INSTITUTIONAL ENVIRONMENT, FACILITIES, AND RESOURCES

University of Arizona College of Medicine – Phoenix Campus and the Scientific Environment

The University of Arizona College of Medicine-Phoenix (UA COM-P) offers exposure to diverse patient populations and opportunities to learn in various clinical environments as the College has agreements with nine clinical affiliates that include Banner University Medical Center-Phoenix (BUMC), Valleywise Health and Phoenix Children's Hospital (PCH). For more information, please visit the university's Clinical Partners webpage.

The University of Arizona Cancer Center (UACC) is the latest edition to the ever expanding Phoenix Biomedical Campus. The UACC is a 220,000-square-foot, five-story, $100 million facility which offers comprehensive cancer services, including: infusion, radiation oncology, diagnostic imaging, endoscopic/interventional radiology, a women's center, specialized cancer clinics, patient wellness and support services, a prevention/executive health clinic, clinical lab space and other related support areas.

Additional partnerships have been established with St Joseph's Hospital and Medical Center including the Barrow Neurological Institute (SJHMC/BNI), and Translational Genomics Institute (TGen). Joint ventures with the other two State of Arizona universities, Arizona State University (ASU) and Northern Arizona University (NAU) complete the current relationships that collectively comprise the downtown Phoenix Biomedical Campus (PBC). The biomedical campus in downtown Phoenix includes the Arizona Biomedical Collaborative 1 (ABC1) research building constructed in 2007. The new UA Biomedical Sciences Partnership Building (BSPB) opened in January 2017. The 10-story, 245,000 square feet state-of-the-art research tower of the BSPB represents the University of Arizona College of Medicine-Phoenix's long-term strategic plan to invest in biomedical research and innovation. The new building features two 80-seat seminar rooms, six floors of wet laboratory space and two floors of dry laboratory space. The PBC is located in the central downtown area of Phoenix and is well suited to form a distributive model of education. All three state universities UA, ASU and NAU are present on the PBC. Within a six-mile radius of the PBC there are two of the largest hospital systems, SJHMC and BUMC along with the Carl Hayden VA Hospital, MIHS and St. Luke's Hospital. Thus, the formation of this collaborative research community brings the three state universities, City of Phoenix, TGen, Valley hospitals, community physicians, foundations, and other organizations to conduct research and biomedical engineering within Maricopa County to strengthen health care for Arizonans. The UA COM-P has twenty departments and a faculty that is both UA and the surrounding institutions of over 1,300.

Academic Profile

The University of Arizona College of Medicine-Phoenix in an accredited public university that accepted its first class of 24 students in the fall of 2007 and provides training leading to a degree in the health sciences, the MD. Ten classes of MDs have graduated for a total of 597 graduates. Currently, four classes are enrolled for a total enrollment of 387 undergraduate medical students on the campus.

There is an exceptional opportunity to expose students to the research environment because all medical students at the University of Arizona College of Medicine-Phoenix campus are engaged in Scholarly Project Research as part of the unique Phoenix curriculum. The Scholarly Project (SP) aims to teach critical inquiry, research methods, teamwork, information literacy, communication, lifelong learning, and research ethics. The Scholarly Project course series (MEDP819A-B-C-D) is one pillar of curriculum at the University of Arizona College of Medicine-Phoenix (COM-PHX). Through the Scholarly Project course, students develop advanced inquiry and problem-solving skills to support clinical practice throughout their careers. Each student takes part in the Scholarly Project course series over four years and undertakes independent scholarly activity culminating in a thesis and participation in a student research symposium prior to graduation. With assistance from Advisors and Mentors, students will acquire the skills required to formulate, resolve, discuss and communicate problems and evidence related to medicine. Through the Scholarly Project course, students develop proficiency in critical inquiry tools that will remain central to their success as clinicians, investigators and communicators throughout their careers.

Administrative

To support the research mission, a fully staffed Research Office is available to research personnel. The Associate Dean of Research oversees the Research Office and provides guidance and mentorship to research faculty. The Research Office provides assistance with grant preparation, expertise in pre and post grant awards, in addition to compliance support in all aspects of research involving human subjects or animal studies. The Manager of Laboratory Operations within the Research Office provides laboratory training required by the University of Arizona College of Medicine-Phoenix.

Clinic Research Operations

Under direction of the Senior Director, Anna Teresa Valencia, MPH, MBEMH, Clinic Research Operations includes staff Research Coordinators and Clinical Research Specialists who assist principal investigators in the design and implementation of clinical research studies conducted at the University of Arizona College of Medicine-Phoenix affiliated hospitals. These include: BUMC-P and Phoenix Children's Hospital. Services offered include training and certification (including REDCap, clinical, HIPAA, Cerner, Citrix, Oncore), Subject Recruitment and Study Management, Data Warehousing, assistance with IRB proposal development and submission and ClinicalTrials.gov, phlebotomy services, and other clinical research protocol design and implementation as needed.

Clinical Research Support Services (CReSS)

What We Do:

At the University of Arizona, College of Medicine – Phoenix, there are multiple departments actively engaged in clinical research in collaboration with Banner – University Medical Center Phoenix. Investigators are committed to supporting Banner's mission of *Making health care easier, so that life can be better* through the conduct of high-quality clinical trials and other medical research. Our investigators participate in both multi-center, national and international Phase II-IV clinical research trials, as well as Investigator-initiated studies across many indications to provide patient access to new therapies and treatments.

