

INSTITUTIONAL RESOURCES

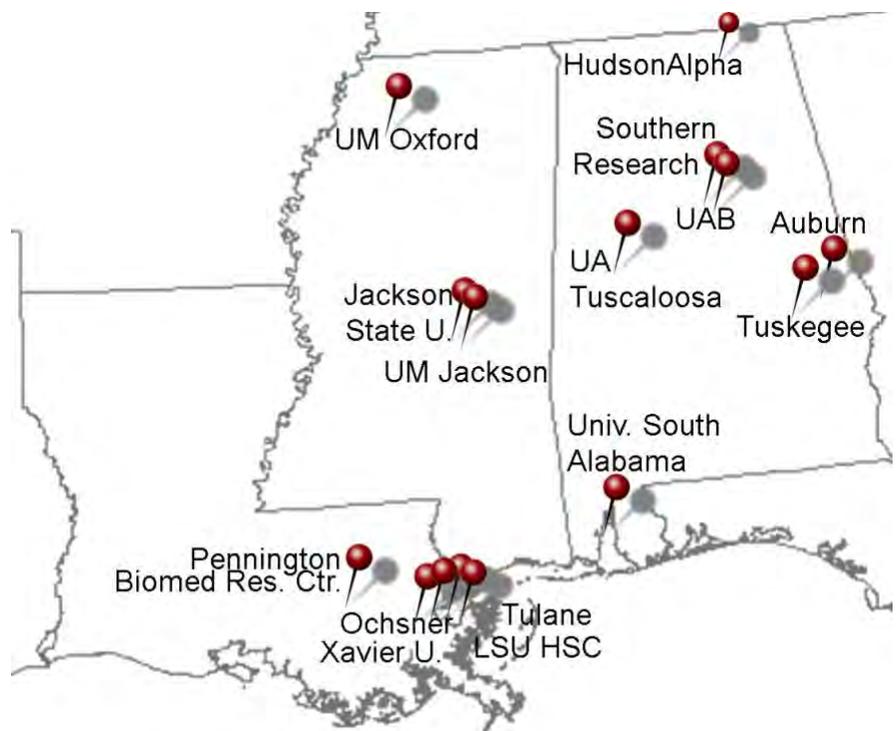
Building on research strengths at the University of Alabama at Birmingham (CCTS Hub), the CCTS continues to engage Institutional Partnerships to create a vibrant scientific environment to improve and accelerate translational research and workforce development. The Institutional Resources herein provide detail on the CCTS facilities and technology, followed by detailed descriptions of CCTS Partners' resources, starting with the Hub and followed by Partners in alphabetical order.

CENTER FOR CLINICAL AND TRANSLATIONAL SCIENCE (CCTS)

To speed the translation of research into improved human health, the CCTS and its Partner Network are committed to increasing research capacity, accelerating research processes, developing and supporting excellence in the research workforce and providing creative, innovative approaches to major health and health care delivery challenges. The CCTS offers access to a number of resources and capacities through its co-leadership of the Clinical Trials Initiative as well as the Training Academy and the Research Commons.

CCTS Partner Network – In synergy with the resource strengths available at UAB, the CCTS has established Institutional Partnerships to improve and accelerate translational research. The CCTS Partner Network crosses institutional boundaries to improve human health and health care delivery. This innovative partnership is well integrated into the fabric of the CCTS and provides the foundation for addressing health disparities through collaborative research and training efforts. Building on some initial relationships from the Deep South Network for Translational Research, we have significantly expanded to create new and more formal

partnerships with regional institutions for mutual benefit. Regional partners are working together to facilitate and promote unique opportunities, including (but not limited to) drug discovery and development, genomics, advanced magnetic resonance imaging, population health and outcomes research. Partners include UAB (Hub), Southern Research, Auburn, South Alabama, HudsonAlpha, LSU, University of Mississippi-Oxford, Pennington, Tulane, UA-Tuscaloosa, Tuskegee). See <http://www.uab.edu/ccts/partners>. Building on this culture of collaboration, the CCTS has expanded its relationship with other affiliate institutions to advance programmatic synergies (University of Mississippi-Jackson, Jackson State University, Ochsner Health, and Xavier University).



Clinical Trials Initiative

The mission of the UAB Clinical Trials Initiative is to promote, foster, and enhance high-quality clinical research at the University of Alabama at Birmingham. UAB's initiative is to provide, support and direct the implementation of cutting-edge human subject research. By promoting clinical research, the effort will help the UAB community meet its mission goals of excellence in patient care, education, research, and community service. The Institution is committed to providing world-class patient care with innovative therapies to treat disease, promote health and wellness, and provide opportunity for patient participation in clinical research. As an academic medical center, it is our responsibility to participate in research that leads to new discoveries and advances the art and science of medicine for future generations. This collaboration provides services to:

- UAB researchers and research teams, assisting with feasibility assessment, methodologic rigor, study start-up, implementation and reporting.
- Patients and the general public, providing opportunities for study participation.
- Sponsors, helping them identify UAB investigators for participation in their research.

As part of this effort, the CCTS mission addresses four programmatic tasks: 1) performance standards to meet and exceed national standards; 2) educated and knowledgeable workforce; 3) implementation of scientifically reproducible research; and 4) services to support rigorous design and interpretation. Toward these goals, the CCTS Hub has developed a multi-modal implementation strategy overseen by the Clinical Trials Advisory Committee (CTAC) and including guidance in Quality and Efficiency and training via Regulatory Knowledge and Support.

Clinical Trials Advisory Committee (CTAC)

UAB's President recently charged the newly-formed Clinical Trials Advisory Committee (CTAC) with the continuous quality improvement toward excellence in clinical trial administration at the Hub. The group meets monthly to refine the expectations in the conduct of trials, consistent with institutional and national objectives. It continually monitors processes to enhance effectiveness and efficiency while upholding the highest standards of transparency, patient safety, ethical conduct and regulatory compliance. The CCTS Director, Dr. Robert Kimberly, chairs the Committee, which reports directly to the President of the University. The director of CCTS Network Capacities, Dr. Jason Nichols, oversees CTAC's Time to Activation Initiative and represents the Partner Network in the context of multi-site studies. CTAC is transforming the organizational culture at the Hub to support trials through the comprehensive integration of institutional workflows, best practices in performance, education, information technology and data systems, financial management and participant safety in coordination with other research administration offices (sponsored programs, IRB, etc.).

Quality and Efficiency

The CCTS supports the design and conduct of ethical and scientifically valid clinical trials in an environment predicated on good clinical practice and implemented by a well-trained research workforce. The CCTS works with individual investigators and research teams and with the enterprise to ensure quality and efficiency in scientific investigation involving human subjects. CCTS Institutions have organized tools, expertise and facilities to help investigators succeed at every stage of trial development and implementation:

- **Pre-Implementation and Study Start-up** (e.g., Training & Education in Good Clinical Practice, BERD expertise for study design & methods, informatics assets for feasibility assessments, regulatory support, scientific review of human subjects protocols, guidance for budgeting and contracting, specialized capacity for multi-site investigation).
- **Study Activation and Implementation** (e.g., informatics tools for recruitment & retention, point of care trial notifications, experienced recruiting teams, integrated clinical trial management system (OnCore), state-of-the-art facilities, trained pool of research coordinators)
- **Analysis, Reporting and Close-out** (e.g., CTAC monitoring, ClinicalTrials.gov assistance, user-friendly data management and archival systems, OnCore tracking, project panels for publications)

Pre-Implementation and Study Start-up

Training. CCTS Clinical Research Support Program (CRSP) serves a vital role in workforce education by supporting a comprehensive portfolio of complementary programs to introduce and to reinforce skills needed to succeed in translational research, especially as it applies to clinical trials (see RM-RKS). Accessible across the Partner Network, these activities embrace established competencies defined by the national CTSA Consortium and address investigator needs at any stage across the career arc.

Study Design. (Described below under Biostatistics, Epidemiology and Research Design (BERD)) BERD engages expert methodologists spanning the Partner Network to support a diverse array of study design and analytic needs in the performance of clinical and translational research. All

investigator-initiated trials work with biostatisticians to optimize study design, power and analytic strategies early in the development of the study. This collaborative effort also defines the key components (e.g., outcome measures) needed for federal registration and reporting expectations, including clinicaltrials.gov.

Feasibility Assessment. (see Informatics, below) Prior to initiating a clinical protocol, a comprehensive feasibility review is conducted by the academic department of the investigator through the Scientific Review Process to determine whether a given trial has the potential to succeed relative to multiple dimensions. This assessment addresses the rigor of science, expertise and availability (effort) of the investigative team and the competitive landscape for duplicative trials. CCTS Informatics has created both self-service and analyst-facilitated query strategies of electronic health record data through i2b2 to assess cohort feasibility.

Regulatory. The CCTS CRSP (see Clinical Research Services, below) is available to work with investigators in the establishment and ongoing management of human subjects protocols. In the case of multi-site, interventional, human subjects research, all CCTS Network Partners have formally agreed to use IRB reliance and have joined NCATS' [Streamlined, Multi-site, Accelerated Reliance for Trials \(SMART\) IRB](#) to harmonize and streamline processes to support the protection of human subjects in research in multi-site research. The CCTS also assists investigators with [IND/IDE applications](#), including protocols related to repurposing existing drugs for new indications, evaluating drugs in new patient populations, new biological-based imaging agents, and gene therapy vectors.

Budgeting & Contracting. As each new protocol is submitted to the IRB, it is also assessed for appropriate billing to sponsors. Members of CRSP are available to advise and assist investigators in the development of study budgets that are allowable and appropriate. In collaboration with the clinical study team, the Clinical Billing Review group evaluates each budget to ensure that the cost of each study procedure is appropriately assigned to the sponsor and that Medicare-assigned costs and/or standard of care costs are accounted for within the budget. Budget negotiations are handled by the department and/or the study team, and contracting is handled by the Office of Sponsored Programs. The CCTS Hub has worked with the National CTSA Consortium in the development, adoption and use of master contracts to support multi-site study execution, including the [Accelerated Research Agreements](#) (ACTA, ACDA) to streamline the negotiation of nondisclosure agreements and clinical trial contracts and to reduce the time that it takes to initiate clinical trials.

Multi-site Trials. The CCTS [Southeastern Health Alliance for Research \(SHARe\)](#) provides the streamlined frame within which to conduct multi-site clinical, translational and comparative effectiveness research across the Partner Network as it serves the health challenges of the diverse populations of our region (see Net Cap). SHARe represents the CCTS Network as it interfaces with NCATS' [Trial Innovation Network \(TIN\)](#) (see Network Capacities). The CCTS Hub and several Partners have also established a partnership with [TriNetX](#), a federated clinical data network of providers and pharmaceutical companies that uses i2b2 to accelerate trial site and patient recruitment. The CCTS currently receives weekly invitations to participate in trials from TriNetX, representing a variety of adult and pediatric diagnoses related to hematology, oncology, nephrology, neurology and genetics.

Study Activation and Implementation

Recruitment and Retention. Trial recruitment is enabled at the point of care by [Cerner PowerTrials®](#), allowing for a seamless integration of the research recruitment process into normal clinical practice. Community-based recruitment is enabled by the Hub's [Recruitment and Retention Shared Facility \(RRSF\)](#), providing hands-on assistance to investigators with recruitment materials and strategies, linkages to communities, culturally appropriate techniques for the recruitment of minority subjects, and maintenance of a Recruitment Database. With the appropriate IRB approvals, CCTS Informatics supports analyst-facilitated data requests defined by study inclusion/exclusion criteria and can return detailed data, including PHI (e.g., name, contact information), to facilitate direct recruitment. For multi-site trials, similar queries against [i2b2-SHRINE networks](#) (e.g., SE-SHRINE and ACT Network) can then be used locally to map to specific individuals by collaborators. The CCTS has also established

strategies, including patient navigation, to increase both the enrollment and the retention of underrepresented minorities in clinical research. The CCTS is leading a consortium effort to develop, test, and disseminate an integrated multi-level, culturally sensitive intervention to engage African Americans and Latinos in translational research ([STRIDE](#)). The CCTS also leverages [XpertTrials](#), a proprietary search algorithm to match trials available at the Hub in ClinicalTrial.Gov with participant inquiries. Individuals interested in clinical trials can search for research opportunities based on medical conditions, procedures, symptoms or clinical specialties. The CCTS connects the potential participant with the appropriate study team.

Trial Management. [OnCore® Enterprise](#) is the Hub's Clinical Trial Management System (CTMS), used to manage protocols, subjects, finances, coverage analysis, biospecimens, scientific review process, ordering of clinical services and electronic data capture. Study teams, in partnership with the CCTS OnCore team and Department-based experts, build their trial in the CTMS, integrating calendar, billing, and regulatory components to improve communications, achieve greater efficiencies and enhance regulatory compliance across teams. OnCore also has the capability to improve patient safety by providing clinicians with important information about a patient's involvement in a trial at the point of care through [Cerner PowerTrials](#), a module now integrated in the Hub's electronic health record. The CCTS CRSP team oversees initial training and continuing education in the use of OnCore and PowerTrials to manage clinical trials.

Monitoring. The CCTS CRSP can provide experienced monitors to assist with independent verification of data, regulatory documents, and the ethical conduct of research. Through the education effort described above, tools are available to other research sites, including those across the Partner Network, to enhance site-specific QA/QC processes. Current practices and reciprocal guidance are shared with Partner Network institutions interested in working with a similar model.

Facilities and Expertise (described below under Clinical Research Services). As the driver of clinical and translational research at the Hub, the CCTS offers a number of clinical resources to investigators, available on a recharge basis, including state-of-the-art physical space and trained expertise to support clinical research encounters across the lifecourse.

Analysis, Reporting and Close-out

Clinical Trial Oversight and Assistance. With the University's integrated research portal (IRAP) and the enterprise adoption of the OnCore CTMS to manage protocol approvals and trial accruals. This structure allows the rapid identification of trials that may be struggling to launch, to recruit or to meet milestones. The CCTS works with these teams to explore ways to overcome such issues in an efficient and effective way. Occasionally, despite best efforts to partner with investigators to meet the aims of a trial, unanticipated challenges may prevent a study from succeeding. In such cases, the CTAC works with the researcher and the affiliated Department to close studies early.

Reporting. Researchers conducting clinical trials have the responsibility to create and maintain records on [ClinicalTrials.Gov](#). CRSP personnel review all human subjects applications at the Hub to identify eligible trials, and, together with BERD, advise investigative teams on how to register studies and to provide annual reports on a timely basis. The CTAC also monitors the publication of trial results to ensure that research results are disseminated publicly.

Data management and archiving. The CCTS supports [REDCap \(Research Electronic Data Capture\)](#) as a secure, web-based application for building and managing online surveys and databases. This instance has been approved by the IRB and the Hub's data security team to manage protected health information. For more complex studies, the CCTS BERD, in collaboration with the Hub's School of Public Health, is able to create custom data management structures. CCTS BERD has also established a data management toolbox, including templates informed by partner experience, web-based tools (e.g., DMPTool) and a series of 'how to' guides for data collection, management and archiving (see BERD).

Close Out. OnCore serves as the central system to track protocol activity from startup to closeout. The CTAC has established enterprise-wide standard operating procedures to guide study closure. These are implemented in partnership with research administration and grants and contracts accounting.

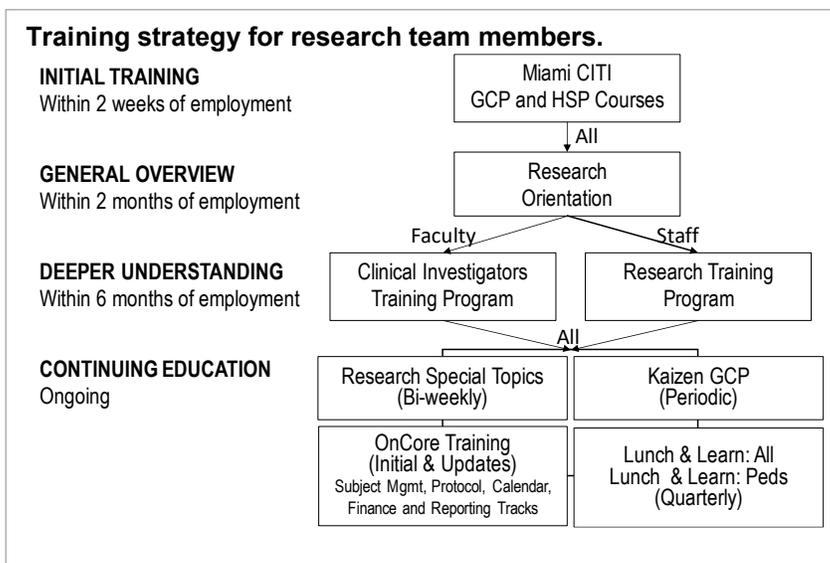
Regulatory Knowledge and Support

Foundational to the success of these strategies is the development of a research workforce, equipped with the skills and knowledge of good clinical practice and the safe and appropriate conduct of research. CCTS educational programs are available network-wide and are archived on the Center’s website. To complement its educational platform, the CCTS maintains a comprehensive, web-based set of standard operating procedures tailored to every stage of implementation.

