing super-resolution microscopy imaging services through state-of-the-art equipment, and expertise supporting basic and translational research. Super resolution microscopy is the focus of this core. A Zeiss Elyra 7 with lattice structured illumination microscopy (SIM) is available to image specimens from fixed and living samples, with up to four colors at high speed (up to 255 fps) and high resolution (up to 20nm in xy and 50nm in z). Single molecule localization microscopy (SMLM) is possible using 3D-PALM or dSTORM techniques. Data are analyzed using a ZEN 3.0 SR workstation equipped with Zen Black software. AIC services include hands-on training at an hourly rate, assisted sample imaging, assisted raw data analysis, and consultations for study design.