Who We Are:

Our clinical researcher team is comprised of highly experienced individuals who aid in the facilitation and conduct of clinical trials across the Banner – University Medical Center Phoenix campus. We offer operational support for clinical trial development and coordination as well as compliance monitoring. We also provide assistance with REDCap database development, specimen and data collection, and guidance to other resources for population outcomes, trial design and grant writing, and access to data and tissue through the Clinical Research Data Warehouse and Biorepository and biostatistical services.

Our Mission

Our mission is to support innovation within academic clinical research while providing exceptional service and valuable resources to our scientific collaborators and industry partners.

Other:

Services and Resources

- Study coordination
- Consenting
- Recruitment assistance
- Study specific REDCap project development
- Regulatory submissions
- IV administration for study infusion therapies
- Phlebotomy services
- EKGs

Located in the UA Clinical Research Suite at BUMCP Medical Institute, our clinical resources include:

- Four (4) private exam rooms
- IV infusion room
- Bariatric exam room
- Three (3) consult rooms
- Specimen processing room
- Two (2) vitals/phlebotomy stations
- 24-hour continuous temperature monitoring of study drug
- Clinical trial supply storage
- Specimen refrigerator
- -80° freezer
- Ambient and refrigerated centrifuges
- Automated blood pressure machines
- Height and weight scales

Please visit https://phoenixmed.arizona.edu/research/clinical-research for more information.

Department Basic Medical Sciences (BMS)

BMS encompasses 23 core investigators and several affiliate faculty that conduct research in a variety of basic medical sciences areas with translational applications, for example including: Autoimmune and Inflammatory Disease; Bone, Skin and Mucosal Disease; Cancer; Cardiovascular Disease and Stroke; Development and Aging Disease; Infectious Disease; Neuro-Degenerative, and Developmental and Psychiatric Disease.

Through discovery, education, and service, the BMS faculty strive to be leaders in their areas of scholarship. Using interdisciplinary approaches, BMS faculty perform hypothesis-driven investigations to reveal cellular and molecular mechanisms that underlie biological processes and human disease. Through a collaborative approach with clinical researchers, the BMS faculty enable the development of novel diagnostics, therapies, and preventive measures. BMS faculty are also engaged in medical and graduate education by developing, delivering, and assessing curricula, and conduct educational scholarship.

The laboratories are well equipped with state-of-the-art technology including autoclave and industrial dishwasher facilities, fully equipped tissue culture rooms, walk-in 4°C cold rooms, dark room, fume hoods, biosafety cabinets, microscopes, balances, Millipore water purification system, pH meters, Li-Cor Odyssey infrared imager, Tecan Safire 2 microplate reader, Beckman Coulter Optima and Avanti Centrifuges, Applied Biosystems 7500 Fast Real Time PCR system, BioRad Chemidoc XRS, BioRad VersaDoc, BioRad DNA engine PCRs, Nanodrop ND-1000 UV spectrophotometer, Molecular Dynamics Storm imager, Kodak in vivo FX imager, Zeiss AxioSkop microscope equipped with Neuroleucida and Stereo Investigator software programs. This suite of equipment is also complemented with access to several Core Services located on the campus. These comprise of the following Cores: Flow Cytometry, Biomedical Imaging and Molecular Discovery. Several of the BMS faculty members also have a joint affiliation with the Center for Applied Nanobioscience and Medicine, the Translational Cardiovascular Research Center, as well as the UArizona Statewide Centers with local operations at COM-P.

Center for Applied NanoBioscience and Medicine

The Center for Applied NanoBioscience and Medicine (ANBM) at the University of Arizona. ANBM comprises several operation modules located within two sites in the Phoenix metropolitan area. The main laboratory is located in the UA Biomedical Sciences Partnership Building (BSPB). It consists of biology/chemistry wet labs, nano/micofabrication cleanroom, optical lab, electronics lab, plastic fabrication lab, and shared cell culture lab with total ~ 4900 sq. ft. ABNM also has analytical equipment and access to bioinformatics tools and services at the Translational Genomics Research Institute (TGen) in downtown Phoenix. The ANBM center also has access to Honor Health Research Institute (SCRI) at the Honor Health Scottsdale Shea Medical Campus, which has a Varian LINAC accelerator in the Radiation Oncology Department for ex vivo biological sample irradiation. The detailed descriptions of each lab are listed below:

Biology/Chemistry Wet Lab UA Biomedical Sciences Partnership Building (BSPB)
The ANBM center has molecular biology and general chemistry lab facilities occupying ~ 1500 sq. ft with 3 fume hoods, 2 biosafety cabinets and 80 feet bench area, which provide the capability for full scale molecular biology research, to facilitate the development of different bioassays and bioanalytical characterizations. Major equipment include:

1. Agilent 2100 Bioanalyzer for analysis of DNA, RNA, proteins and cells on a microfluidics-based platform
2. Applied Biosystems 310 & 3130 Genetic analyzer for nucleic acid fragment & sequence analysis.
3. MinION DNA/RNA Sequencing Device from Oxford Nanopore Technologies
4. MJ Research PTC-200, PTC-225G and Minicycler Thermal cyclers
5. Eppendorf Mastercycler for gradient PCR
6. Invitrogen Qubit Quantification Platform for DNA, RNA and protein quantification.
7. Stratagene Mx3005P Real-time PCR system for fast and accurate nuclear acid quantification
8. Stratagene UV Stratalinker for controlled polymer crosslinking.
9. Automated 96-wellplate pipetting station Tecan EVO 150
10. Mettler Toledo Analytical Balances.
11. NovaGenesis Instrument for supercritical C02 processing.

Other general lab equipment includes electrophoresis devices, centrifuges, incubators, and water baths which are also well maintained in the lab.