Clinical Operations	Fiscal Management
<ul style="list-style-type: none"> • Adverse Event and Serious Adverse Event Reporting • Eligibility Confirmation • Monitor Visits (SAV, IMV, COV) • PI Oversight • Source Document Development • Data Management: CRF Completion and Query Resolution 	<ul style="list-style-type: none"> • Reviewing the Protocol for Financial Impact • COI Reporting • Monthly Reporting and Reconciliation • Billing Compliance
Regulatory Management (includes device studies)	
<ul style="list-style-type: none"> • SOP Development • Regulatory Document Management Process (Initial and Continuous Submissions) • Sponsor, CRO and Internal Audits • Required Training • Note to File 	<ul style="list-style-type: none"> • 1572 Management • Site Specific Informed Consent Form • Administrative Hold • Closing a Study • Record Storage • FDA Audits • Drug Accountability

The CCTS is dedicated to the initial training and continuous education of all members of translational research teams throughout the Partner Network to ensure a deep understanding of good clinical practice and high standards of regulatory adherence in clinical investigation. Within the CCTS Training Academy, CRSP manages a comprehensive portfolio of training and enrichment activities. Through a combination of Miami CITI training, Hub-based research orientation, basic clinical studies and trials implementation skills, and tailored continuing education, CRSP supports clinical research education that is accessible across the Partner Network, embracing established competencies defined by the national CTSA Consortium and addressing investigator needs at any stage across the career arc. These educational venues also serve to create a substantial network of clinical research team members, faculty and staff alike, that provides another level of support and reference.

- All investigator and research team members involved in the conduct of human subjects research are required to fulfill compliance-based training for clinical research, good clinical practice and conflict of interest. This is accomplished by a combination of *CITI-based modules and custom courses* developed in partnership with each Network institution.
- Building on this preliminary IRB training, the *Research Orientation Program (ROP)* is intended for researchers, faculty, staff and



trainees alike, as an entry into the principles required to excel in today's dynamic clinical research environment. The half-day activity, offered every other month, addresses fundamental principles across the life-cycle of a study, including roles and responsibilities of members of the research team, Pre-study activities (e.g., IRB approval process, ClinicalTrials.gov registration, recruitment strategies, study feasibility), Study Implementation (e.g., consenting, cultural humility, data collection, QC/QA, DSMB, AE/SAE reporting, billing compliance, monitoring & audits) through Post-study Issues (e.g., last visits, data archiving, study closure, reporting).

- The *Research Training Program (RTP)* for staff and the *Clinical Investigator Training Program (CITP)* for faculty build on ROP concepts to enhance strategies for implementing and managing a clinical study or trial, utilizing GCPs as the backbone of the curriculum, with an emphasis on the unique considerations, IRB procedures, trial management, recruitment & retention, and other key topics associated with trials. Twice annually, RTP meets for 4 hours weekly over seven weeks. During the last week, participants work as teams to apply their new knowledge to case studies. These advanced courses use a strategy of pre- and post-examination to assess knowledge-gain and competency and to identify topics that may require more or less attention to ensure understanding. Programmatic impact is assessed through follow-up surveys, structured interviews, and tracking career metrics
- The *CCTS Clinical Trials Lunch & Learn* (meets quarterly) provides a continuing education opportunity with critical guidance on new or changing requirements in the conduct of clinical research. All clinical research teams across the network, regardless of study type or discipline, are encouraged to send at least one person to attend and disseminate updates to their team and home office. These events routinely draw ~200 team members and address issues related to IRB, clinical billing review, informatics tools (OnCore, PowerTrials), ClinicalTrials.gov, and contracting. This has become an essential venue for research teams to stay attuned to changing policies and expectations at the national and local levels. They have also served to foster a community of clinical researchers to approach outside of such enrichment activities to get real time guidance to questions or concerns. CRSP has also recognized that there are a variety of topics, updates and considerations that are specific to special populations. Responsive to growth in pediatric trials across the Network, CRSP has launched an additional *Lunch & Learn: Pediatrics series* that is dedicated to child health research. Based on this experience, the CCTS will continue to survey the needs of its research base to develop similarly tailored events and series for other disparity populations.
- The *CCTS Research Special Topics Series* (biweekly) also provides continuing education to fill any gaps and to expand on topics with information related to the implementation of clinical trials. The special topics also provide the opportunity to dive deeper into a particularly complex issue (e.g., budget building, ClinicalTrials.gov (see below) and effort reporting). Routine survey of investigators and their research teams, as well as guidance from subject matter experts, are used to identify topics for upcoming seminars. In addition to trial-related subjects, the Special Topics Series takes a holistic approach in training to explore complementary issues like stress management, business etiquette, and team dynamics.

CCTS Training Academy

The CCTS Training Academy offers research training and career development to investigators across the career arc and research team members to efficiently accelerate scientific insight across the translational spectrum through a combination of didactic coursework, tailored enrichment and experiential learning. The CCTS works with investigators to harness their creative imagination as they develop a translational perspective. In addition to the NIH-funded [NRSA Training \(TL1\)](#) and [Mentored Career Development \(KL2\)](#) programs, the CCTS offers the Clinical and Translational Science Training Program and the Research-Team Training Program (both certificate courses). The [Clinical and Translational Science Training Program \(CTS-TP\)](#) offers additional training in clinical and translational research over a six-month period (January-June) for two hours per week. Course content comprises modules including clinical trials, epidemiology, biostatistics, ethics, clinical genetics research, behavioral research, outcomes research, dissemination of results, and grant writing and funding opportunities. All of the sessions are presented by experienced clinical and translational researchers or individuals with special expertise in areas such as grants and contracts and regulatory issues. Preceptors include faculty and research staff from across the Partner Network. The six-session [Research-Team Training Program](#) provides research staff (investigators, study coordinators, billing staff, regulatory coordinators, etc.) with the basics of implementing and managing a clinical trial with emphasis on good clinical

practices (GCPs), research compliance, and other key topics. This Program has been expanded to become a regional training resource for the conduct of clinical trials.

The CCTS supports a Summer Research Training Program in Patient-Centered Outcomes Research (PCOR) and Comparative Effectiveness Research (CER) for trainees from Partner Network institutions. The 8-week Summer Program provides mentored research training experiences in PCOR and CER for health professional students or other clinically-oriented doctoral students that have completed their first year of training. Trainees must devote full-time effort (40 hours/week) for the duration of the program (June and July).

For mentoring and career development, the CCTS works with all learners to identify individual training needs and navigate the many resources available. Through individualized consults, learners identify additional competencies needed for specific clinical and translational research domains as well as the necessary training and research resources. The CCTS also provides assistance with Individual Development Plans (IDPs), which can facilitate dialogue between mentors and trainees as they establish training goals. An IDP is now strongly encouraged for many funding mechanisms. Information on creating IDPs is available on the CCTS website, along with information on related seminars and our entering mentoring curriculum.

Career development activities include the CCTS Forum, the Friday Fellows, and TIERS (Training Interdisciplinary Emerging Research Scholars). The CCTS Forum is a venue in which significant achievements and opportunities in translational research are explored in depth. It highlights individuals who have already advanced translational research or whose work has recognized potential to open new avenues of inquiry. Friday Fellows meets weekly to provide an additional way to foster a community of scholars, brought together to discuss broadly applicable topics pertinent to research translation, including methodology, data management, informatics, special populations, and to provide a venue for trainees to present their work. Of particular interest are joint presentations by invited guests and their UAB colleagues whose collaborative or complementary work has contributed significantly to clinical or population science. TIERS gathers junior faculty, postdoctoral fellows and professional students interested in academic research careers. Its mission is to provide beneficial information on career planning and development including mentoring, presentation of findings, grant preparation, and project and team management. These topics are presented in a relaxed environment structured to promote collaborative learning and problem solving and to strengthen relationships in an effort to broaden the potential of each researcher both individually and collectively.

Open to investigators at any level from across the CCTS Partner Network, from pre-doctoral students to seasoned faculty members who mentor developing research scientists, participants complete eight weekly hour-long topics in the Case Studies in Mentoring series receiving a certificate documenting Excellence in Mentoring suitable for departmental review and academic promotion. The series is repeated approximately every 10 weeks to enable participants to complete the series as time allows. Modeling after a successful faculty mentoring series, the Training Academy will offer a similar series for clinical and translational research team members in collaboration with the CRSP.

To assist with institutional awards, the CCTS provides a webpage with resources for training grant directors, including a library of successful T32 applications and information on training in the Responsible Conduct of Research. For individual career development awards, the CCTS also offers assistance with personal statements and the career development plans – with the option of Panels to strengthen the scientific content. The Training Academy is enhancing the K to R Program (K2R), providing structured activities over a 4-6 month timeline to assist cohorts of K scholars in their preparation of a first R-series application. Utilizing existing CCTS programs, like Project Panels, and offerings including a Specific Aims Workshop, R Writing Group, and Mock Study section, the CCTS extends the engagement of scholars in their ongoing research development.

The CCTS also provides training in specific content areas – most notably informatics, drug discovery, bioethics, and biostatistics methodology. Informatics offers lectures and seminars, as well as an annual Summer Seminar Series. The Alabama Drug Discovery Alliance (ADDA), in collaboration with the CCTS, offers an annual Drug Discovery Seminar Series. Biostatistics methodology lectures have been provided, specifically targeting pilot program applicants. The CCTS hosts an annual bioethics conference featuring discussions about trust, the ethical considerations in genomic and precision medicine and the role of respect in

clinical investigation. These lectures are archived and available through the CCTS website. Other training has also been provided related to biorepositories, data management, biostatistics, etc.

CCTS Research Commons

Through the Research Commons, investigators can access research-related services and resources available at UAB and our Partner Network institutions. The Commons provides individualized assistance to all investigators, from trainees to full professors. CCTS personnel direct investigators to appropriate services and resources and help identify related opportunities. They facilitate scientific connections between investigators and research capacities and among investigators to promote scientific interactions. One resource, especially useful to junior faculty and trainees, is the Panels Program. The CCTS offers a large, multi-disciplinary Nascent Projects Panel (NPP), smaller, more agile Panels Done Quickly (PDQs), and Innovation Panels (iPanels) oriented toward commercialization opportunities. All three provide consultation in early phase project design, grant proposal development, evaluation and revision of unfunded grant proposals, implementation of research protocols, and interpretation and or dissemination of experimental results.

The NPP includes over a dozen faculty members and staff who are experts in their fields and are able to provide multi-disciplinary feedback in areas relevant to clinical and translational research including, but not limited to, epidemiology, exercise medicine, biostatistics, health economics, health disparities, comparative effectiveness research, and community-based participatory research. Each session also includes content-specific experts chosen after discussion with presenters. Presenters provide a brief overview of their research to the Panel, which is followed by a 20-30 minute session during which NPP members ask questions, discuss the project, and provide feedback. A written summary of the discussion is provided to presenters. The NPP Chair, other panel members, and members of the Research Commons later meet one-on-one with investigators to solicit feedback about the value of the NPP and to identify areas in which additional or ongoing assistance would be helpful.

For those who need a more rapid response mechanism, PDQs are available to address specific needs in a more targeted way. In contrast to the NPPs, PDQs are relevant for specific phases of research, such as project development, implementation, interpretation and/or dissemination. Consultation through PDQs can be requested through the Research Commons online portal or by direct personal request. Meetings are coordinated by the Commons and a member of the CCTS Executive Committee. Relevant materials are submitted for review and within 10 working days of the initial request, a PDQ is convened. As with the NPP, there is an emphasis on multiple viewpoints and content-specific expertise, but from a smaller group of experts (usually two to four). For those who seek additional opportunities to assess progress and identify opportunities for improvement, follow-up PDQs may be convened. In order to provide continuity, at least two of the original members serve as part of the follow-up PDQ. As with the NPP, written as well as oral feedback is provided to the investigator who requested the session.

The CCTS has realized an opportunity to help investigators explore the commercialization space by creating a new type of Panel, called Innovation Panels (or iPanels). iPanels are geared less on bringing peers with disciplinary expertise (i.e., biology) together and more on bringing together expertise on aspects of Intellectual Property Disclosure, Patents, Licensure, Small Business Innovation Research awards, Small Business Technology Transfer (STTR) awards, and NSF's Innovation Corps program (I-Corps), etc. The goal is to bring many of the relevant stakeholders to the table to advise investigators on next steps for the commercialization of their research discoveries, inventions, and ideas. Due to the nature of this work, UAB's Institute for Innovations and Entrepreneurship is a close collaborator. iPanels are open to investigators across the CCTS Partner Network.

The CCTS Research Commons is also the primary portal through which investigators can connect with important expertise including Biostatistics, Epidemiology and Research Design (BERD), informatics, clinical research services and other scientific capacities.

CCTS Biostatistics, Epidemiology and Research Design (BERD)

The CCTS Biostatistics, Epidemiology and Research Design (BERD) unit is a multidisciplinary team of biostatisticians, epidemiologists, and methodologists who collaborate with researchers to serve fundamental, clinical and translational research methodology needs. The BERD mission is to provide

consultation, guidance, and expertise for study design, data management, and statistical analysis. Its goal is to gather methodological expertise as a single coordinated resource and match individual methodological skills and interests with study-specific needs in order to advance research. BERD achieves this goal by providing methodological training (short courses, on-line video library), in-person directed consultation (walk-in clinics, scheduled expert consultation), methodology review of grant applications and clinical trials (panels), and collaborations for intermural and extramurally funded research.

The extent and intensity of services vary by study design. In support of study design, sample size and power calculations, data presentation and interpretation of results, the BERD has organized walk-in clinics. Responsive to investigator demand, these standing venues are available several days a week at multiple locations to enhance accessibility. For investigators who do not have the flexibility to attend a clinic, they may contact CCTS Research Commons to arrange scheduled methodologic consultation. After preliminary consultation in weekly clinics, BERD methodologists are often engaged to a greater extent to ensure the scientific rigor. For independently funded clinical trials and other studies requiring sustained methodologic contributions, BERD experts participate as co-investigators, effort funded and addressed through the grant/contract, to guide standard operating procedures and to ensure accuracy and reproducibility of scientific results.

BERD provides a large array of methodological services to clinical and translational researchers throughout the CCTS. The services provided are dependent upon the nature of either the mechanism being developed (Pilot Design, Clinical Trial, K Awards, R-series or Program Project Mechanisms) or mechanisms that are funded. BERD collaborates on the development of essential elements including specific aims, statistical analysis strategies, data management plans, and sample size/power calculations. Recognizing that sample size estimations differ between pilot / feasibility studies and large clinical trials, these calculations are appropriately customized for every mechanism and application.

CCTS Informatics

CCTS Informatics is responsible for providing a broad range of informatics collaborative opportunities and analytical services in support of basic and clinical research. These collaborative services extend from support for basic genomics and bioinformatics analyses to clinical informatics research for population health and outcomes research and health care informatics operations. Specifically, in support of the computational analysis needs of UAB investigators, CCTS Informatics formed the Informatics Consulting Service to provide consultation and collaborative assistance on the collection and analysis of data derived from basic biomedical research (Bioinformatics) to clinical, outcomes, public health, and health services research (Clinical and Health Informatics). Our expertise extends from traditional sequence and genomics analysis, microarray gene expression analysis, protein and RNA structural prediction, and the analysis of data from next generation sequencing (NGS) technologies, to the analysis of data derived from clinical research studies. We have extensive experience in the analysis of NGS data including data derived from whole genome and exome sequencing studies, genome methylation studies, RNASeq data, and microbiome and metagenomic analyses.

CCTS Informatics currently consists of 7 Bioinformaticians (4 PhD level, 2 MS, and 1 BS); 4 Clinical Informaticians (3 PhD, 1 MSHI); an Informatics Architect who designs and implements data management and analytical frameworks for the storage and processing of all our bioinformatics data; and 5 Programmer/Analysts who support the consultation, analytical, training, and educational aims of the service. CCTS Informatics participates in the Southeastern Informatics Consortium, offering consultation services and collaborative opportunities across the CCTS Partner network.

i2b2 (Informatics for Integrating Biology and the Bedside)

i2b2 is a scalable informatics framework designed for translational research. i2b2 was originally designed to support cohort identification, allowing users to perform an enterprise-wide search on a de-identified repository of health information to determine the existence of a set of patients meeting certain inclusion or exclusion criteria. Building on this precedent and with the appropriate regulatory approvals, i2b2 can also facilitate recruitment of this cohort when the study is launched. The informatics tool is also instrumental in addressing population health questions and comparative effectiveness and outcomes research. i2b2 data facts and patient stats are provided in the i2b2 Data Summary table, below.