Nano/Microfabrication Cleanroom UA Biomedical Sciences Partnership Building (BSPB)
Our nano/microfabrication lab occupies 900 sq. ft area. It is a class 1000/100 clean room with equipment for fabrication of nano/microstructures over a wide range of feature sizes, from sub-10 nm to hundreds of microns. It has the capability of nanoimprinting and nanocontact printing, photolithography and soft lithography, dry and wet etching, thermal and anodic bonding, metal deposition, etc. Below is a list of our key equipment:

1. PHI Hot Press: used for thermal bonding and for hot embossing of plastic microfluidic channel devices, as well as thermal nanoimprint;
2. UV nanoimprinter: capable of 4-inch gas press UV nanoimprinting;

3. HTG contact mask aligner: for photolithography, UV nanoimprinting and nanocontact printing with high resolution alignment capability;
4. Laurell Spin Coater: Spin coating of resist thin films;
5. Oxford Reactive Ion Etcher: ion enhanced plasma dry etching;
6. Semicore Electron Beam Evaporator: for physical vapor deposition of metals and other materials;
7. O2 plasma cleaner: Oxygen plasma cleaning of surfaces;
8. Anodic bonder: for bonding Si and Glass substrates for hot embossing stamper;
9. Solvent and Acid hood: for solvent/acid/base cleaning, etching and other chemical processing;
10. Rudolph Ellipsometer and Dektak Surface Profiler: for characterizing thin film and structure thickness, surface topography;
11. Optical microscope: for lab sample inspection; Hitachi SEM and Veeco SPM (pending purchase)
12. Vacuum Ovens: for thermal processing of materials
13. GeSim Nanoplotter 2.1 picoliter droplet dispenser

Optical Lab UA Biomedical Sciences Partnership Building (BSPB)
Our 500 sq. ft optical lab is capable of fluorescence microscopy analysis, Raman microscopy analysis of different samples. It has an Innova 70C Spectrum multi-wavelengths laser light source, one inverted Nikon Ti fluorescence microscope. The microscope is equipped with Andor electron magnified CCD cameras for sensitive imaging. There is also an Andor Shamrock Spectrograph for Raman analysis. Also installed in the same room are a Rame-Hart Instrument's goniometer for contact angle measurement, and a Olympus iSPEED camera for ultrafast video imaging for solid/liquid interface characterization. Below is a list of our equipment:

1. Innova 70C Spectrum laser: multiwavelength laser light source;
2. Nikon Eclipse TE300 microscope: inverted fluorescence microscope;
3. Andor iXon camera: EMCCD cooled camera for fluorescence microscopes;
4. Andor Shamrock Spectrography: for light spectrum analysis;
5. Andor iDus camera: CCD camera working with the spectrograph;
6. RHI Goniometer: for contact angle measurement.
7. Olympus iSPEED Camera; ultrafast video camera for solid/liquid interface characterization.
8. Melles-Griot MG-543 air-cooled argon-ion laser (x3): for fluorescent dye excitation (max. power: 250 mW at 488 nm);
9. Hamamatsu Orca-ER B/W CCD camera: intermediate high-intensity imaging;
10. BioDot AD1520 liquid dispenser
11. GelSight high resolution 3D visualization system with elastomeric tactile sensor
12. Two NanoSurf Atomic Force Microscopes LensAFM and FlexAFM

Electronics Lab UA Biomedical Sciences Partnership Building (BSPB)
The electronics lab occupies ~750 sq. ft. It is used for instrumentation prototyping. It has a LPKF ProtoMat S62 Advance Circuit Board Plotter, inspection microscope, power supplies, function generator, oscilloscope, and stocks of electronic components, FLIR infrared camera, and LabView software for instrument control. There are also several software platforms using industry standards databases for circuit design and components (e.g. Altium) as well as software packages for device design, modeling and simulation (e.g. AutoCAD, SolidWorks, multi-physics COMSOL). The equipment includes:

1. EVOM2 voltohmmeter from World Precision Instruments;
2. LPKF ProtoMat S62 Advance Circuit Board Plotter;
3. LPKF ProtoFlow S reflow oven;
4. Inspection microscope, power supplies, function generator, oscilloscope, stocks of electronic components,
5. FLIR infrared camera;
6. LabView software for instrument control and Altium Circuit Design and AutoCAD and SolidWorks software packages for device design;
7. Focused ultrasound (FUS) system, including a Siglent SDG 1032X Waveform Generator, 20W NP Technologies NP961 RF amplifier, Olympus A303S and A301S focused immersion ultrasound transducers, Siglent SDS 1104X-E oscilloscope, and Precision Acoustic 1mm needle hydrophone.
8. Amalgamator for nanobubble activation

9. FireStingO2 Optical Oxygen Meter.

Plastic Fabrication Lab The lab is used as an in-house manufacturing lab for ANBM. Our primary focus is on manufacturing plastic parts for lab on chip applications however we have the capabilities to CNC plastic and soft metals, Mill medium metals, CO2 laser machine parts, 3D-printing, precision fluid dispensing, screen printing, and UV curing. Below is a list of our equipment:

1. Two Roland MDX 540 CNC machines: for machining plastic plate stock for lab-on-chip cartridge manufacturing
2. Bolton tools ZX745AD Milling and Drilling machine: for manual mill operations of plastic parts
3. Versa/laser VL-200 C02 laser: used to cut gaskets and or Pressure Sensitive tapes/adhesive films
4. Weiss Machine Tools Lathe, Model WBC250FX550, for turning of plastic parts
5. Dymax Bluewave 200 UV Curing machine: used for electrode install and other part assemblies
6. Formlabs 3B SLA printer; 3-D printing parts and services
7. Carver manual press Model 3669, Pressing of Laminate cartridge assemblies

Shared Cell Culture Facility UA Biomedical Sciences Partnership Building (BSPB)
The shared cell culture facility is a 480 sq. ft BSL-2 level bio-containment laboratory. A dedicated room for sterile handling of human cell cultures is available with a biosafety cabinet (certified annually), water-jacketed CO2 incubators, an inverted microscope, water bath, centrifuges, small fridge and a liquid nitrogen Dewar for cryopreservation of cells. A second and isolated room with similar equipment plus a platform shaker-incubator are also available for bacterial culture.

Translational Cardiovascular Research Center

The Translational Cardiovascular Research Center (TCRC) is located on the 8th floor in the new Biomedical Sciences Partnership Building (BSPB) at the University of Arizona, College of Medicine - Phoenix. The TCRC has a new constructed animal physiology room of 1,500 sq. ft. in addition to the shared procedure room in the vivarium. The dedicated physiology room is equipped for microsurgery, which includes three dissection microscopes, small animal ventilation machines, isoflurane anesthetic systems (suitable for mice and rats), three complete sets of microsurgery instruments (including eye scissor, utra forceps, vannas straight capsulotomy scissors, micro suturing needle holder, micro dissecting forceps, hemostatic forceps, micro vascular clips, scalpel blades, scalpel handles, suture needle and sutures). The dedicated small animal physiology room also houses a Vevo 3100/LAZR-X small animal Imagine System (ultrasound and photoacoustic), an M7 SimPET compact high-performance MRI and PET imaging system for mice and rats, *in vivo* invasive hemodynamics, telemetry for up to 16 mice at-a-time, 2 B2 biosafety cabinets, a tail-cuff CODA instrument from Kent Scientific capable of measuring up to 8 mice at-a-time, and a treadmill from Columbus Instruments capable of running up to 5 mice at-a-time. The TCRC also houses a new designated confocal imaging room and histopathology rooms of 250 sq. ft. each. The confocal room houses a Leica TCS SP8 STED super-resolution confocal with white light laser, FALCON/FLIM and Tau Sense, and a Leica DMi8 S Infinity THUNDER with TIRF module equipped with a stage top incubation chamber for live cell imaging. The histopathology room houses a Leica HistoCore manual microtome, a Leica CM1950 cryostat, a Leica HistoCore Arcadia paraffin system and 2 recirculating air chemical hoods. Separately, the TCRC houses an adenoviral lab space that is shared laboratory space and equipped with a tissue culture and a BSL2 retroviral and adenoviral tissue culture facilities, Olympus CM20 cell culture imaging system, 6 Thermo Forma Series 3 incubators, cold and centrifuge rooms, cell cryostorage, and autoclaves/dishwasher service.

CORE SERVICES & FACILITIES

Animals

The University of Arizona Animal Care and Use Program and its animal facilities and farms are accredited by The Association for Accreditation and Assessment of Laboratory Animal Care International (AAALAC) as one unit. The Institutional Animal Care and Use Committee (IACUC) and University Animal Care (UAC) are

responsible for managing and administering a centralized program of animal care and use that complies with The Animal Welfare Act/Animal Welfare Regulations (AWA/AWR), and other applicable federal regulations such as GLP, for covered species and activities; The National Research Council Guide for the Care and Use of Laboratory Animals 8th Edition 2011 (Guide) for all vertebrate animals used in biomedical research; The Guide for Care and Use of Agricultural Animals in Research and Teaching 4th Edition 2020 (Ag Guide) for production farm animal research and teaching; the U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research, and Training"; and the PHS Policy on Humane Care and Use of Laboratory Animals. The University has an approved PHS Assurance, which covers all vertebrate animals used in biomedical research (#A3248-01), on file with OLAW. The Phoenix Biomedical Campus Animal Facility (PAF) (19,603 GSF; 9,317 NASF) was completed in 2013 and serves the UA College of Medicine-Phoenix and its affiliates. The animal facility is controlled and operated by University Animal Care and is a component of the centralized UA animal care and use program.

Biostatistics and Study Design Services

The Biostatistics and Study Design Services provides statistical support to researchers at every stage of research projects, from study design to publication. Support typically includes evaluating the research protocols to ensure appropriate hypotheses and outcome measures, performing power and sample size analysis, drafting the statistical analysis plan, drafting the statistical section for grant proposals and IRB applications, setting up randomization procedures, providing advice on data collection and management, participating in study monitoring, conducting statistical analysis, and preparing presentations and manuscripts. The service team can also provide advice on statistical analysis and assistance with statistical software usage if the investigators prefer to perform the analysis themselves.

Biomedical Imaging Core

The Biomedical Imaging Core offers leading edge instrumentation to meet the microscopy and imaging needs of researchers at the University of Arizona College of Medicine – Phoenix and around the Valley. Conveniently located on the downtown Phoenix Biomedical Campus at the UA College of Medicine – Phoenix, the core is designed to be a campus-based resource available to UA affiliated and non-affiliated faculty and researchers. The core offers epifluorescence, confocal and two-photon imaging, along with resources for sample preparation and post-acquisition processing and analysis.