SHRINE (Shared Health Research Information Network)
 SHRINE is a web-based platform that connects i2b2 instances and facilitates queries of available data at multiple institutions to compile insights on large groups of well-characterized patients. Investigators may use i2b2/SHRINE to determine the aggregate number of subjects at participating institutions who meet a given set of inclusion and exclusion criteria (e.g., demographics, diagnoses, medications, and selected laboratory values). This information can provide the collaborative basis for clinical study feasibility and population-based research.

Natural Language Processing

One of the major initiatives of CCTS-Informatics has been to develop a Natural Language Processing (NLP) infrastructure to support the processing and analysis of unstructured medical records. This has been initially deployed within the UAB Health System to support the State of Alabama Cancer Registry reporting requirements. This NLP Infrastructure is used to facilitate cancer case detection by reviewing and processing all UAB Health System Pathology reports in real time to detect cancer concepts as defined by the National Association of American Cancer Registries (NAACR). We have improved cancer case detection throughput by 41%. Currently, approximately 1,000 cases are processed through this NLP platform each month. From the beginning, we built this platform with extensibility in mind and have extended its use to support cohort detection for retrospective research and active detection of participants for clinical trial enrollment. For example, this NLP infrastructure is currently being used to support the identification of patients in a Multiple Myeloma research study. Development of this infrastructure through a partnership with the UAB Department of Computer and Information Sciences has also included utilization of NLP to improve the medical documentation skills of our medical students, and we are currently exploring opportunities to utilize NLP to facilitate national reporting in our transplant programs. We are also working on extending these tools to support the processing of records derived from clinical research studies to both support the research goals of the study as well as to support the entry of NLP-derived structured data directly into patient’s electronic health record.

UAB Information Technology Operations

The responsibility for the campus network, IT resources, and IT security resides with the UAB Office of the Vice President for Information Technology. UAB Health System IT operations are provided by the Health System Information Services (HSIS) unit. The CCTS utilizes services and resources provided by both UAB-IT and HSIS. The UAB-IT Research Computing Office maintains and supports the local campus High Performance Computing infrastructure.

Offices and Data Centers - CCTS Informatics personnel are located in offices in the Sparks building (900 sq. ft.) as well as the Bevill Biomedical Research Building (BBRB) building (200 sq. ft.) and Tinsley Harrison Tower (900 sq. ft.). A small Data Center is located in BBRB (250 sq. ft.) that houses several development servers. Production servers are located in the central UAB IT Data Center (3,000 sq. ft.),

i2b2 Data Summary

Fact Type	# Distinct Patients	Total # of Facts
AGHI_FORM_DATA*	964	164070
Allergy Data	898381	1856598
Billed Charges	446174	7736674
Biospecimen Data*	52104	5639145
Blood Pressure	658928	72552089
BMI and Waist	653206	5683870
Cancer Registry	132541	6107992
Clinical Diagnosis	723279	100301442
Consult Orders*	260625	4910883
DRGs*	84685	301418
Encounter Insurance	792882	15921847
Encounter Service*	952986	15818164
Height/Weight	683854	24862446
ICDA_DOCUMENTS*	751806	18795529
Immunizations*	115522	368923
Lab Panels*	488033	10810937
Lab Powerplans*	345474	3034539
Labs	601775	204751919
Medications	654096	89164310
Microbiology*	201480	1499119
Powernotes Neurosurgery*	6984	144685
Problems	556290	9363246
Procedures (CPTs, ICD9s, ICD10s)	193002	932033
Radiology Events*	497897	5123909
Rheumatology Powernotes Data*	10568	176876
Social History	584831	9641700
Surgery Data*	175070	1965093

* New data elements added in the last year

and within the HIPAA-compliant Health System Data Centers, with both an off-site primary data center and a local on-site secondary data center (2400 sq. ft.), maintained and monitored 24 X 7 by HSIS. A separate Data Center houses the UAB High Performance Computing infrastructure (1,500 sq. ft.).

CCTS Informatics Computer Equipment - The CCTS owns and leases access to a large collection of servers, storage systems, workstations, laptops and peripherals. Separate servers are utilized for production web sites, production database systems (MySQL, SQL Server, Oracle), data entry and curation databases, application development, database development, web site development, bioinformatics analysis, backup, and failover. Currently CCTS Informatics utilizes over 25 different servers comprising a mixture of dedicated hardware and cloud-based Virtual Machines with a combination of Windows, Linux, and Macintosh operating systems. These systems include Dell PowerEdge (PE) server systems and Dell PowerVault (PV) storage systems that provide in excess of 350 TB of disk storage. Hardware maintained directly by CCTS Informatics includes three Dell PE R710 servers, two with 192 GB RAM and 7 TB of storage and the third with 96 GB of RAM and 7 TB of storage; two PV NX3200 storage arrays, each with 48 TB of SAS disk storage; two PE R730x systems each with 72TB of SAS storage; one PV MD3400 with 96TB of SAS storage; and 4 PE 2950/2850 servers. All servers are connected to the campus network backbone using 1GigE (gigabit per second) network connections to the building's router. The building utilizes a 10GigE connection to the 40GigE campus backbone. As detailed below, additional petabyte-scale storage is available locally within the UAB Research Computing infrastructure. CCTS Informatics has an additional 350 TB of storage specifically allocated for its use from this 6 petabyte system for a total of 700 TB of storage devoted solely to CCTS-supported projects. All servers are backed up on a daily basis using a combination of a LTO tape backup system (Dell TL2000 library with two LTO-4 drives) and network-attached disk storage arrays. All data maintained by CCTS Informatics that contains PHI (protected health information) is housed within the HSIS HIPAA-compliant data processing facility. All other systems outside of these secured facilities contain only non-PHI, de-identified datasets.

Clinical Research Services

A centralized hub provides a supportive environment for early phase and task-intensive clinical research in humans. The environment ensures safety and provides standardized pathways for the administration of investigational agents and the collection/management of valuable patient samples essential for translational advances. CCTS clinical services include the Clinical Research Unit (CRU), the Phase I Clinical Trials Unit, the Child Health Research Unit (CHRU), the Clinical Research Support Program (CRSP), the Specimen Processing and Analytical Nexus (SPAN), CCTS Biorepository and the Bionutrition Unit. The Phase I Unit, the Bionutrition Unit and part of SPAN are housed on the 15th floor of Jefferson Tower, in immediate proximity to the CRU, which was renovated to become the central location for CCTS clinical services. The CHRU is located on the UAB campus within Children's Hospital of Alabama.

Clinical Research Unit (CRU)

The CCTS has 15,450 square feet of dedicated clinical research space located on the 15th floor of Jefferson Tower. This space has two clinical units; The Clinical Research Unit (CRU) and the Phase I Unit. The CRU provides clinical services for investigator initiated clinical studies and Phase II and III clinical trials and the Phase I Unit provides services for Phase I clinical trials. The nursing staff support a wide range of clinical research including, but not limited to aging, Alzheimer's disease, diabetes, hepatic disease, obesity, pain, psychiatry, reproductive health, nutrition, and various cancers. These units are supported by two nurses' stations and a pneumatic tube station to allow for quick transport of specimens to the hospital lab as well as receipt of some pharmaceuticals. The CRU is located on the west wing of JT 15 and has four private rooms, one semi-private room, and an infusion suite with six infusion chairs. In addition, the west wing has storage space for equipment and/or supplies that are specific to investigator needs. If inpatient care is required, the CRU has access to inpatient beds located on the 8th floor of UAB Hospital. Inpatient utilization focuses on studies requiring hospitalization of participants for proper study activities, ranging from 24 hour sample collection protocols to studies for which participant safety is best served by an inpatient setting. L. Burt Nabors, MD, is the Medical Director of the CRU, and Jolene Lewis, MSN, serves as the Nurse Manager for the CRU. She has more than 10 years of service managing inpatient and outpatient research nursing staff. In addition to Ms. Lewis, the nursing staff includes four full-time nurses, one part-time nurse, and seven nurses who

work on an as needed basis. CRU nurses have extensive research experience with the infusion of research medications, monitoring of participants, collection of PK, PD, PG, and biomarker samples, data collection, and use of scientific research equipment. All nurses complete required hospital competencies, human subjects training, certification on pharmacokinetics and Good Clinical Practice (GCP) training.

Phase I Clinical Trials Unit

In 2013, the CCTS expanded our CRU by adding a 7,950 square foot Phase I Clinical Trials Unit. The unit is located on the 15th floor of Jefferson Tower, adjacent to the existing CRU and the sample processing facility. It is comprised of seven rooms to accommodate patients for the administration of research agents. Each room has the flexibility to be used as private or semi-private to allow for maximum space utilization and appropriate participant monitoring. The unit also includes the capacity for the administration of standard of care drugs and routine infusions, which enhances the nurses' focus on the care given to those receiving Phase I agents. A centrally located nurses' station supports the unit. The Phase I Unit is led by Mansoor Saleh, MD, a Professor of Medicine and Medical Director of the UAB Clinical Trials Office. Prior to coming to UAB, he served as Director of Clinical Research for Georgia Cancer Specialists in Atlanta, the largest community-based oncology practice group in the Southeast. His research has been focused on translational research and targeted therapies for cancer. Dr. Saleh is nationally known for his work with monoclonal antibodies in the treatment of cancer as well as the treatment of idiopathic thrombocytopenic purpura (ITP) using novel agents. The Hub's Phase 1 Program supports all 'first in human' clinical trials in a variety of disease conditions, especially oncology. Several of these trials represent the first subject enrollment in the United States to test the safety of novel therapeutics, including a CD40 agonist as well as inhibitors of the androgen receptor, OX40, arginase, FGFR4, chemokine receptor and CD47.

Child Health Research Unit (CHRU)

The CHRU was developed to provide a platform to improve our understanding of child health and childhood disease pathogenesis, and to accelerate the development of new treatments for diseases that are manifested in childhood. The CHRU is a partnership between Children's of Alabama, one of the largest and busiest centers for child health care and the third largest pediatric hospital in the US, the UAB Department of Pediatrics and the CCTS. Its mission is to provide outpatient research space to pediatric investigators that reduce barriers to the conduct of scientifically rigorous clinical and translational research. The CHRU facilitates the execution of safe and age-appropriate clinical research protocols in a flexible fashion to accelerate our understanding and treatment of childhood diseases.

The CHRU has expanded in May 2017 to establish a reception/registration area, triage room with scales and stadiometer, six well-equipped exam rooms, office and conference space, workspace with monitors & locked storage, lab space with centrifuge and freezer for short-term storage and an equipment storage room. Additional space is available to support primarily for ambulatory patients with special needs (e.g., respiratory conditions, such as asthma and cystic fibrosis) and it includes four outpatient beds (suitable for long-duration PK studies), a specimen processing laboratory, a state-of-the-art biospecimen storage facility with real-time monitoring and specimen-tracking capabilities, a nasal potential difference laboratory. Specialized equipment housed for CFTR clinical science are also housed in the satellite CHRU, including two sweat iontophoresis devices (each compatible with the Macroduct collection system), two sweat evaporimeters (Cyberderm RG), a carbon monoxide monitor, a Lung Clearance Index measurement device (EcoMedics) for use by the nitrogen washout technique, nasal and exhaled nitric oxide measurement (EcoMedics), two spirometers with calibration equipment (NSpire), an EKG machine, a Code cart, and general laboratory supplies. Investigators and research coordinators have access to CHRU research space and equipment. All protocols that utilize the Unit must have a designated, protocol-specific physician with primary responsibility for the safe conduct of the study and must have IRB or WIRB approval. Details for study implementation are developed on a project by project basis, with input provided by the Clinical Research Support Program. The hours of utilization are flexible and can include after-hour visits.

Steven Rowe, MD, MSPH, and Suresh Boppana, MD jointly serve as Co-Directors of the CHRU. In this capacity they oversee operations, set policies and procedures, assign project responsibilities, and in collaboration with the Clinical Research Support Program, review budget development for industry contracts, review IRB submissions and renewals, and direct weekly team meetings that include junior investigators and evaluation of potential projects. Dr. Rowe serves as the CC-CHOC Point Person for the CTSA Consortium and also directs the Cystic Fibrosis (CF) Therapeutics Development Network at UAB, as well as is a member of the UAB Lung Health Center. He has broad training in Pediatrics, Internal Medicine, and Clinical Research, and is an expert on studies that address fundamental aspects of CF disease pathogenesis, including industry and investigator-initiated studies examining CFTR modulators, relationships between CFTR activity and CFTR biomarkers, and new assay development. Dr. Rowe also directs the Center for CFTR Detection and provides research quality conduct, support, and interpretation of CF research trials, supporting sites throughout the United States and Europe. Dr. Boppana, Professor of Pediatrics and Microbiology, has spent over two decades studying the natural history and pathogenesis of maternal and congenital cytomegalovirus (CMV) infection. His work has elucidated the importance of non-primary maternal infections in the overall disease burden of congenital CMV infection. As the co-PI of a large, multicenter newborn CMV screening study, he developed a highly sensitive, real-time PCR assay of saliva for newborn CMV screening. His current work focuses on understanding the correlates of immunity and protection from the acquisition of CMV infection in human breast milk. Investigators are working to improve the lives of children living with seizures, chronic kidney disease, urinary incontinence and esophagitis; nonsense mutation mediated disorders such as Rett Syndrome, Neimann-Pick Disease and neuromyelitis optica, as well as those at risk for HIV exposure, respiratory syncytial virus and community acquired pneumonia.

Clinical Research Support Program (CRSP)

The current research environment has been impacted by the increase in regulatory requirements, the decrease in funding due to the economy, and the challenge for research sites to manage unexpected events. Additionally, novice research coordinators and limited educational experience of study coordinators leaves research sites unable to cope with these challenges. In late 2010, the Center for Clinical and Translational Science (CCTS) developed the Clinical Research Support Program (CRSP) for the exclusive purpose of functioning as a modified institutional clinical research organization. This program was designed to provide any or all support for implementing a clinical (or non-clinical) study at UAB.

CRSP provides a pool of trained, certified research coordinators to assist investigators with study implementation, including interpretation and adherence to regulatory requirements, organizational and budget management, communication with sponsors, internal quality measures, and data management. Resource pooling provides flexibility and limits the need for individual investigators or programs to overstaff in order to handle sporadic needs. Additionally, trained, experienced research staff are capable of managing and implementing research studies more efficiently and effectively. CRSP personnel function in a flexible manner and provide services when and where needed. Most services and support are conducted at the study investigator's site. All staff received CCTS training, in addition to the standard human subjects training, certification on pharmacokinetics, and GCP training. Staff are also certified for working in UAB Hospital, the BVAMC, and Children's Hospital. Staff have experience in cardiology, cancer, endocrinology, nephrology, neurology, pediatrics, School of Public Health, infectious diseases, pulmonary, CV surgery, GI, and continues to expand. CRSP personnel ensure that investigators have the required research implementation resources and that research teams have the knowledge and skills for conducting protocols. They assist with pre-study activities such as site and study feasibility assessments, staff education and training, budget development and negotiations, DSMB plans, regulatory preparation (e.g., IRB, IND/IDE, Clinical Trials.gov, institutional requirements, sponsor requirements), site assessment visits, and study initiation meetings. They also provide study implementation services, which include subject visits and assessments, study report generation, maintenance of regulatory documents, budget maintenance, safety reporting, quality management assessments, monitoring/preparation for monitor visits, subject retention efforts, and data and specimen management. Finally, CRSP staff provide services related to study closure, including study closeout visits, reconciliation of final data, final study reports, and archiving.

Additionally, CRSP provides educational programs to better serve the research needs of the CCTS Partner Network by building courses to increase knowledge and training for all members of the investigative team. Some of the programs that have been implemented so far are bi-weekly comprehensive research seminars that incorporate Good Clinical Practice training (GCPs), monthly research orientation program, bi- annually research training program, an investigator training program, various workshops (budget, IRB, Clinical Trials.gov) and templates for Standard Operating Procedures (SOPs).

Specimen Processing and Analytical Nexus (SPAN)

SPAN is the central clearinghouse for sample collection, login, handling, and storage for clinical research studies at UAB. SPAN also assists investigators in specimen distribution to other UAB analytical Cores, investigator laboratories and outside laboratories. SPAN consists of two laboratories on campus, all within a two-block radius. The primary specimen-processing laboratory (545 sq ft) is located within the CRU in Jefferson Tower to facilitate centralized collection and preparative activity of specimens from participants in clinical trials. This laboratory is equipped for BSL2 level work including use of a laminar flow hood. Specimen processing capacity for the handling of blood, urine, CSF and other liquid specimens includes two refrigerated centrifuges, six non-refrigerated centrifuges and tube rockers. Centrifuges can accommodate all specimen collection tubes and can achieve centrifugation speeds of up to 4740xg. Specimen storage capacity includes a refrigerator, a non-cycling -20°C freezer and three -80°C freezers. More sophisticated laboratory space for specimen processing and specimen long-term storage is located in the Shelby Interdisciplinary Research Building (1357 sq ft). Equipment includes 2 Beckman Allegra-X-14R refrigerated centrifuges (capable of up to 3210xg), 3 Hettich EBA20 + 2 IEC Clinical non-refrigerated centrifuges, tube rockers, pipets, incubators and fume hood. Sterile cell culture facilities include 2 Forma laminar flow hood, 3 Forma CO2 incubators, inverted Olympus microscope and 2 Invitrogen Countess automated cell counters. DNA extraction capacity includes an Autogen Flexstar automated DNA extraction system. DNA quality control is assessed by both absorbance and fluorescence based systems including a Tecan Infinite Pro 200 (absorbance + fluorescence) with nanoquant adaptor, the Trinean Dropsense (absorbance) and the Thermo Qubit (fluorescence).

All SPAN activities are fully integrated with CCTS/UAB clinical activities using the OnCore clinical trials management system. Within OnCore, a full specimen inventory is maintained at the individual tube level. Relevant specimen associated collection information can also be associated with each individual specimen aliquot. This system has full reporting capabilities and a record of chain of custody. SPAN actively works with investigators to develop specimen process protocols that meet the needs of each individual study and develops/implements new methods as required. Studies utilizing the core cover a broad range of translational research. SPAN protocols range from complex therapeutic clinical trials with PK/PD blood processing needs, to glucose tolerance tests in healthy controls with frequent blood sampling to simple phlebotomy of healthy controls for preparation of blood-derived materials (serum, plasma, buffy coats, PBMC, DNA).

Biorepository

The CCTS Biorepository, also in the Shelby laboratories, provides access to standard operating procedures for biobanking and a full spectrum of long-term specimen storage options for studies using the CCTS. In addition to the laboratory space associated with SPAN, an additional 460 sq ft dedicated freezer room is available for long-term freezer storage. Total storage capacity includes an array of 16x -80°C and 6x liquid nitrogen cryogenic freezers. All cryogenic freezers are equipped with automatic LN2 filling valves. Freezers are inventoried to the individual tube level using the Biospecimen Management module of OnCore. All freezers throughout the CCTS SPAN Biorepository are centrally monitored for alarms with call lists in the event of a freezer malfunction. In addition, every freezer has an independent NIST-certified temperature probe monitored by an on-line temperature monitoring system Temptrak (Cooper-Atkins).

In addition to physical sample management, the CCTS has established a link with the UAB i2b2 instance where available specimens are linked to available EHR data through the MRN. UAB Investigators can search for specimens in an aggregate basis associated with clinically relevant

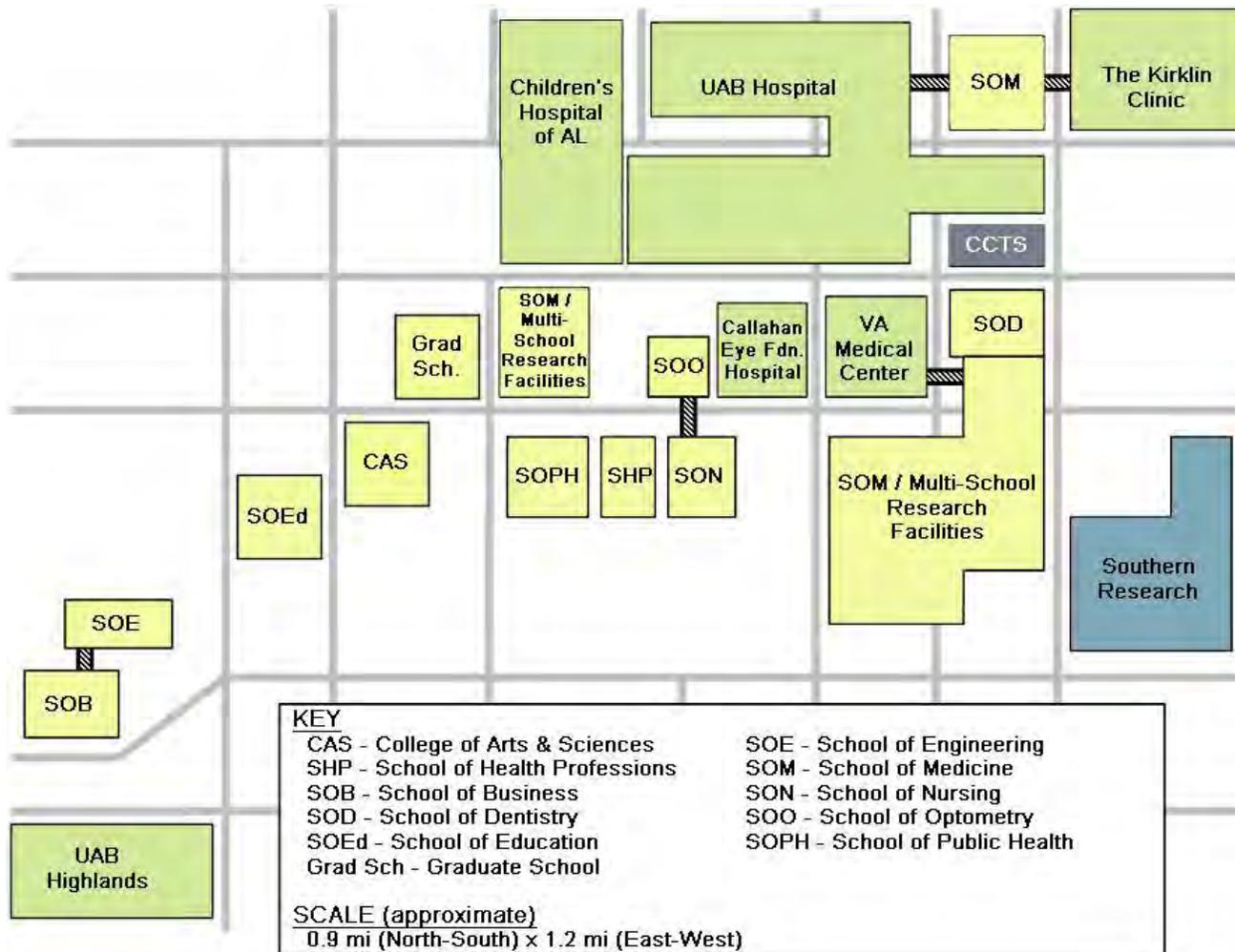
parameters to enable scientific investigation and enhance our capacity to serve our populations. The CCTS Biorepository would act as an honest broker to connect the recruiting study team with the requesting investigator. This process connects investigators but does not obligate sample sharing; rather it connects investigators to determine whether they would like to pursue a collaborative relationship that may involve biospecimens.

Bionutrition Unit

The Bionutrition Unit, Clinical Research Unit (CRU), fosters the integration of nutrition into clinical and translational research by providing nutrition research expertise and resources for investigators. The Unit offers a number of core services: 1) Research design, development and implementation—this includes one-on-one assistance with the initial research design, calculating research diets, providing menus and meals as required by protocol, help with participant recruitment and retention, development of nutrition data collection forms, and data collection. 2) Nutrition education—assistance with educating participants about dietary protocols and assistance with specific diet prescriptions and other individual or group counseling as needed. 3) Body composition analysis—standardized height and weight measurements, anthropomorphic measurements (skinfold thickness and body circumferences), and bioelectric impedance analysis (BIA) to determine body composition (fat free mass, body fat mass, percent body fat), using a Tanita body composition analyzer TBF-310 and BC-418, a Scaletronic digital scale, a Biodynamics bio-impedance analyzer, a stadiometer to measure height electronically, and Lange calipers. 4) Nutrient Intake Analysis—analysis of 24-hour food recalls, multiple-pass food records using Nutrient Data System for Research (NDS-R) software, a comprehensive nutrient calculation software that can perform analyses of 139 nutrients, nutrient ratios and other food compounds. And 5) A state-of-the-art Metabolic Kitchen that provides ideal infrastructure to prepare specially-designed research diets for participants in outpatient-based studies; a multi-purpose room is also available for nutrition studies that require on-site feeding. The staff includes two full-time research dietitians and four designated research cooks that have many years of experience implementing detailed nutrition interventions studies.

UNIVERSITY OF ALABAMA AT BIRMINGHAM (UAB; CCTS Hub)

UAB is a comprehensive urban university with over 20,902 students from across the US and internationally. As a state-affiliated institution, UAB ranks 15th nationally federal research support among public universities, with a sponsored projects portfolio exceeding \$400 million (FY2016). The University of Alabama at Birmingham, one of three autonomous institutions within The University of Alabama System, is the only four-year, public university in the state's largest metropolitan area. The University spans more than 100 blocks in the city center with over 245 buildings providing over 11 million feet of assignable space. UAB is Alabama's largest employer with an annual economic impact exceeding \$7.15 billion. As of the fall of 2016 (most recent data), the University employed 21,245 people, had a faculty of 2,543 (41.8 percent of whom are female), and had a student enrollment of 20,902 at the undergraduate through doctoral levels. The graduate student population is 67.3 percent female and 35% are among minority ethnicities. UAB is comprised of 10 academic colleges and schools in the health sciences and academic areas. The UAB Academic Health Center includes the Schools of Medicine, Dentistry, Nursing, Optometry, Public Health, Health Professions, the Graduate School, and the Lister Hill Library of the Health Sciences. The University's academic campus consists of the College of Arts and Sciences, the Collat School of Business, the Schools of Education and Engineering, the Graduate School, and the Mervyn Sterne Library. The university has 190 endowed chairs/professorships. The Institution has been ranked among the top quarter of all U.S. colleges and universities by The Princeton Review, and among the top 10 for diversity for several consecutive years.



UAB Office of Sponsored Programs (OSP) The UAB Office of Sponsored Programs (OSP) is a central office reporting to the Vice President for Research and Economic Development. The OSP offices are located in 6913 square feet of office space within one and a half city blocks from the Veterans Affairs (VA) Medical Center and Coordinating Center in Faculty Office Towers (FOT). The OSP assists UAB's faculty and staff in their efforts to secure and fulfill extramurally sponsored programs by performing pre-award and non-financial post-award administration. The OSP is charged with the following, including but not limited to, performing preliminary review and approval of all proposal submissions, submitting proposals through Grants.gov and most awarding agency portals, serving as representative of the UAB business office with official signing authority, negotiating execution of clinical trial agreements and other extramurally sponsored projects to include research, services (selected), non-sponsor funded collaboration, and master agreements, continuing professional education agreements, confidentiality and data use agreements.

The OSP provides ongoing training for the campus, principal investigators, department administrators, and center administrators to include workshops and other structured opportunities. The UAB Research Administration listserv from the OSP distributes latest updates, news and information to the UAB community. There are 12 OSP officers supporting federal grants management and 9 officers assigned to non-federal awards. In addition, the OSP staffs 12 data processing specialists for the data management of the OSP activities including UAB's Integrated Research Administration Portal (IRAP). IRAP's software consists of a suite of modules developed by InfoEd Global Inc. These modules support electronic submission of funding applications and compliance forms and will seamlessly connect the operations of the OSP with the Institutional Review Board for Human Use (IRB) and UAB Research.

UAB Institutional Review Board (IRB) and Office of the IRB (OIRB) The UAB IRB is a committee established under federal regulations for the protection of human subjects in research (45 CFR 46). Its purpose is to help protect the rights and welfare of human participants in research conducted under the auspices of UAB. The UAB IRB is located in the UAB Administration Building, with 4,526 square feet of office space and conference rooms, and housing 23 staff.

INSTITUTIONAL RESEARCH ENVIRONMENT & EXPERTISE IN CLINICAL AND TRANSLATIONAL SCIENCE

School of Medicine (est. 1945; Selwyn M. Vickers, MD, Dean and Senior Vice President)

As the largest School within the University of Alabama at Birmingham, one of the South's premier research universities, the School of Medicine is dedicated to the education of physicians and scientists in all of the disciplines of medicine and biomedical investigation. The school provides medical education and internship opportunities for students throughout the world. Its comprehensive approach to teaching future physicians covers all facets of medicine, including medical education, research, and patient care -- delivered in one of the most technologically advanced medical facilities in the country. The SOM has nationally recognized clinical programs in many areas including, but not limited to, Oncology, Neurology, Psychiatry, and Immunology/Rheumatology. UAB is also a national leader in organ transplantation. Many of UAB's most productive extramurally-funded research centers, including the Comprehensive Cancer Center, Comprehensive Diabetes Center, Center for AIDS Research, and others are based in the SOM and report to the Dean. The School of Medicine is also a national leader in research, and has been ranked in the top 30 of NIH funded Schools of Medicine for more than 20 years.

School of Public Health (est. 1981; Peter M. Ginter, PhD, Interim Dean)

The UAB School of Public Health (SOPH) offers the opportunity to join a vibrant community of professionals and scholars whose world-class research and scholarship is exploring complex problems like HIV/AIDS, obesity, and therapeutic intervention in creative and unusual ways. The interests of the faculty and staff extend from community organization in the Black Belt regions of rural Alabama to understanding the dynamics of the HIV epidemic in Sub-Saharan Africa. The institution offers a highly interdisciplinary, collaborative atmosphere to support the missions of training and research excellence. With active research programs in diabetes, cardiovascular diseases, cancer, infectious diseases, and Alzheimer's disease, SOPH faculty interact with key researchers within the CCTS Network Partnership. The Department of Epidemiology offers a Master of

Science in Public Health in Clinical and Translational Research, a one year MSPH program available for CCTS TL1 trainees to complete during their training (please see TL1 description).

School of Health Professions (est. 1969; Harold P. Jones, PhD, Dean)

The UAB School of Health Professions, one of the largest health professions schools in the nation with more than 25 innovative programs, shapes the future of healthcare through teaching, research and translation of discoveries into practice. To improve the quality of health around the world we listen to needs and identify real-world problems; focus our resources and expertise to address the problems; tailor innovative teaching and research to solve the problems; and partner with strategic community, business and global leaders to expand the impact of our efforts. The UAB School of Health Professions' strategy uniquely positions us to lead efforts to inspire quality health and living of individuals, communities and the world. www.uab.edu/shp

School of Dentistry (est. 1945; Michael S. Reddy, DMD, Dean)

The University of Alabama at Birmingham School of Dentistry was created by an act of the state legislature in 1945, the same year that the School of Medicine moved to Birmingham from the university campus in Tuscaloosa, and became a four-year school. The School of Dentistry admitted its first class of students in October 1948. In addition to its first professional degree (D.M.D.) program, the school offers accredited postdoctoral programs in twelve areas of study. Building on these foundations, the School is committed to training, research and refinement in prosthodontics and restorative dentistry. In this frame, the goal is to ensure that the UAB School of Dentistry remains a visible contemporary model for healthcare innovation.

Collat School of Business (est. 1971; Eric P. Jack, PhD, Dean)

Located in the heart of Alabama's business center, UAB's Collat School of Business offers an engaging learning environment with classrooms extending well beyond the walls of the UAB campus. The school's unique location allows faculty to integrate the practical experiences of the State's leading companies - from Fortune 500 corporations to entrepreneurial startups - into the programs it offers. Students gain valuable, real-world experience through a wide variety of internships and other opportunities in the business community. The school offers eight undergraduate programs in accounting, economics, finance, human resource management, industrial distribution, information systems, management, and marketing. It offers three graduate programs in accounting, business administration and management information systems as well as certificates in technology commercialization and entrepreneurship, social media, enterprise systems, and professional sales.

College of Arts and Sciences (est. 2010; Robert Palazzo, PhD, Dean)

The UAB College of Arts and Sciences was formed in 2010 with the integration of the schools of Arts and Humanities, Social and Behavioral Sciences, and Natural Science and Mathematics. Today, the college is home to 19 academic departments and 6 centers, offering 40 baccalaureate undergraduate majors and 23 graduate programs. In addition to our more than 5,000 majors, nearly every student pursuing a baccalaureate degree at UAB takes their core curriculum classes in the College of Arts and Sciences. The college includes more than 300 full-time faculty members, approximately 59% percent of whom are tenured.

Department of Sociology- The UAB Department of Sociology offers the only PhD program in medical sociology in the state of Alabama, and more than 50 alumni having graduated with a PhD in medical sociology from UAB. With UAB's prestigious medical school, seven hospitals, and several on-campus clinics and medical research centers, there are numerous opportunities and fellowships for research and training.