The core has multiple microscopes that address a variety of different research needs and applications. Core instrumentation includes the following: **1) A Zeiss Axio Imager M2** upright fluorescent microscope equipped with filters for DAPI, Alexa488/GFP, Alexa546/Cy3, and Alexa647/Cy5 dyes. The microscope is capable of automated x-y-z scanning and tiling. **2) A ZEISS LSM710** inverted confocal microscope that offers multiple laser lines for imaging multi-color fluorophores and is equipped with a temperature control chamber and CO2 supply for time-lapse imaging. **3) An Olympus FV MPE RS Apollo system** equipped with dual two photon laser lines (690-1300 nm tunable and 1040 nm fixed), allowing simultaneous imaging of multiple fluorophores in vivo. The microscope is equipped with high resolution galvo scanner, a resonant scanner for fast dynamics imaging, and a stim scanner. **4) A Keyence BZ-X800E** automated inverted digital microscope system equipped with filter cubes for detecting DAPI, GFP/488, Cy3 and Cy5 fluorochromes. The BZ-X800E includes automated slide scanning capabilities and can accommodate a variety of sample formats including slides and tissue culture plates, dishes, and flasks. **5) A MBF Bioscience system with Neurolucida and Stereo Investigator** that allows accurate reconstruction of cells for detailed morphometric analyses and 3D mapping along with unbiased estimates of the number, length, area, and volume of cells or biological structures in a tissue specimen. The core also provides access to workstations for post-acquisition processing and analyses including deconvolution, colocalization and quantitation along with a **Leica CM195 Cryostat** and a **Cytospin centrifuge** for sample preparation.

Flow Cytometry Core

The core is located on 5th floor of Phoenix Biomedical Science Partnership Building (BSPB), Rm E535.

Expertise and Training: The flow cytometry core is led by Mrinalini Kala, PhD, SCYM(ASCP)$^{CM.}$. Dr. Kala is a Research Assistant Professor in Department of Internal Medicine, who is certified by American Society of Clinical Pathology board of certification for flow cytometry. She provides expertise on conceptual development for flow cytometry related projects, experimental design, panel development, consultation, assay design, training, sample preparation, data analysis and keeping the investigators updated with technology development, via organizing seminars and workshops.

Equipment's: The core houses a **cell sorter, FACSAria II (BD Biosciences, San Jose, CA)**: 3 (RBV) laser system capable of high throughput sorting (25000 EPS) with greater than 99% purity. This sorter also has high performance analysis capabilities for assays of cell proliferation, immunophenotyping, and apoptosis. It can perform aseptic sorting with 4 different markers at one time on tubes, slides and micro well plates. This system is also capable of single cell or specific number cell sorting.

Additionally, the core houses **2 analyzers, Canto II (BD Biosciences , San Jose, CA)**: A 3(RBV) laser 8 Color Analyzer with 488nm, 647nm and 405nm wavelength laser system. It is capable of high-performance analysis for assays such as cell proliferation, immunophenotyping, cell cycle, and apoptosis. FACSDiva software is used for acquisition and analysis. The core also houses **2 (RB) laser analyzers, Guava (MD Millipore)** with high throughput system. Another 2-laser analyzer is located in ABC 1, 3rd floor, **BD LSRII,** capable of 6 color analysis in single tube manual mode. A **lyse wash system** is available for lysis of blood for flow cytometry. The core also provides training to investigators, students and postdocs on analyzers and analysis workstation for high-end data analysis software such as FlowJo, Diva and Incyte.

The Flow cytometry core is a fee for service infrastructure resource for PIs. It is supported by College of Medicine Phoenix, that provides subsidy for its sustainability. The rates charged are indicated in table below:

	Internal	
Equipment	**Unassisted**	**Assisted**
Aria II (Sorter, laser RBV)	N/A	$125/hour
Canto II (Analyzer, laser RBV)	$40/hour	$104/hour
Guava (Analyzer, laser RB, HTS system)	$25/hour	$90/hour
LSR II (Analyzer, laser RB)	$25/hour	$90/hour
Consultation	Free	N/A
Training	Free	N/A

Molecular Discovery Core

The Molecular Discovery Core (MDC) is a comprehensive core that provides the Phoenix Biomedical Campus research community with multiple instruments geared towards the discovery and analysis of biomolecules. This core supports a wide variety of research activities that facilitate the screening and analysis of proteins, compounds, nucleic acids, bioactive molecules, and biomolecular interactions. Furthermore, the core offers full peptide synthesis and purification services. Dr. Timothy Marlowe is Director of the core facility.
The MDC has the following equipment: a Pioneer FE Surface Plasmon Resonance (SPR) system, a Tecan Freedom Evo 100 Liquid Handling Robot, BMG ClarioSTAR+ Multimode Plate Reader, Schrodinger Small Molecule Drug Discovery Suite, Biotage Initiator+ Alstra Automated Microwave Assisted Peptide Synthesizer, Agilent 1260 Prep HPLC System, Agilent 1200 Analytical HPLC w/ Single Quad Mass Spectrometer, LabConco -105C Lyophilizer, and a GE Typhoon FLA 9500 imaging system. The MDC offers the following

services: Consultation on SPR or other bioassay design, consultation on protein purification, assay development and optimization, protein immobilization optimization, buffer and pH screening, binding and kinetic characterization, small molecule and/or fragment screening, kinetic data analysis (KD, Ka, Kd, etc.), assay automation, plate replication/reformatting, in silico screening, processing of clinical sampes, solid-phase peptide synthesis, compound/peptide purification by HPLC, analytical LC-MS, lyophilization, fluorescent, chemiluminescent, radioisotopic, and colorimetric imaging, imaging of blots/gels, imaging of tissue sections, imaging of arrays, phosphor screens, grant writing and preliminary data.

Other Core Facilities and Resources
This state-of-the art biomedical campus is an exceptional environment in which to conduct our research. In addition, the University of Arizona's main campus, in Tucson, AZ provides core facilities, equipment, and resources that are also available to Phoenix faculty. The complete list is found here: Research Services | UArizona Research, Innovation & Impact.