The Department of Sociology features faculty who are either teaching specialists or leaders in research in a research-intensive environment. The Social Determinants of Health Core of the Mid-South Transdisciplinary Collaborative Center investigating the health of African Americans in the Mid-South is housed in our department. It is funded by the National Center on Minority Health and Health Disparities (NCMHD) through the Division of Preventive Medicine at UAB and involves the participation of several graduate students, PhD alumni, and faculty. With the exception of few alumni who hold administrative positions, about half of graduates teach and conduct research in universities, while the other half conduct research full-time. Some are affiliated with medical schools (e.g., UAB, Harvard, South Carolina, Texas, Miami), schools of public health (e.g., UAB, Brown), and various colleges and universities in the US (e.g., UAB, William & Mary, Mary Baldwin, Tuskegee, Mississippi State, Western Kentucky, Middle Tennessee, Akron) or abroad in Europe and Asia.

School of Education (est. 1971; Lynn D. Kirkland, Interim Dean)

The School of Education provides an innovative environment that promotes professionals in education, health, and wellness in collaboration with content experts in associated academic areas. This collaboration in developing strong professionals is emblematic of UAB's interdisciplinary, collaborative culture, strengthening cooperation between departments and programs for excellence in research and scholarship where students can thrive in an open environment with a bold, innovative approach to education.

School of Engineering (est. 1971; J. Iwan D. Alexander, PhD, Dean)

The UAB School of Engineering embraces a collaborative mission, supporting projects that bring engineers together with medical professionals, business leaders, and fellow scientists from other disciplines, in order to push the envelope and discover new, innovative solutions for the challenges in the world. It is likewise committed to training at the undergraduate and graduate levels, where student engagement in design projects is prioritized throughout the curriculum.

School of Nursing (est. 1969, Doreen C. Harper, PhD, RN, FAAN, Dean)

The UAB School of Nursing offers innovative bachelor's, master's, and doctoral programs under the leadership of an interdisciplinary clinical and research faculty vested in developing the next generation of compassionate nurses committed to contributing to the improvement of the health and quality of care for individuals, families, and populations. Among these are the oldest and most honored PhD in Nursing and a Doctor of Nursing Practice (DNP) and Nurse Anesthesia Track; a Master's of Nursing program with more than 15 nurse practitioner specialty tracks with dual degree options, advanced nursing executive majors in administration and informatics, and an Accelerated Master's in Nursing Pathway (AMNP) program for students who already have one degree, among other unique opportunities. Most graduate courses are taught in a distance accessible format with on-campus intensives. The UAB School of Nursing is designated as a Pan American Health Organization/World Health Organization Collaborating Center for International Nursing- one of 10 in the U.S. Additionally, the School is one of three Paul D. Coverdell Peace Corps Fellows programs and is one of the leading VA Nursing Academic Partnerships in the US. The School is a leader and trendsetter in collaborative science and home to the state's only nursing-specific research initiative with a diverse funding portfolio supporting scholarship in oncology, international nursing, HIV/AIDS, pediatrics, occupational health, aging, among others, and offers students opportunities to learn and investigate with faculty and student teams from nursing, medicine, dentistry, health professions, public health, and optometry. The School of Nursing is home to an innovative nursing simulation and skills laboratory, which provides faculty and students with interprofessional learning opportunities. Faculty hold more than 70 appointments in university-wide research centers

School of Optometry (est. 1969; Kelly K. Nichols, OD, MPH, PhD, FAAO, Dean)

The School of Optometry was established in 1969. Since that time, the School has grown to include graduate degrees (MS, PhD) in Vision Science and post-doctoral residency education in addition to the 4-year professional program. Students can also participate in combined OD/MS, OD/MPH, OD/MBA degree programs with other health professional students, unique to our university. As one of the smaller optometry schools in the country, the school offers a competitive enrollment that benefits the world-class educational environment with a family feel. Recently re-accredited to 2025, the School of Optometry has a first-rate reputation for educating optometrists and vision scientists from across the country, primarily from the South-Eastern region. Their faculty is among the best known in the country through their lectures, research and publications including many national and international textbooks, service on editorial boards, and Newsletters for optometrists. Their clinical service is widely respected for the excellent patient care including several new specialty clinics, myopic control clinic, dry eye clinic, and vision therapy clinic in the UAB Eye Care clinic, a 34,000 square foot state-of-the-art facility that covers everything from primary eye care, including the dispensing of glasses and contacts, to the treatment of ocular disease and pediatric vision care. The school also houses and supports the Vision Science Research Center (VSRC), a campus-wide center with over 80 investigator members from across campus, with the common commitment to vision research. The core facilities allow vision researchers to successfully compete for research funding and this support has aided the School of Optometry research profile to remain among the top schools and colleges of optometry. Collectively, these commitments help the school in its mission to educate optometry students, residents, and future scientists; to discover and broadly communicate new principles and concepts in eye care and vision science; to translate these ideas into clinical practice; and deliver health care with integrity and compassion.

Joint Health Sciences

Within the academic health system, the Joint Health Sciences (JHS) represents a set of coordinated units embraced by the Schools of Medicine, Optometry and Dentistry that are based on shared goals in teaching and research missions. These include the Departments of Biochemistry & Molecular Genetics; Biomedical Engineering (in the School of Engineering); Cellular, Developmental, and Integrative Biology; Genetics; Microbiology; Neurobiology; Nutrition Sciences (in School of Health Professions); Pathology; and Pharmacology & Toxicology. In an effort to leverage the expertise throughout these programs, the JHS Departments provide faculty leadership in graduate/first professional training, mentorship, curricula development, interdisciplinary research as well as participating in institutional roles in multiple schools.

UAB Libraries (est. 1945, John Meador, Dean) administratively merged in 2015 to provide shared services, such as a single catalog, and achieve economies of scale while collectively expanding access to digital resources. UAB Libraries encompass the *Lister Hill Library of the Health Sciences* and the *Lister Hill Library at University Hospital*, the *Mervyn H. Sterne Library*, *UAB Special Collections*, the *Alabama Museum of the Health Sciences*, and an off-site storage facility termed the *801 Building*.

- *Lister Hill Library of the Health Sciences*, the largest biomedical library in Alabama, was established in 1945. Located in the heart of the academic medical center, LHL provides a variety of reference and educational opportunities ranging from one-on-one instruction at point of need to scheduled workshops on using library resources. A recent renovation of physical space increased group study rooms from 7 to 18 and added ergonomic furniture for individual study in public spaces and access to 3-D printers.
- *The Lister Hill Library at University Hospital*, located in the West Pavilion, provides clinicians onsite support for education, research, and patient care.
- *Mervyn H. Sterne Library* maintains a collection of over one-million items and rapidly expanding access to digital resources in support of teaching and research in arts and humanities, business, education, engineering, natural science and mathematics, and social and behavioral sciences. The Sterne Library recently consolidated services to a new single desk and added ergonomic study spaces. A Maker Space is staffed by engineering students.
- *UAB Special Collections* are located on the third floor of Lister Hill Library. The largest special collection, the *Reynolds-Finley Historical Library*, is an internationally respected collection of manuscripts and books in the medical sciences dating from the Middle Ages. *University Archives* comprise the official historical records of UAB since its founding.
- *Alabama Museum of the Health Sciences* is dedicated to the preservation and display of equipment, instruments, and objects that represent the history and development of the health sciences in the areas of education, research, and practice in the United States with special emphasis on the state of Alabama and its contributors to the practice of medicine. Notable artifacts include small ivory 16th and 17th century anatomical models, a collection of wax moulage and an antique iron lung.
- The *801 Building* is a remote storage facility where less-frequently requested items in the collection are kept. These items remain available to library users and can be requested through our courier service. A sampling of items stored here include journals from the Sterne Library dating from 1999 and back, microfilm, microfiche, cassettes, albums, kits, and print books. Many of the items here may be of interest to individuals doing historical research.

University-Wide Interdisciplinary Research Centers

University-wide thematic centers provide a framework for research and training. These multidisciplinary centers are open to all investigators with interests consistent with the mission of the given center. The centers assist in coordinating thematically-oriented efforts for extramural grants and contracts, in developing center-associated core facilities and in integrating enrichment programs that are important trainee resources. Centers require sponsorship from at least three UAB schools, substantive interdisciplinary faculty involvement; contribution to the intellectual environment in order to enhance faculty and student recruitment, development, and retention; an extramural financial base to support center and core activities; internal and external review processes to ensure quality and productivity; and leadership in the integration of research and service including community outreach or partnerships. Through a competitive review process, the Deans of sponsoring Schools and the

Provost provide modest funds for research cores, pilot and feasibility studies and selective enrichment activities. The Center for Clinical and Translational Science, a university-wide center, integrates essential resources and services for clinical and translational research for all faculty and centers and has developed a jointly sponsored pilot program in translational research.

UAB Research Administration

In support of the research endeavors of a dynamic institution, the administration reporting to the Office of the Vice President for Research develops and improves processes and services that promote research and scholarship by faculty, staff, and trainees, that foster an environment of integrity in research and scholarship, that improve the quality of research, and that enhance economic development. Administrative units include the Office of Sponsored Programs (OSP), Conflict of Interest Review Board (CIRB), Institutional Review Board (IRB), Animal Resources Program (ARP), Institutional Animal Care & Use Committee (IACUC), Occupational Health and Safety (OH&S) and the Office of Sponsored International Programs (OSIP). Working in close affiliation with UAB Research Administration and individual Offices, the CCTS serves translational researchers to optimize business and oversight practices in support of research and training.

UAB's Harbert Institute for Innovation and Entrepreneurship

The Harbert Institute for Innovation and Entrepreneurship (HIIE) exists to help UAB faculty, staff, and student commercialize their knowledge for the benefit of the global community. The HIIE cultivates innovative and entrepreneurial excellence through building connections from research to industry to startup. The HIIE strategically evaluates, protects, and licenses technology while also providing resources for patenting, funding and startup.

Innovation Depot

Innovation Depot is a business incubator facility and program in Birmingham, AL, that resulted from a public-private economic development effort funded by the Birmingham regional business community, the Community Foundation of Greater Birmingham and other local private foundations, UAB, the City of Birmingham, and Jefferson County. Centrally located within close proximity of the UAB academic health center, the financial district, and the entrepreneurial district, Innovation Depot provides a broad support infrastructure to emerging biotechnology/life science start-ups, information technology operations and service businesses in collaboration with UAB.

Informatics Institute

The Informatics Institute is an academic unit that conducts hypothesis-driven applied informatics research. Faculty in the Institute have primary appointments in other UAB departments and schools but come together to collaborate on research projects that provide direct solutions to biomedical research problems while contributing to the science of informatics to explore new approaches that can be applied to broader sets of problems.

The Informatics Institute, in collaboration with CCTS Informatics, provides:

- Tenured and tenure-track faculty who can advise and collaborate on the design and execution of biomedical research studies generating and utilizing large datasets.
- Consultation services that comprise software, hardware, data sets and methodologies, to provide "one stop shopping" informatics support.
- Support for researcher access to clinical data through the Enterprise Clinical Data Warehouse and the i2b2 data repository.
- Research and development on creating new tools and extending existing ones (such as i2b2).
- Education and training of undergraduate, graduate and postgraduate trainees through courses, journal clubs, seminars and research opportunities.

Information Technology (UAB IT)

UAB Information Technology Operations - The responsibility for the campus network, IT resources, and IT security resides with the UAB Office of the Vice President for Information Technology. UAB Health System IT operations are provided by the Health System Information Services (HSIS) unit. The CCTS utilizes services and resources provided by both UAB-IT and HSIS. The services and resources available to the CCTS are outlined below.

Integrated Research Administration - UAB has implemented an Integrated Research Administration Portal (IRAP). The underlying software consists of a suite of modules developed by InfoEd Global Inc. When fully implemented IRAP will support electronic submission of funding applications and compliance forms and will seamlessly connect the operations of the Office of Sponsored Programs (OSP), Institutional Review Board for Human Use (IRB), Institutional Animal Care and Use Committee (IACUC), Institutional Biosafety Committee (IBC), Chemical Safety Committee, Radiation Safety Committee, Conflict of Interest Review Board and UAB Research Foundation. Other features of the system provide access to potential collaborators and automated notification of funding opportunities meeting criteria users set.

UAB Network Infrastructure

- *Campus High Speed Network Connectivity.* The campus network backbone is based on a 40 gigabit redundant Ethernet network with 480 gigabit/second backplanes on the core L2/L3 Switch/Routers. For efficient management, a collapsed backbone design is used. Each campus building is connected using 10 Gigabit Ethernet (GE) links over single mode optical fiber. Within multi-floor buildings, a 10 gigabit Ethernet building backbone over multimode optical fiber is utilized. Category 5 or better unshielded twisted pair wiring is used to connect desktops to the network with 1 GE default desktop connections. Computer server clusters are connected to the building entrance using Gigabit Ethernet. All CCTS servers and desktops have 1 GE connections. The campus wireless network blankets classrooms, common areas and most academic office buildings.
- *UAB 40GigE Research Network.* The UAB Research Network is currently a dedicated 40 Gbps optical connection between the UAB Shared HPC Facility and the RUST Campus Data Center. The network supports direct connection to high-bandwidth regional networks and has the capability to connect data intensive research facilities across the institution with the high-performance computing services of the Research Computing System. This network can support very high speed secure connectivity between nodes connected to it for high speed file transfer of very large data sets without the concerns of interfering with other traffic on the campus backbone; thus ensuring predictable latencies.
- *Off-campus Network Connections.* UAB connects to the Internet2 via the University of Alabama System Regional Optical Network (UASRON), a University of Alabama System owned and operated DWDM Network offering 100G Ethernet to the Southern Light Rail (SLR)/Southern Crossroads (SoX) in Atlanta, Ga. The UASRON also connects UAB to the University of Alabama in Tuscaloosa, and the University of Alabama in Huntsville, and the Alabama Supercomputer Center utilizing Gigabit Ethernet speeds. UAB is also connected to other universities and schools through AREN (Alabama Research and Education Network). Connection to the commodity Internet is via Gigabit Ethernet, of which UAB currently uses approximately 3.0 Giga-bits-per-second (Gbps).
- UAB was recently awarded an NSF CC*DNI Networking Infrastructure grant (CC-NIE-1541310) to establish a dedicated high-speed research network (UAB Science DMZ) that establishes a 40Gbps networking core and provides researchers at UAB with 10Gbps connections from selected computers to the shared computational facility.

High Performance Computing Resources

The UAB Shared High Performance Computing (HPC) Facility provides UAB and CCTS researchers with a shared software and hardware infrastructure along with the necessary support for high performance parallel and distributed computing, numerical tools and information technology-based computing environments, and computational simulation. Expansion and use of this computational and storage infrastructure is subsidized by UAB-IT and the office of the Vice President for Research. Through these subsidies, investigators are provided access to these shared HPC resources at no cost for routine processing needs (such as for the analysis of next generation sequence data).

The core compute resources for the Research Computing System is Cheaha, a commodity cluster totaling over 2,800 cores with fourteen data rate (FDR and Enhanced Data Rate (EDR) InfiniBand networks. This cluster is rated at more than 460 Teraflop/s aggregate theoretical peak computing capacity. Storage is provided through FDR InfiniBand access to a high-performance GPFS parallel file system running on a 6.6PB (5.2PB usable) DDN disk array. The currently available generations of hardware include:

- Gen7: 18 nodes with 2 cpu/node, 14 cores/cpu (504 cores total), 2.4 GHz Intel Xeon E5-2680 v4 compute nodes. Each node has 4 NVIDIA P100 GPUs, 256GB RAM, and connected through the EDR InfiniBand network. These 18 nodes provide a theoretical peak performance of 350 teraflops.
- Gen6: 97 nodes with 2 cpu/node, 12 cores/cpu (2328 cores total), 2.5 GHz Intel Xeon E2650 compute nodes. 44 nodes with 5GB RAM per core (128GB RAM total), 39 nodes with 10GB RAM per core (256GB RAM total) and 14 nodes with 16GB RAM per core (384 GB RAM total). This gives the entire system a floating point performance of 110 teraflops.

HPC Software Tools. CCTS Informatics has installed and supports a variety of bioinformatics tools that are available to be run from Cheaha. The Galaxy tool suite is available to provide web-based access to tools for analysis of next generation sequence data and analytical workflows. In addition, standalone packages are available for quality control (fastQC, Picard Tools), alignment (Abyss, Velvet, BWA, Bowtie) visualization (IGV), variant calling (GATK, SnpEff, annoVar), RNAseq (Ballgown suite, RNA STAR, Cufflinks, Cuffdiff, TopHat) and microbiome and metagenomic analysis (QIIME, HUMAnN, MEGAN). These are just a few of the tools available from Cheaha.

Other Available High Performance Computing Resources

UAB is a member of the SURAgriD Virtual Organization (SGVO) on the Open Science Grid (OSG) (<http://opensciencegrid.org>). This is a national computer network and consists of nearly 80,000 computer cores aggregated across national facilities and contributing member sites. The OSG provides operational support for the interconnection middleware and facilitates research and operational engagement between members.