PARTNER FACILITIES

PHOENIX CHILDREN'S HOSPITAL, PHOENIX, AZ

Phoenix Children's Hospital (PCH) is a tertiary care center which provides comprehensive inpatient, outpatient specialty and primary care, urgent care, emergency, and level one pediatric trauma services. Phoenix Children's Hospital is a free standing children's hospital in the sixth largest metropolitan region in the country and the only facility dedicated solely to the needs of children in the state. In its first ten years as a free standing hospital, it rapidly became one of the largest in the country being easily in the top 10 in volume (355 licensed beds) and major disease conditions (for example, PCH is with the top 5-6 for cardiovascular and neurological procedures). PCH is an American College of Surgeon's Level I trauma center seeing about 2100 patients/yr. In 2011, a new patient tower opened (over $500 million in construction costs). In 2014, Phoenix Children's had 18,286 admissions; 78,612 visits to the Emergency Department; 216,241 outpatient visits; and 16,227 surgical procedures in the primary facility and 4 major outreach locations. Phoenix Children's offers care in more than 70 subspecialty fields of pediatric medicine including 6 centers of excellence. Nine of Phoenix Children's divisions— Neurology & Neurosurgery (14), Cancer (16), Cardiology & Heart Surgery (16), Nephrology (17), Urology (21), Orthopedics (28), Pulmonology (28), Gastroenterology & GI Surgery (36), and Diabetes & Endocrinology (37)—were ranked in the 2015-2016 edition of U.S. News & World Report Best Children's Hospitals.

The overall clinical program at PCH includes over 220 employed medical staff, over 800 medical staff with privileges, and transplant programs in blood, kidney, heart, and liver. The staff of PCH is the primary pediatric staff of the University of Arizona, College of Medicine – Phoenix, a school which is 10 years old and has preliminary LCME accreditation as a separate and distinct school from the Tucson campus. The research areas are also new but growing rapidly and include wet bench research at the University of Arizona College of Medicine - Phoenix, Arizona State University, the Translational Genomics Research Institute (TGen), and the Barrow Neurological Institute at St. Joseph's Hospital. Internally, PCH has over 340 IRB approved active research protocols. In addition to these collaborators, clinical research collaboration also includes the University of Arizona College of Public Health.

Phoenix Children's Hospital is a freestanding hospital licensed to care for pediatric patients 18 years of age and younger. There are circumstances where it may be in the best interests of those patients older than 18 to be admitted to this facility. These patients may include patients with complex medical conditions that are either congenital (e.g., congenital heart disease, spina bifida, cystic fibrosis), began in childhood or would be considered to be a pediatric disease process. In these cases, providers at Phoenix Children's Hospital may be uniquely qualified to provide care for these patients that are not otherwise available in adult hospitals.

In the Fall of 2014, Phoenix Children's Hospital announced the development of a joint venture with Nanthealth, LLC and the Chan Soon-Shiong Foundation, resulting in the planned creation of the Chan Soon-Shiong Children's Institute for Precision Medicine at Phoenix Children's Hospital (CSSCIPM). For PCH, the creation

of this venture will allow researchers, clinicians, and patients unprecedented access to whole genome sequencing, transcriptomics and proteomics capabilities with a rapid turnaround time frame offered in a CLIA laboratory setting. The molecular profiling capabilities of the CSSIPM at PCH will include access to high-speed computers and state-of-the-art bioinformatics algorithms that will allow rapid and accurate analysis of the high volumes of data generated for each patient. The access to a high quality, clinical grade pediatric database that houses the molecular profiling information of large numbers of pediatric patients will allow the meaningful interpretation, reporting, and investigational research of 3 – 4 million variants that are uncovered with the sequencing of each pediatric patient. More importantly, a pediatric focused approach using these next generation sequencing technologies will enable rapid discovery of new genes and new pathogenic variants leading to an unprecedented rate of knowledge expansion for pediatric diseases. Currently, our knowledge of the genes involved in pediatric diseases is very limited and thus in today's medical setting, care that is delivered based on the child's molecular profile is almost non-existent. The care is therefore not personalized to the patient's genetics and is focused more on traditional approaches based on protocols and checklists arising out of observational studies for care management. The genomics, transcriptomics and proteomics research within the CSSCIPM will enable cutting edge research for pediatric diseases that include cancer and inherited Mendelian diseases as well as common, complex genetic diseases such as autism, type 2 diabetes, obesity, and autoimmune diseases. Because the focus of PCRI is translational research, the discoveries within the CSSCIPM are expected to guide decision-making concerning standard of care and/or investigational treatment within a rapid time frame. PCRI will provide operational and administrative oversight for research activities undertaken by the CSSCIPM and will oversee the biorepository operations required to support such an initiative.

The clinical staffs for each division are provided offices within the clinic space. Each office is approximately 100 square feet in size. Each office includes a PC computer, phone, and network capabilities. Support staff has access to workstations which include computer, phone, and network capabilities. Additionally, the hospital has work stations in each of the clinical inpatient and surgical areas where staff can access electronic medical records for patients. Offsite clinics are networked into the main systems to provide electronic access.

Electronic medical records systems, computerized order entry and all support information needed for this project can be easily obtained in a secure fashion via the hospital's integrated IT system. PCs, printers, scanners, and fax machines are located all throughout the hospital. Personnel can easily obtain, in a secure fashion, electronic medical records systems, computerized order entry, and all support information needed for this project via the Phoenix Children's integrated IT system.