The *Alabama Supercomputer Center (ASC)* is a State-wide resource located in Huntsville, Alabama. The ASC provides UAB investigators with free access to a variety of high performance computing resources. These resources include:

- An SGI UltraViolet system composed of 268 CPU cores, 4160 GB of shared memory, and 182 terabytes in a GPFS storage cluster. The compute system is configured with 256 Xeon E5-4640 CPU cores operating at 2.4 GHz and 4 TB of shared memory. The front end node is configured with 12 Xeon E5-2667 CPU cores operating at 2.9 GHz and 64 GB of memory. This gives the entire system a floating point performance of 5194 GigaFLOPS.
- A Dense Memory Cluster (DMC) HPC system has 2216 CPU cores and 16 terabytes of distributed memory. Each compute node has a local disk (up to 1.9 terabytes of which are accessible as /tmp). Also attached to the DMC is a high performance Panasas file server, which has 17 terabytes of high performance storage accessible as /scratch from each node. Home directories as well as third party applications use a separate Panasas Filesystem and share 47 terabytes of storage. The machine is physically configured as a set of 8, 16, or 20 CPU core SMP boards. Forty nodes have 2.3 GHz quad-core AMD 8-core Opterons and 128 gigabytes of memory. Ninety-six nodes have 2.26 GHz Intel quad-core Nehalem processors. The DMC has 32 NVIDIA GPU (Graphic Processing Unit) chips. These are a combination of: two Tesla S1070 units (external GPUs connected in pairs to four DMC nodes); four DMC nodes configured with a pair of Tesla M2070 cards each, and four DMC nodes configured with four Tesla K20m cards each. These multicore GPU chips are similar to those in video cards but are installed as math coprocessors.
- The processing capacity of the DMC cluster is: Conventional processing capacity - 29.52 TFLOPs; Single precision GPU capacity - 74.92 TFLOPs; Double precision GPU capacity - 23.53 TFLOPs
- A large number of software packages are installed supporting a variety of analyses including programs for Computational Structural Analysis, Design Analysis, Quantum Chemistry, Molecular Mechanics/Dynamics, Crystallography, Fluid Dynamics, Statistics, Visualization, and Bioinformatics.

Operational Healthcare Information Systems

The UAB Health System (UABHS) through HSIS houses and supports over 3,600 servers and more than 350 applications and databases in a mostly virtualized computing infrastructure with a mix of operating systems including Windows, AIX, Linux (both Red Hat and SUSE), Solaris, zOS and Macintosh. The current storage for UABHS resides mostly on Hitachi Data Systems and provides over 10 Petabytes of storage across a redundant fiber channel network. Both data centers run on a 10Gig backbone, utilizing Cisco Nexus equipment, and have redundant 40 Gig connections between the primary and secondary data centers. Backups are done on tape and multiple disk arrays.

- Clinical, financial, and administrative data are managed on behalf of the UAB Health System and include patient demographics records available in the Enterprise Master Member Index (EMMI) system; lab results dating back over ten years; documents dating back over ten years; encounter records, showing paths of patients across the UAB Health System; clinical images, including CT, MRI, X-rays, and more; user audit trails, showing the usage of the data by operational and clinical staff. Multiple systems are in place, and an active program to enhance integration / interoperability has been underway for several years.
- Horizon is a UAB-developed web portal used across the UAB Health System. Horizon includes all inpatient discharge and operative notes, all The Kirklin Clinic outpatient documents and notes and all laboratory and imaging results, each of which is integrated with EMMI to ensure valid patient demographics on the front end of the process. No documents can be created without first selecting a valid EMMI patient, and this occurs via a self-developed CORBA PIDS (Patient Identification Service) implementation wrapped around EMMI.
- The Cerner Millennium Core Clinical system is used as our core clinical system, supporting a complete clinical environment, with medication management, bedside device integration, and clinical decision support via alerts and content as some of the primary features. Cerner Millennium objects allows for object based access to the Cerner system for the purpose of integration. Although we have direct database access as well, this is a preferred abstraction layer that protects both Cerner and their customers from breakage due to changes in the database layer.
- The Cerner PowerInsight Clinical Data Warehouse is used to support reporting, analytics, quality measures and data extraction for research, clinical and administrative operations within UABHS. PowerInsight feeds data into our i2b2/SHRINE (version 1.7) informatics framework.
- Oracle SiteMinder supports clinical trials with tools for scheduling patient visits, tracking completion targets, and tracking expenses and billings to enhance optimal protocol performance and appropriate financial management for the study sponsor. To date, the major focus has been financial management.
- Forte Systems OnCore eClinical Solution is used by the Comprehensive Cancer Center and the CCTS Clinical Research Unit for management of clinical trials.

Software Licenses (Partial Listing)

A variety of software packages are available through institutional licenses maintained by UAB-IT. These include:

- Institutional campus-wide license for Oracle RDBMS.
- Institutional campus-wide Microsoft Campus Agreement and Microsoft Select programs that provide licenses for operating system upgrades, SQL Server, Microsoft Office, and Microsoft program development tools.
- Access to the complete catalog of Microsoft products for STEM programs through Microsoft Dreamspark/Imagine.
- Institutional campus-wide licenses for Antivirus software (Sophos and Microsoft), EndNote, GraphPad Prism, Mathematica, MATLAB, LabView, IBM/SPSS, SAS, Qualtrics, Adobe, VMWare, and others.
- The UAB Department of Biostatistics provides investigators with access to a wide range of statistical software including SAS, S-plus, SPSS, and R. They also maintain many more specialized software programs including some specifically for statistical genetics such as SAGE, SIMWALK, ALLEGRO, DANDELION, GENEHUNTER, MERLIN, MX, PEDCHECK, PHASE, PREST, SOLAR, FASTLINK, VITESSE, SIMLA, and SUPERLINK amongst others. For software development purposes, the group has access to compilers for Fortran, C/C++, Perl, and Java as well as Fortran and Java IMSL libraries.
- CCTS Informatics maintains licenses and provides investigators with access to the Ingenuity Pathway Analysis tool suite and database that provides the ability to mine genomic and other –omics data for information on pertinent biological systems, networks, and pathways.

UAB and UAB Health System (UABHS) Security Policies and Practices

UAB-IT and the HSIS maintain a unified and comprehensive privacy and information security program that preserves and protects the confidentiality, availability and integrity of all information assets including patients, research, customer and business data. The integrated security program upholds values and provides high standards of service, trust, confidentiality and responsiveness to patients, customers, employees and business associates.

The security program includes the following:

- IT security policies designed to help ensure a secure state of operations and information management.
- Technical security standards that document baseline security requirements for key technologies and platforms such as major operating systems, databases, network device operating systems, firewalls, web-server security, email, encryption, secure file transfer protocols, virus defense, media reuse and media disposal.
- A comprehensive risk management program.
- A computer security incident response plan that is supported by cross-functional response and recovery teams.
- User system access is tightly controlled and meets standards required by various regulations and accrediting agencies such as HIPAA, JCAHO and CAP. Two-factor authentication is utilized for many of the shared systems. Users must agree to maintain password confidentiality, log-off terminals at the end of each user session and alert management when security violations become known. We also must routinely demonstrate compliance with Federal granting agencies and the corresponding security requirements such as the NIH, FISMA and the VA.
- An Institutional Firewall for perimeter and layered protection.
- Network Intrusion Detection Systems (NIDS) and Network Intrusion Prevention Systems (NIPS) have been strategically deployed to continuously monitor Internet, Extranet and Internal communications.
- A perimeter Email gateway with spam prevention and virus scanning.
- Encrypted VPN tunnels for business associates, staff remote access, or partner VPN connectivity,
- Capability to support encrypted secure file transfers.
- Virus protection agents and comprehensive patch management programs installed on all computer workstations and servers to protect against malware infections.
- Whole disk encryption software that is required for all laptops.
- In-depth security training that is provided for all Faculty, Staff and students.

UAB has an extensive infrastructure to secure HIPAA-defined Electronic Protected Health Information (ePHI) from its creation and throughout its lifecycle. Secure web portals are utilized to make the required information accessible only to those who need access. The existing wireless infrastructure and secure VLAN architecture make the required ePHI portable but secure and transmissions are encrypted.

UAB/UABHS applications are designed and developed using a comprehensive set of security standards. Areas addressed within application security standards include: password construction, strength and control, browser technologies, authentication and access control, security administration, and logging, auditing, and monitoring.

Internet applications mandate TLS encryption with strong cipher suites for the transmission of any sensitive data. Before going into production, all new Internet applications must be submitted for security testing. All identified security issues that could impact the confidentiality / integrity / availability of our data must be corrected prior to production release. Applications are retested on a regular schedule that coincides with major release cycles. A comprehensive change management system is utilized for updates, production changes, quality control and revision management.

Physical security is controlled by the following:

- Access to data center facilities is electronically controlled using card access systems. The access to computing facilities is granted on an as needed basis based upon the employee's job function.
- Access to the data center is removed as soon as the employee leaves or changes jobs within the UAB/UABHS. Authorizing approvers perform periodic reviews of employees with data center access. All IT personnel are required to submit to pre-employment security background screening.
- Access of personnel entering the data center area is monitored by operators in the Control Room. Operators are authorized to permit access of individuals such as vendors who may be required to support a system in the data center, but do not have a card that permits them access and provide escort while on site.
- A video surveillance system is in place to monitor the main data centers. This system is managed and monitored by physical security and operations personnel.

Environmental security is integral at each data center. All data centers are equipped with smoke and heat alarm systems, water sensors, fire suppression systems, fire extinguishers, emergency lights, air conditioning, humidity control systems, and backup power (UPS and Emergency Generators). UAB/UABHS has comprehensive provisions for Business Continuity and Recovery Systems. UAB contracts with third party vendors for rapid emergency equipment shipping and are currently implementing a “hot site” alternative-processing center. Supplemented by on-site technical and administrative personnel, this solution will facilitate the exercise of a recovery plan, thus enabling the institution to rebound from an unplanned outage should a critical IT disruption occur.

Data Security Plan

Each CCTS Partner Network site maintains a unified and comprehensive privacy and information security program that protects the confidentiality, availability, and integrity of all information assets (i.e., patient, research, customer, and business data). In addition, the CCTS is committed to providing an IT environment focused on ensuring compliance with all applicable laws, regulations, and guidelines for investigators at all Partner institutions. The information security environment maintained by each institution is described in the Institutional Resources section of this proposal. Generally, these security programs are the responsibility of the institution and its health system IT office working as necessary with institutional personnel to provide the required services and resources. Below we describe in general, the environment that all CCTS institutions provide to protect the security and privacy of human subject research data, and more specifically, the environment available at the UAB hub.

Policies, Standards, and Controls. Review and consolidation of existing security policies and requirements is a continual process, involving individuals from each Partner and their respective health system. Information security policies establish controls based on educational and research needs, patient care, governmental guidelines, and other best practices. Data security controls are a part of IRB review as well. Each health system follows HIPAA policies and undergoes review by the Joint Commission on Accreditation of Healthcare Organizations. Each academic organization complies with Family Educational Rights and Privacy Act controls for student information. Every Partner institution dealing with PHI has an appointed HIPAA Entity Security and Privacy Officer. Compliance with IT Security policies and local and federal laws and regulations is further ensured through review by each institutional health system and its internal audit organization. UAB has also adopted the NIST Risk Management Framework (NIST SP 800-37) – a security life cycle approach that consists of Categorization, Selection, Implementation, Assessment, Authorization and Monitoring, as the basis of its Information Security Program to ensure compliance.

In addition to HIPAA requirements, the Federal Information Security Management Act of 2002 (FISMA) requires a minimum set of security controls and protection of the sensitive data created, stored, or accessed by either the federal government or any entity on behalf of the federal government. Investigators will work with the CCTS, Office of Sponsored Programs, IRB, and UAB-IT to identify how the information and information systems detailed in their grants and contracts have been categorized by NIH or other federal agencies to determine the level of control needed meet the required security and privacy standards. UAB-IT has established policies (<http://www.uab.edu/it/home/technology-solutions/email/item/818-data-protection-rule>) and provides guidance to investigators (<https://www.uab.edu/it/home/images/01documents/UAB-Restricted-Data-Handling-Procedures.pdf>) to help with this assessment and with meeting any requirements. Security categorization provides a structured way to determine the criticality and sensitivity of the information and to assign a security impact value (low, moderate, high) to meet the objectives of confidentiality, integrity or availability. Once the overall security impact level of the information system is determined, an initial set of security controls is selected from the corresponding FISMA or HIPAA standards.

Restricted Data Environment. To provide the required controls and meet security standards, UAB-IT provides and supports the Restricted Data Environment (RDE), an enhanced cyber security network and server infrastructure for the processing, transmission and storage of restricted data as defined by the UAB Data Classification rule. This RDE provides highly secured computing-servers, database instances, and data storage, ensuring the protection of highly sensitive research data created, used, or stored by the University's research and clinical departments. The RDE includes monitoring and controlling processes and procedures that can meet the baseline standards to satisfy FISMA Low and Moderate level compliance requirements as

outlined in NIST 800-53. While meeting FISMA levels of security is not required for all grant-supported research, we believe that use of the RDE is the best way to meet HIPAA standards, and ensure data security and privacy.

Implementation, Management, and Enforcement. All Partners working with clinical data also have HIPAA-compliant data processing facilities to support their research needs. To ensure that these systems continue to protect patient privacy, adhere to updated or new standards, and meet the needs of investigators, representatives from the CCTS, IRB, and IT organizations of each Partner will regularly review technical standards and will revise policies and procedures as necessary. The CCTS also supports training for investigators handling covered research data to familiarize them with the data security plan as well as the use of the RDE to store and process their own datasets. We will also work with IRB staff and Board Members to ensure that they have the knowledge necessary to support their review of the data security requirements of each covered study.

TRANSLATIONAL RESEARCH INFRASTRUCTURE

Core Facilities

UAB's shared Core Facilities offer state-of-the-art instruments, resources and technologies that are beyond the reach of the individual laboratory, available to investigators and trainees throughout the Hub and Partner Network research enterprise. Scientific capacities that include animal models, biomolecular analysis, imaging, genomics, proteomics and metabolomics, exercise medicine, structural biology, biological sample repositories and many others are available to CCTS investigators to support fundamental and translational research. Selected examples are listed below:

Biomolecular Analysis – To assist in the characterization of molecular interactions, signal transduction pathways and other fundamental analyses, Core expertise and technology are available to help define mechanisms of action and clinical and translational applications of research discovery.

- *Pharmacokinetic and Pharmacodynamic Shared Facility* – The PK/PD Shared Facility offers pre-clinical and clinical trial design to support sample analyses for drug and metabolite quantitation as well as PK/PD determinations. Data analysis and interpretation is also available.
- *Cystic Fibrosis Transmembrane Conductance Regulator (CFTR) Expression Core* – The CFTR assists investigators interested in CF with the complex technology necessary to efficiently express CFTR in experimental systems. It maintains a repository of reagents for studying CFTR, including over 50 constructs containing mutations that lead to disease and CFTR plasmid molecules used as part of gene therapy protocols in CF patients in the past. Expertise is available to assist with expression using vaccinia, adenovirus or other methodologies and to detect expression using antibody directed against CF related gene products.
- *Islet Resource Facility* – The Islet Resource Facility provides state-of-the-art islet isolation and in vitro/in vivo assessment of functionality. The Islet Resource Facility is equipped to process human and non-human tissues and isolating islets. A complementary facility, the Beta Cell Biology Core assists investigators with islet morphology and measurements of whole pancreas beta cell mass, whole pancreas insulin content, whole pancreas beta cell morphometry, and whole pancreas islet visualization (stitching).
- *UAB Vector Production Facility* - The UAB Vector Production Facility provides the UAB translational research community with the capability of producing viral vectors and cell-based proteins in compliance with current Good Manufacturing Practices (cGMP) for FDA-directed preclinical studies and early phase human clinical trials of cancer.
- *Tissue and Immunopathology Core Facility* - The Tissue and Immunopathology Core Facility has extensive experience in collecting, processing, storing/banking, and distributing a wide range of cancer-related tissues. The Core has established a bank of well characterized tumor specimens and matching normal/control specimens from patients who have given informed consent for their tissues to be used in genetic and other types of research so tissue can be supplied to investigators along with clinical data including outcome and familial histories of ovarian, breast, and related tumors. Fresh, frozen and

paraffin preparations of tissues can be supplied as well as unstained tissue slides, tissue matrix arrays, microdissection and other histology services. The Core also provides light microscopic and immunocytochemical interpretation of animal and human tissues and cytologic materials including methods to detect gene products within transfected cells and adjacent tissues.