IT AND DATA MANAGEMENT

Phoenix Children's Hospital (PCH) has a fully functioning data warehouse that combines data from over 43 discrete systems used throughout the organization. This data warehouse is complete, mature, and used daily by hundreds of staff at PCH to make real-time clinical decisions that affect patient care. PCH has been able to define and utilize linking between all the data from the clinical, financial, and operational systems to discover relationships between data that are not immediately obvious to someone focused on traditional, specific, clinical datasets. This capability has supported many research initiatives through the use of not just the core clinical dataset for a patient but also all the ancillary data to help describe the patient's complete case. This ability to report in real-time and across a broad range with a complete array of datasets, places PCH in a unique position to derive a complete clinical picture of the patient often outside the thinking of traditional data capture methods.

This strategy has been so successful that PCH is now widening the scope of clinical data gathering to include clinical data from our affiliated community physicians with the implementation of a privately managed health information exchange between its networks of providers. This initiative allows the analysis of clinical data from a broader continuum of care for each patient and leverages PCH's data management skills in both a shared data/cloud storage solution while controlling the security and management of identifiable patient data.

Phoenix Children's Hospital has a specialized skill in predictive analytics by leveraging the opportunity to analyze big data mined from our very large datasets to predict future outcomes based on past history. Using

techniques and personnel from the banking and retail industry, PCH has been successful in utilizing predictive analysts to better position its resources to meet patient demand in its clinics. These same tools are now being used to analyze historical patient data to predict future patterns or events in very focused and specific scenarios.

PCH classifies data work into three broad categories: data architecture, data analysis and data consumption. The data architecture role describes the collection and normalization of the data from the source systems into the data warehouse and is a core competency at Phoenix Children's. The data analysts are individuals with both data manipulation skills (SQL) and subject matter expertise of the data being analyzed. They then transform the data into meaningful information for consumption. The final role of data consumption uses an array of data visualization tools. It is focused on the subject matter expert and allows that person to quickly ask different questions of the derived dataset prepared by the analyst.

PCH INSTITUTIONAL REVIEW BOARD

The Institutional Review Board at Phoenix Children's Hospital (PCH IRB) is an experienced board with a wide variety of medical disciplines represented. The scientific members currently serving on the IRB represent Neuroscience, Trauma, Pathology, Hematology/Oncology, Critical Care, Nursing, and Pharmacy. The non-scientific members include a retired judge, an attorney, and a Chaplain. This diverse membership allows the PCH IRB to review a wide variety of research protocols. In addition, the Scientific Review Committee (SRC) is a sub-committee of the IRB that reviews studies to ensure scientific merit has been achieved before they are reviewed by the IRB. This added review provides the IRB with important information regarding the scientific validity of a study. The PCH IRB is currently monitoring over 360 active studies being conducted at PCH.

The PCH IRB is housed in its own office located inside of the PCH Office of Research, consisting of one office suite that encompasses almost 300 square feet of space that houses the administrative office of the IRB Administrator and the IRB Coordinator. The Director of Research Operations, Denise Drumm-Gurnee, has ample administrative office space, and is individually supported by the IRB Administrator, IRB Coordinator, and the Research Manager, along with research coordinators and a Research Office Coordinator.

The IRB offers quarterly Research Office/IRB training sessions to provide information to the research coordinators and investigators conducting research at PCH. Past sessions have included information on how to submit a study to the IRB, a session on informed consent, statistics, etc. These presentations are videotaped and housed on the PCH intranet to allow for any interested parties to add to their knowledge of research and the IRB.

BARROW NEUROLOGICAL INSTITUTE at PHOENIX CHILDREN'S HOSPITAL

Barrow Neurological Institute at Phoenix Children's Hospital (Barrow at PCH) is a Center of Excellence at Phoenix Children's Hospital (PCH) and is affiliated with the University of Arizona, College of Medicine - Phoenix (U of A COM- PHX). Barrow at PCH has developed a comprehensive and integrated neuroscience program and serves as the administrative umbrella for all of the "neuro" divisions at Phoenix Children's Hospital including its core divisions; Neurosurgery, Neurology, Psychology, Neuropsychology, Psychiatry, and Physical Medicine and Rehabilitation, as well as the collaborative divisions of Neuroimaging, Neurocritical Care, Neuro Neonatal Intensive Care, Neuropathology, Neuro-Oncology, and Neuro-Otology, with over 70 faculty and 100 support staff.

Barrow at PCH is housed in its own building on the PCH Medical Center main campus and consists of 2.25 floors and over 30,000 square feet of office, clinical/ clinic, and rehabilitation space as well as dedicated clinical research space consisting of 8 offices, 1 conference room and 1 consult room for the Neuroscience Research Division that includes Research Coordination, Bioinformatics, Biostatistics, Biorepository, Neuroimaging, and Neurophysiology. The Director has ample administrative office space including 6 offices for staff, 1 boardroom, and is individually supported by a full-time administrator, administrative executive assistant, and clinical

administrative assistant, along with clinical staff and a full-time research staff. There are presently over 25 research staff including research scientists, research coordinators, biostatistician, research associates, biomedical engineers, administrators, and support staff dedicated to the Neuroscience Research Division.

Barrow at Phoenix Children's has very active fellowship and residency programs. With the alliance between Barrow Neurological Institute at St. Joseph's Hospital and Medical Center and Phoenix Children's Hospital, the Child Neurology Residency Program moved to Barrow at Phoenix Children's in June 2011. Child Neurology is classified as a "dependent residency" and is linked to the Adult Neurology Residency Program at Barrow at St. Joseph's. The Child Neurology Residency Program is a three-year program which follows two years of general pediatric preliminary training. With the alliance, a five-year combined program was launched at Barrow at Phoenix Children's. The program has successfully matched two years in a row with the establishment of the new five-year combined program. Since July 2014 the program has a full complement of six residents. The Institute has a fellowship program in Neurosurgery that started in July 2013 and a Neuropsychology Post-Doctoral Fellowship that started in 2012.