- *Multidisciplinary Molecular Interaction (Biacore) Core (MMIC)* – The MMIC uses a GE Biacore T200 optical biosensor to detect biomolecular interactions of proteins, nucleic acids, carbohydrates and lipids. Characterization of interactions includes binding specificities, kinetics, affinity, concentration and epitope mapping.
- *Comprehensive Flow Cytometry Core* - The Comprehensive Flow Cytometry Core provides instrumentation and expertise to support fundamental mechanistic studies of disease and the identification of new biomarkers for disease diagnosis and the development of novel treatments. The facility is equipped with two BD FACSAria II, two BD LSRII, two FACSCalibur instruments, a Tecan Infinite M200 Pro multifunctional microplate reader that can provide a variety of measures including fluorescence intensity, time resolved fluorescence, fluorescence energy transfer, flash fluorescence, absorbance, glow fluorescence, bioluminescent resonance energy transfer in 6 to 384-well microplates, and a GUAVA EasyCyte flow cytometer that is available for simple flow cytometry analysis. High throughput flow cytometry is enabled using a high-throughput flow cytometry platform interfaced with a FACSCalibur flow cytometer. A BioPlex Suspension Array System (a flexible multiplex analysis system permits the simultaneous analysis of up to 100 different biomolecules (proteins, peptides, or nucleic acids) in a single microplate well.
- *Targeted Metabolomics and Proteomics Laboratory (TMPL)* – TMPL is organized to provide a variety of analytical and technical services using mass spectrometry to UAB and consortium investigators. The laboratory is well equipped to analyze the metabolome, including a triple quadrupole instrument (SCIEX 4000) and a quadrupole-linear ion trap instrument (SCIEX 6500Qtrap), both of which have been combined with microflow LC systems to improve analyte sensitivity. The SCIEX 6500Qtrap is fitted with a SelexION interface for performing ion mobility separations of isomeric species. In addition, there is a quadrupole-TOF (SCIEX 5600 TripleTOF™) which is combined with nanoLC to carry out highly quantitative and comprehensive SWATH analysis of proteins. The SCIEX 5600 TripleTOF™ is also particularly powerful for comprehensive and targeted lipidomics and metabolomics. These technologies are instrumental in characterizing host molecules, those coming from the diet and those produced by bacteria. The latter represent the link between the microbiome and chronic diseases such as cancer, diabetes, neurodegeneration and obesity. TMPL also offers training in data analysis, particularly for statistical evaluation of the data obtained from comprehensive analyses.

Southeastern Biosafety Laboratory (SEBLAB) - Southeastern Biosafety Laboratory is a 43,500 s.f. facility that houses state-of-the art biosafety level 2 and level 3 laboratories as well as animal biosafety level 3 laboratories. SEBLAB's design includes flexible and secure laboratories, animal housing and procedure space, and laboratory support space. Specialized resources at SEBLAB include an aerobiology suite, imaging suite, irradiator, vaporized H₂O₂ decontamination and a decontamination chamber.

UAB Heflin Center Genetics/Genomics –UAB cores support fundamental, routine capacities in sequencing and genotyping, DNA Sequencing as well as leading-edge technologies in next-generation genomics on a low-throughput scale to establish proof-of-concept among a broad research portfolio.

Laboratory

- The Genomics Core is dedicated to basic and applied research in genomics and genetics. The Core, which opened in 2001, is housed on the fourth floor of the Kaul Human Genetics Building and the facility is well-equipped state-of the-art laboratories. The Core laboratory is 2,500 square feet in area and has bench and desk space for all the staff required to run the facility and all the standard equipment for molecular biology, genetics, and genomics work, including several PCR machines, refrigerators, freezers, centrifuges, incubators, water baths, etc. The Core provides the necessary expertise in Next-Generation Sequencing library production. To that end, the core has the Covaris S2 sonicator to randomly shear genomic DNA for whole genome based library production that is housed in a separate room on the 4th floor of the Kaul building. The core utilizes a NextSeq500 and a MiSeq Next-Generation sequencing systems from Illumina to generate NGS related data. In addition, the core

can also process Illumina genotyping microarrays for SNP and methylation based studies. Finally, the core is the provider of Sanger sequencing data of individual clones for campus.

Computer

- UAB IT Research Computing maintains high performance compute and storage resources for investigators. The Cheaha compute cluster provides 2800 conventional CPU cores and 80 accelerators interconnected via InfiniBand network and provides 468 TFLOP/s of aggregate theoretical peak performance. A high-performance, 6.6PB raw GPFS storage on DDN SFA12KX hardware is also connected to these compute nodes via the Infiniband fabric. An additional 20TB of traditional SAN storage is also available for home directories. This general access compute fabric is available to all UAB investigators.

Major Equipment

- Illumina Next-Seq500 and MiSeq instruments for Next-Generation sequencing data.
- Covaris S2 Sonicator. The Covaris S2 sonicator provides the mechanism to fragment DNA molecules for library generation for Illumina sequencing. The Covaris has a dedicated laptop computer to run the instrument.
- An Illumina iScan instrument. Located in a dedicated equipment room adjacent pre-PCR room, the Illumina scanner includes full robotics and are staffed by a team of three dedicated technicians.
- Tecan Evo robot for liquid handling and Illumina microarray processing.
- Roche 480 LightCycler for real-time quantitative PCR using with Taq-man or fluorescent detection.
- Applied Biosystems 3730 Genetic Analyzer. The 3730 is used to process samples for Sanger Sequencing and fragment analysis. It is housed in the main core laboratory and is staffed by a dedicated technician.

Animal Models - To enable proof of principle investigation and studies of biological function / significance, model systems play an essential role in clinical and translational science. UAB has an extensive animal resources program (UAB ARP) that provides support to the animal research community. To facilitate investigators in the identification and access of the best animal models, CCTS established, the human to animal model (H2M) consultative service, which won an AAMC innovative practices award in 2014. The H2M works closely with the UAB ARP to ensure investigators have access to cutting edge animal models and resources. The UAB ARP is accredited by the AAALAC, is registered as a research facility by the USDA, and has an Assurance of Compliance on file with the Public Health Service Office of laboratory Animal Welfare. The UAB ARP encompasses ~225,000 sf of animal housing and procedure space in 15 buildings. The program provides husbandry, veterinary care, diagnostic and research histopathology, facility and equipment management for approximately 450 animal researchers with approximately \$150M in extramural funding. The average daily census of animals at UAB is approximately 28,000 cages of rodents, 2,000 aquaria of fish and 350 larger animals such as rabbits, tree shrews, pigs, ferrets, guinea pigs, and dogs. The UAB ARP has ~90 husbandry staff, 10 veterinary staff and the necessary personnel to manage the administrative, financial, safety and personnel responsibilities of the program. The UAB ARP program also has the needed support of other institutional units such as the Facilities and Maintenance, Department of Occupational health and Safety, Human Resources Management, Project Management, Police, Physical Security, Communications, and Information Technology. The following are examples of the animal cores integrated within the UAB ARP providing specialized services.

- *UAB Animal Model Systems Facility*– Genetically modified murine models continue to be the most tractable system to examine the role of an identified genetic variant associated with human disease, as well as creating much needed translational models for developing novel therapeutics. The facility provides expertise and technical service related to the creation of genetically modified rodent models. The Core works with investigators to devise targeting strategies and will facilitate DNA or ES cell microinjection, ES cell gene targeting, assisted reproduction and line cryopreservation. Additionally, it provides unique services for in vitro fertilization, embryo and sperm cryopreservation, long-term storage of cryopreserved embryos and sperm, and assistance with reproduction / re-derivation of transgenic animals.

- *UAB Zebrafish Facility Resource* - This resource includes a recirculation aquaria system with a central water conditioning/purification system supplying 27 racks (>2200 aquaria) to support the use of Zebrafish as an investigative model of human development. The *in vitro* manipulation laboratory includes four embryo processing stations equipped with dissection microscopes, injectors, and micromanipulators; incubators; a pipette puller; and a fluorescent microscope, as well as other smaller equipment to be used for embryo manipulation.
- *Small Animal Microsurgical Core* – The major goals of this unit aim to provide investigators with the expertise and technology to develop animal models of human disease that provide important insights that can help to define the impact(s) of therapeutic interventions and preventative approaches. The core supports the development and evaluation of rodent models of acute kidney injury specifically in the setting of ischemia/reperfusion injury, sepsis and renal transplantation. It also provides access to multi-modality imaging of small animals, as well as microsurgical techniques and measurements of GFR, tubular reabsorption, renal hemodynamics with assessment of tubulo-glomerular feedback, metabolic assessment of kidney oxygen consumption and nitric oxide in rodents. It provides surgical expertise and facilities to UAB investigators interested in various aspects of organ injury and repair. Services offered include heterotopic heart transplantation, orthotopic kidney transplantation, orthotopic abdominal aortic transplantation, ischemia/reperfusion models for lung, kidney and heart.
- *Animal Physiology and Imaging Shared Facility* - This facility provides body composition assessment of non-human primates and rodent models by chemical analysis, DXA, QMR, and micro-computed tomography. The core can also evaluate energy balance by measurement of metabolic rate, food intake, fecal output, activity and body temperature as well as cardiovascular assessment with echocardiography and blood pressure. It can also facilitate animal imaging including bioluminescence and fluorescence imaging, gamma ray imaging, SPECT/CT, microPET/CT, bioluminescence, fluorescence, magnetic resonance (MR) imaging and ultrasound imaging. This technology has been used to detect tumor location and mass, receptor expression (tumors, brain, etc.), organ function, metabolism, perfusion, and response to therapy.
- *Behavioral Assessment Core* - The Behavioral Assessment Core provides a facility for the behavioral testing of mice and rats. Newly created transgenic mice can be analyzed using the most-accepted battery of behavioral tests, including a primary neurological screen, sensory and motor tests (including rotarod, spontaneous locomotor activity, walking coordination, etc.), an open field test for emotional and exploratory activity, and an elevated plus maze for anxiety. Motor function testing is available, and cognitive testing is provided with the Morris water maze, Barnes maze, holeboard maze and eight-arm radial maze tasks. Other, more complex, tasks are also available.
- *Gnotobiotic Animal Core* - The microbiota in an organism can exert both beneficial as well as deleterious effects on their animal hosts. The Gnotobiotic Animal Core provides the expertise, sterile technology (e.g., isolators) and standard operating procedures / quality control protocols to develop animal models ideally suited to characterize the role of the microbiome in pathology. The Core is also equipped to assist investigators in the development of transgenic models in a germ-free environment.

Imaging - These facilities offer pre-clinical research support with a range of cutting-edge imaging modalities and assistance with protocol development and analyses. The resources are available to CCTS Partner network investigators, trainees and partners. These core capacities support imaging across the research spectrum.

- *High Resolution Imaging Facility* – The High Resolution Imaging Facility (HRIF) is a cutting-edge facility providing a variety of microscopy services for UAB Scientists. The HRIF supports research by offering access to a comprehensively equipped Shared Resource. Available are confocal laser scanning microscopy, transmission and scanning electron microscopy, Ca²⁺ imaging, FRET, FRAP, and FLIM imaging, 3d time lapse with extensive digital analysis for cell fluorescence quantification, colocalization and image processing, Imagestream, high throughput fluorescent imaging, Nanosight system for studying exosomes and nanoparticles, and a laser capture microdissection system. In addition the facility offers STORM and SIM super resolution imaging capability.
- *Civitan International Neuroimaging Laboratory* – The Civitan International Neuroimaging Laboratory (CINL) is located on the first floor of UAB Highlands Hospital in a newly renovated 5000 sq. ft. suite. It houses a research dedicated Siemens Prisma 3T whole body scanner for structural and functional

brain and body imaging, MRI preparation rooms and interview rooms for pre- and post-scan patient monitoring and testing, and a fully-equipped experimental suite for behavioral and physiological recording. Research equipment is housed in a dedicated room adjacent to the scanner room with a dedicated research penetration panel. The Siemens MAGNETOM Prisma MRI Scanner offers a 3T whole body MRI platform for the highest quality MRI research. Its design delivers maximum performance under prolonged high-strain conditions. Unmatched 3T full body magnet homogeneity, XR 80/200 gradient coil, parallel transmit architecture for shaped excitation and B0 shimming, and at-the-scanner 64 channel receiver architecture.

- *Advanced Imaging Facility and UAB Cyclotron Facility* - The Advanced Imaging Facility, which operates in close coordination with the UAB Cyclotron Facility, is designed to develop novel imaging techniques based on Positron Emission Tomography (PET) and to enable clinical trials using these techniques. The Advanced Imaging Facility houses two state of the art GE PET/CT scanners and a new GE PET/MR imaging system (installed in 2015) for both clinical and research use. The UAB Cyclotron Facility is adjacent to the Advanced Imaging Facility and creates custom radiopharmaceuticals for PET imaging, thus enabling enhanced imaging capabilities in basic and preclinical efforts. The centerpiece of the Cyclotron Facility is a TR24 cyclotron, which is a variable energy machine capable of accelerating protons from 16- 24 MeV with a current capacity of 300uA. This instrument enables UAB investigators access to many different radionuclides for the development of radiopharmaceuticals for both small animal imaging and clinical trials. UAB Radiology currently holds 7 approved Investigational New Drug Applications (IND) for the use of novel radiopharmaceuticals in neurology, oncology and cardiovascular imaging studies.

Structural Biology - A comprehensive structural biology capacity at UAB has been developed, leveraging the robust expertise and technological investment to enable high resolution microscopy and proteomics, including mass spectrometry, post-translational modification analysis, X-ray crystallography and high-field NMR. Together, these bioanalytical resources are a critical feature available to the biomarker and drug-discovery initiatives.

- *Mass Spectrometry/Proteomics (MSP) Shared Facility (SF)* – The Institutional UAB & CCC MSP-SF provides a variety of analytical and technical services using mass spectrometry to UAB investigators. Standard workflows include 1) help with experimental design, 2) complete sample preparation, 3) quantitative high-resolution MS driven proteomics, 4) in addition to advanced informatics, statics, and systems biology analysis. In addition to standard sample preparation and separation equipment, the Facility is also equipped with multiple high-end MS systems: two LTQ Orbitrap Velos Pro's, two LTQXL's with CID & ETD, and an Ultraflex III MALDI TOF/TOF. All of these instruments are paired with updated UPLC's and nano-HPLC systems, in addition to software tools that include MASCOT, MASCOT Distiller, SEQUEST, and Proteome Software (Scaffold, Scaffold PTM, and Q+S modules) to offer the very best outcomes for a wide range of proteomics-driven procedures.
- *UAB High Field NMR Facility* - The UAB High-Field NMR Facility provides instrumentation and expertise for elucidating the structure and dynamic behavior of macromolecules, perform solution metabolite analysis, and characterize small molecule structure and binding. The facility provides enables analysis of molecular interactions critical for both understanding basic mechanistic structures and using that information to refine potential therapeutics for a variety of diseases. The facility is equipped with Bruker 600 (Avance III), 700 (Avance II), and 850 (Avance III) MHz NMR spectrometers with cryoprobes. In addition, a 500 MHz Bruker Avance NMR Spectrometer with TXI and TBI probes is also available.
- *X-ray Crystallography Shared Facility* – Cutting-edge technology and expertise are available to study protein-protein/ligand interactions using differential scanning, isothermal calorimetry and surface plasmon resonance. High-throughput aqueous and membrane protein crystallization robots, protein crystallization imagers, high throughput crystal growth optimization and structure determination via in-house or national synchrotron x-ray systems.
- *Cryo-Electron Microscopy* – High resolution EM of negatively stained or cryogenically frozen samples, electron tomography, cryo-sectioning and immunocytochemistry on cryo-sections (Tokuyasu technique). The facility is equipped with an FEI Tecnai F20 FEG microscope and is located in the

basement of Shelby Biomedical Research Building (SHEL B40). An FEI Vitrobot, a Leica cryo-ultramicrotome, lab space for sample preparation and a dark room for film processing are available.

DATA RESOURCES AVAILABLE TO CCTS INVESTIGATORS, SCHOLARS, AND TRAINEES (Examples)

1. Medicare, Medicaid, and Administrative Databases from Private Insurers

CCTS HUB faculty (Curtis, Kilgore, and Muntner) have considerable experience in managing and analyzing the Medicare 5% sample and (50 state) Medicaid (MAX) data. Work to date has predominately focused on the epidemiology of osteoporosis, bone mass measurement, the longitudinal comparative effectiveness and safety of biologic medicines, and the prevention and treatment of cardiovascular disease. The data management and analysis team includes 14 faculty members in the Schools of Public Health and Medicine, supported by a senior systems analyst, 2 senior statisticians, and 19 statistician/analysts. Data management and analysis tasks and resolution of study design and statistical analysis issues are coordinated through monthly Medicare/Medicaid Data Group meetings, attended by investigators and project staff and weekly meetings dedicated to specific projects.