Barrow at PCH places a large emphasis on teaching and research activities. Each division participates in training PCH pediatric residents as well as the Neurology, Neurosurgery, and Psychiatry residents from Mayo Clinic Arizona and St. Joseph's Hospital. In addition, many of the faculty are involved in teaching and mentoring medical, graduate, and undergraduate students from the University of Arizona College of Medicine (COM)-Phoenix, Creighton University, and Arizona State University.

Clinical:

Neurotrauma/ Concussion Program

Through an interdisciplinary collaboration of Neurosurgery, Neurology, Neurocritical Care, Sports Medicine, Neuropsychology, Neuroimaging, Injury Prevention, and Neurorehabilitative Services, the program provides improved communication, clinical care, research, education, and patient- and family- centered care to children who have suffered from a concussion or traumatic brain injury.

Stroke Program

Under the direction of Dr. John Condie, the multidisciplinary Pediatric Stroke Program is focused solely on providing comprehensive care in the evaluation, management and treatment for infants, children, and teens who have suffered a stroke, or children who may be at risk for stroke due to other medical conditions. The dedicated pediatric stroke team has the appropriate expertise and resources for the diagnosis and treatment of pediatric stroke and pediatric stroke prevention. Early recognition and diagnosis are critical for stroke patients, as delays in seeking treatment can lead to permanent disability and stroke recurrence.

Inpatient Rehabilitation Program

The Frances H. McClelland Rehabilitation Program at Phoenix Children's Hospital is made up of a comprehensive team of pediatric trained physicians, nurses, and therapists who care only for growing children. Among the specialties of our rehab program for kids is the Inpatient Rehabilitation Program - offering services tailored specifically to the needs of each child. Our inpatient rehabilitation program -- the only one just for children in Arizona -- has been caring for hospitalized patients for more than 15 years. We help children ages 8 months to 17 years. The goal is to serve the comprehensive needs of our patients and return them to their home, school, and community as quickly and safely as possible. The inpatient rehabilitation program provides a comprehensive, multidisciplinary approach provided by a team of experienced pediatric professionals to maximize the recovery of children with conditions such as traumatic brain injury, spinal cord injury, stroke, neuromuscular diseases, orthopedic conditions, burns, deconditioning, and respiratory/cardiac conditions.

Scientific Environment

Barrow at PCH places a large emphasis on teaching and research activities. There are presently over 20 research staff including research scientists, research coordinators, biostatistician, research associates, biomedical engineers, administrators, and support staff dedicated to the Neuroscience Research Division. Each division participates in training PCH pediatric residents as well as the Neurology, Neurosurgery, and

Psychiatry residents from Mayo Clinic Arizona and St. Joseph's Hospital. In addition, many of the faculty are involved in teaching and mentoring medical, graduate, and undergraduate students from the University of Arizona College of Medicine (COM)-Phoenix, Creighton University, and Arizona State University.

TRANSLATIONAL GENOMICS RESEARCH INSTITUTE (TGEN), Phoenix, AZ

The Translational Genomics Research Institute (TGen) is a non-profit 501(c)(3) organization focused on developing earlier diagnostics and smarter treatments. Translational genomics research is a relatively new field employing innovative advances arising from the Human Genome Project and applying them to the development of diagnostics, prognostics and therapies for cancer, neurological disorders, diabetes and other complex diseases.

The TGen Proteomics Lab includes a new Waters GCT Premier time of flight mass spectrometer with accurate mass measurement capabilities of sub 5 ppm and mass resolution of 7000 that is interfaced to an Agilent 7890 gas chromatograph with split/splitless and programmed temperature vaporizer injectors and sub-ambient oven temperature program capabilities. The primary sample injection technique can be accomplished using a LEAP Technologies Combi-Pal automated Solid Phase Micro-Extraction (SPME) and liquid injection system. Our capillary gas chromatography time of flight mass spectrometer (GC-TOFMS) system is configured for head space sampling of volatile organic compounds from liquids, in particular biological fluids such as blood and urine. This equipment enables discovery studies of chromatographic profile of volatile organic compounds (VOC) that can be correlated to a particular disease or metabolic change (e.g., radiation exposure). Bioinformatics algorithms developed at TGEN and running on the IBM cluster are also available at this site.

HONORHEALTH, SHEA CAMPUS AND THE HONORHEALTH RESEARCH INSTITUTE, Scottsdale, AZ

HonorHealth Shea Campus (HHSC) is a 405-bed JCAHO-accredited acute care hospital with all private rooms. Known for its cardiology, orthopedics, oncology and women's services, the hospital recently added a 28-bed inpatient unit devoted to its Bariatric Surgery program. Other facilities include level II trauma center, cardiology services, oncology services, pediatric services, family birthing center, women's diagnostic center, weight management center, daVinci Surgical System, Piper Surgery Center and Virginia G. Piper Cancer Center. At HHSC, the HonorHealth Research Institute serves as an umbrella for HonorHealth's research activities, which include research by community physicians and hospital staff members, as well as research affiliations with several institutions including the Translational Genomics Research Institute, Arizona Cancer Center, International Genomics Consortium, University of Arizona, and Arizona State University. Key equipment for the Radiation Oncology Department comprises Varian LINAC accelerators used for ex vivo blood sample irradiation but also accessing patients undergoing total body irradiation that can be of relevance to the present study and under IRB protocols.