One strength of Medicare and Medicaid is that the computerized pharmacy records provide an objective, detailed, high-quality, and relatively low-cost measure of drug exposure. Inpatient, outpatient, nursing home, and other files provide information on outcomes and other important study variables. Although the limitations of these data always must be considered, Medicare and Medicaid databases have long been recognized as an essential resource for pharmacoepidemiology and health services research.

CMS encourages researchers to use its diagnosis and treatment database. They will provide a file that contains all records submitted with date of birth, gender and date of death information. The Medicare ID returned on this file is an encrypted ID that contains no identifying information including no component of the SSN. The encryption is uniquely created for this proposed study and does not correspond in any way to Medicare data obtained for other studies. CMS has well established, secure procedures for linking research subjects' identifiers to Medicare files for purposes such as this. They uniquely encrypt IDs for each project. Thus, the Medicare data received cannot be combined with Medicare data from any other source or project without CMS assistance.

The Medicare component of this resource includes (1) 1999-2014 claims on a national sample of over 3.3 million beneficiaries, including all claims from inpatient, outpatient, physician, skilled nursing, home health and hospice providers; (2) 2006-2014 claims data for 7 million beneficiaries with osteoporosis; (3) Medicare data on over 18,000 subjects included in a large prospective cohort study of stroke and other medical conditions; (4) Medicare data on subjects with autoimmune disorders included in a large retrospective cohort study; (5) Medicare data linked to Surveillance Epidemiology and End Results (SEER) cancer registry data on over 400,000 cancer patients diagnosed during the period 1999-2005; and (6) 100% cohort of 585,000 MI (myocardial infarction) Medicare beneficiaries from 2006-2012. The Medicaid database includes: (1) national claims data on over 55 million beneficiaries for 1999-2002; (2) claims data on over 490,000 Medicare/Medicaid dual-eligible beneficiaries for 2003-2005; (3) claims data on over 9 million beneficiaries with autoimmune diseases and ADHD for 2006-2010; and (4) claims data on subjects included in the special cohorts mentioned above. In addition, we have Medicare Part D data for 2006-2014 on the 5% national sample of beneficiaries. We also have medical and pharmacy claims data on over 100,000 VIVA Health members for 2010-2014.

Computing resources are housed in the Multimedia Information and Technology services facility in the School of Public Health. The facility is locked and all servers and drives are physically secured. Entry into sensitive areas requires appropriate identification and passwords for access. Computing resources available in the UAB PEER Group consist of multiple Dell PowerEdge (PE) servers, tape drive units, network switches and software for word processing, data management, and statistical analyses. The primary file servers on which analyses will be run are Dell PowerEdge R510s, each with 64gb of RAM and dual-core processors running Microsoft Windows 2008 R2 server operating system. These servers are clustered together to provide both redundancy and system integrity in the event of hardware malfunctions. Approximately 48tb of disk space is available for data storage and is optimized for storing large SAS datasets across separate drive arrays. A Dell robotic tape library is used to back up data on a nightly basis. Additional Dell servers are used for Active Directory, Web

server, and other system management tasks. Software available for projects includes SAS versions 9.3 and 9.4, R version 3.0.3, Stata version 12, Microsoft Office 2010, and other utility software.

Data security and integrity is accomplished by a combination of hardware and software protocols. Comodo and Microsoft firewall software packages are used to prevent access from unauthorized computers. Microsoft Forefront is used to provide anti-virus protection. Access to the server is restricted to computers located on the UAB campus with specific IP addresses. Data containing individually identifiable data are stored in encrypted, password-protected datasets that can only be accessed through a Remote Desktop Connection to the server. Data integrity is accomplished by a nightly backup routine and by replicating the data to a secure, off-site server. The UAB Office of Internal Audit conducted an audit of the facility where the data are housed. Based on their recommendations, additional security protocols were implemented and the User Authorization Agreement was amended to reflect stricter CMS guidelines. The auditor was pleased with the attention to detail and also gave suggestions for maintaining a secure environment. All project personnel are required to have current IRB and HIPAA training and will be signatories to Data Use Agreements in order to access any research identifiable data.

2. Coronary Artery Risk Development in Young Adults (CARDIA)

The Coronary Artery Risk Development in Young Adults (CARDIA) Study examines how heart disease develops in adults. In 1986, it began with a group of 5,115 African-American and Caucasian men and women aged 18-30 years. The participants were selected so that there would be approximately the same number of people in subgroups of race, gender, education (high school or less and more than high school) and age (18-24 and 25-30) in Birmingham, AL; Chicago, IL; Minneapolis, MN; and Oakland, CA. These same participants were asked to participate in follow-up examinations during 1987-1988 (Year 2), 1990-1991 (Year 5), 1992-1993 (Year 7), 1995-1996 (Year 10), 2000-2001 (Year 15), 2005-2006 (Year 20), 2010-2011 (Year 25), and 2015-2016 (Year 30). A majority of the group has been examined at each of the follow-up examinations (90%, 86%, 81%, 79%, 74%, 72%, 72%, and 71%, respectively).

While the specifics of each examination has differed somewhat, data have been collected on a variety of factors believed to be related to heart disease. These include conditions with clear links to heart disease such as blood pressure, cholesterol and other lipids. Data have also been collected on physical measurements such as weight and skinfold fat, as well as lifestyle factors such as substance use (tobacco and alcohol), dietary and exercise patterns, behavioral and psychological variables, medical and family history, and other chemistries (e.g., insulin and glucose). In addition, subclinical atherosclerosis was measured via echocardiography during Years 5 and 10, computed tomography during Years 15 and 20, carotid ultrasound during Year 20, and Brain MRI during Years 25 and 30. Lewis and K. Saag have mentored trainees using CARDIA data.

3. Consortium for the Longitudinal Evaluation of African Americans with Early RA (CLEAR)

The CLEAR Registry and Repository is a National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)-funded project established through a contract in 2000 and renewed in 2006. The goals of this registry were to compile extensive demographic, socioeconomic, clinical, and radiographic data on African-Americans with rheumatoid arthritis and to collect biological samples (genomic DNA, RNA, serum) to allow a comprehensive analysis of factors influencing disease susceptibility and severity in African-Americans with RA. The CLEAR Registry provides a unique and valuable resource for the scientific community to explore genetic and non-genetic factors that influence disease occurrence and outcomes. The CLEAR Registry is composed of African-Americans RA patients with both early disease (≤ 2 years) who were followed longitudinally, as well as a cross-sectional cohort at various disease durations. CLEAR was a collaborative effort among five institutions: University of Alabama at Birmingham (Coordinating Center), Grady Hospital/Emory University, Atlanta, GA, University of North Carolina, Chapel Hill, NC, Medical University of South Carolina, Charleston, SC, and Washington University, St. Louis, MO. The CLEAR Registry is the largest available cohort of African-American RA and has a wealth of data, including radiographic, genetic, and autoantibody data.

4. (ENCOURAGE): Evaluating Community Peer Advisors and Diabetes Outcomes in Rural Alabama

ENCOURAGE is a group-randomized, controlled implementation trial in partnership with the UAB DRTC and established community coalitions. It is designed to improve diabetes health outcomes in adult patients (> 18 years of age) with uncontrolled diabetes living in Alabama's Black Belt region. Peer advisors with diabetes or

familiar with its management will counsel and link patients to clinical care and community resources. Part of the 12-month, weekly intervention for 8 weeks, followed by monthly contacts for the remainder of the year, is empowering/activating patients to self-manage their diabetes. Four community coordinators, 36 peer advisors, and 424 research participants were enrolled for the full study. The infrastructure established through the initial study has led to four additional projects. The first is examining the cost-effectiveness of using peer advisors. The second will assess peer support intervention for patients with diabetes and chronic pain. The third will examine peer advisor roles and integration into a larger health care team. Finally, investigators will look to implement the program in Birmingham. All of these projects will provide junior investigators with the opportunity to conduct research in disadvantage areas and engage both patients and other community stakeholders in research.

5. The Global Longitudinal Study of Osteoporosis in Women (GLOW)

GLOW is an international study that collects, analyzes and distributes data to understand ways in which practice patterns influence the care of patients at risk for osteoporotic fragility fractures. GLOW is a prospective, longitudinal, observational study of women 55 years of age and older who visited a primary care physician during the two years prior to the study. A major study objective is to characterize the clinical and demographic attributes of patients at risk of fracture from representative sites in Europe, North America and Australia in order to improve patient outcomes. Data on osteoporosis risk factors, treatment approaches, patient behavior, and fracture outcomes with an annual patient survey over a 5 year period are collected. GLOW participants are from 10 countries, 17 regional sites with 706 (337 in the US) physicians enrolled and 60,461 (31,074 in the US) women enrolled. K. Saag has mentored trainees using GLOW data.

6. The Osteoporotic Fractures in Men (MOs) Study

The Osteoporotic Fractures in Men (MrOS) Study (Lewis, CE PI) funded by the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), the National Institute of Aging (NIA), and the National Cancer Institute (NCI), began in July 1999. MrOS a 7-year multi-center prospective, longitudinal, observational study examining risk factors for vertebral and all non-vertebral fractures in older men, and of the sequelae of fractures in men enrolled approximately 6000 men aged 65 and older). The specific aims of the MrOS study include: (1) to define the skeletal determinants of fracture risk in older men, (2) to define lifestyle and medical factors related to fracture risk, (3) to establish the contribution of fall frequency to fracture risk in older men, (4) to determine to what extent androgen and estrogen concentrations influence fracture risk, (5) to examine the effects of fractures on quality of life, (6) to identify sex differences in the predictors and outcomes of fracture, (7) to collect and store serum, urine and DNA for future analyses as directed by emerging evidence in the fields of aging and skeletal health, and (8) define the extent to which bone mass/fracture risk and prostate diseases are linked. Lewis and Curtis have mentored trainees using this cohort.

7. The Multicenter Osteoarthritis Study (MOST) Study

Knee osteoarthritis (OA) is a common chronic painful disorder that is the most frequent cause of mobility disability in older people. The MOST study has been a major source of new knowledge about the course of this disease and factors that affect its course. Since the study began in 2003, it is increasingly recognized that by the time people develop chronic symptoms of knee OA, they usually have advanced structural findings of disease on MRI. Findings such as meniscal tears, malalignment and cartilage loss drive further structural deterioration and almost certainly limit prevention opportunities. MOST investigators believe that prevention opportunities are likely to be greater if started in those who do not yet have severe continuous knee pain or advanced structural findings of disease, and that there are opportunities to develop treatments and disease prevention strategies that have been unexplored, and that by using new technologies and focusing on persons at a milder or earlier disease stage than previous studies, we can identify such opportunities. While continuing to follow the existing cohort, originally over 3000 participants, MOST is recruiting a new mild disease cohort of 1500 participants to identify new risk factors for disease and to study consequences of disease. The goal is to find new strategies to prevent disease at an early stage and to limit the impact of disease once it has occurred.

8. Reasons for Geographic And Racial Differences in Stroke (REGARDS)

Funded in 2003 (R01) by the National Institute of Neurological Disorders and Stroke (NINDS), the Reasons for Geographic And Racial Differences in Stroke (REGARDS) cohort, is a prospective study of 30,239 community-dwelling Caucasian and African American adults aged 45+ who were sampled from 1,866 of the approximate 3,000 counties in the continental US. The cohort was oversampled for African Americans (~42%) and

residents of the Southeastern Stroke belt (~56%). Drs. George and Virginia Howard lead the study. The purpose of the REGARDS project is to understand why people in some parts of the country develop more strokes than people in other parts of the country, and why African-Americans develop more strokes than whites. However, the study has been enriched by over 100 funded ancillary studies, both adding new and novel exposures (childhood socio-economic status, air pollution, direct measures of physical activity, kidney biomarkers, etc.) and outcomes (cognitive change, myocardial infarction, sepsis, venous thrombosis, etc.). Participants are randomly sampled with recruitment by mail then telephone, where data on stroke risk factors, socio-demographic, lifestyle, and psychosocial characteristics are collected. Written informed consent, physical and physiological measures, and fasting samples are collected during a subsequent in-home visit. Participants are followed via telephone at 6-month intervals for identification of stroke events. A second in-home assessment approximately 10 years after the baseline assessment is currently being completed on approximately 15,000 of the participants. The study has recently been funded through 2022 for the continued follow-up of the cohort, an increased emphasis on disparities in cognitive change and the development of dementia, and biomarkers for the development of cardiovascular risk factors including diabetes and hypertension. The novel aspects of the REGARDS study allow for the creation of a national cohort to address geographic and racial differences in a wide range of diseases.

9. Systolic Blood Pressure Intervention Trial (SPRINT)

The University of Alabama at Birmingham serves as one of the NIH/NHLBI Clinical Center Networks (CCN; Oparil, PI; Lewis, Co-PI) and Tulane serves as one of the clinic sites (Krousel-Wood, Site-PI) for the Systolic Blood Pressure Intervention Trial (SPRINT). The Systolic Blood Pressure Intervention Trial is a multicenter, randomized, controlled trial that compares two strategies for treating systolic blood pressure: one targets the standard target of <140 mm Hg, and the other targets a more intensive target of <120 mm Hg. Enrollment focused on volunteers of age ≥ 50 years (no upper limit) with an average baseline systolic blood pressure ≥ 130 mm Hg and evidence of cardiovascular disease, chronic kidney disease, 10-year Framingham cardiovascular disease risk score $\geq 15\%$, or age ≥ 75 years. The Systolic Blood Pressure Intervention Trial recruitment also targeted three pre-specified subgroups: participants with chronic kidney disease (estimated glomerular filtration rate < 60 mL/min/1.73 m²), participants with a history of cardiovascular disease, and participants 75 years of age or older. The primary outcome is first the occurrence of a myocardial infarction (MI), acute coronary syndrome, stroke, heart failure, or cardiovascular disease death. Secondary outcomes include all-cause mortality, decline in kidney function or development of end-stage renal disease, incident dementia, decline in cognitive function, and small-vessel cerebral ischemic disease. For the trial, 9361 people from 102 clinics were recruited and randomized. This includes 3331 women, 2648 with chronic kidney disease, 1877 with a history of cardiovascular disease, 3962 minorities, and 2636 ≥ 75 years of age. The major findings of SPRINT were a 25% reduction in the primary outcome and a 27% reduction in all-cause mortality. The extension of SPRINT, SPRING-ASK (Alzheimer's, Senior and Kidney), is ongoing. Oparil, Lewis, Krousel-Wood, and Muntner are available to mentor trainees using this cohort.

10. UAB 1917 HIV Clinic Cohort

The 1917 Clinic Cohort is a prospective, observational HIV clinical cohort study established in 1992 through support by CFAR. It includes extremely well characterized patients (>7000 overall, 3,700 active). In 1999, the database was expanded to include real-time collection of clinic utilization data, thereby allowing cost/expenditure analyses. In 2004, UAB 1917 Clinic deployed a client-server based point-of-care electronic medical record system (1917 EMR) developed within the clinic to its own specifications. The 1917 EMR system allowed for real-time collection of medication, laboratory, clinical, behavioral, and health care utilization data. Taking the collection of data to a higher level, in 2012, the 1917 Clinic migrated its locally developed EMR data to the *Cerner Ambulatory HER (IMPACT) and started relying primarily on IMPACT collected data*. Over the years numerous clinical and behavioral comparative effectiveness studies have been conducted through the cohort. These include evaluation of the "efficacy vs. effectiveness" of initial ART regimens in patients treated in clinical trials vs. routine care.

The UAB 1917 Clinic Cohort Database reside in a scalable servers' infrastructure that can expand to accommodate flexible and comprehensive data query capabilities. Data are stored in a dedicated Storage Area Network (SAN). Both SANs and servers are housed in the UAB Datacenter run by HSIS which also houses electronic health record data for patient's receiving care at the UAB Health System. Consequently, all information collected in our instances reside within an infrastructure that meets national standards and

guidelines for data security (e.g., National Institute of Standards and Technology). Over 200 users utilizing our 250 personal computers (including 5 computers dedicated to trainees) regularly access the applications housed in this secured environment. Additionally, 13 exam rooms are outfitted with touchscreen computers linked to a web-based platform for completion, transmission and secure storage of Patient Reported Outcomes (PROs) questionnaires completed routinely during clinic visits. Shared conference rooms, fax machines, scanners, and copy machines are co-located and readily available to 1917 Clinic Cohort personnel and trainees.

11. Study of Aging (SOA)

The Study of Aging is a prospective, observational study of a population-based sample of 1000 community-dwelling Medicare beneficiaries, stratified by sex, race, and urban/rural residence ending its 3rd cycle of R01 funding from NIA in 2015. The hypothesis underlying this major research initiative is that potentially modifiable factors predict mobility (life-space) trajectories associated with aging among community-dwelling African Americans and whites. Brown and Locher have mentored trainees using this cohort.

12. Healthcare Cost and Utilization Project (HCUP)

The Healthcare Cost and Utilization Project (HCUP) is a family of health care databases and related software tools developed through a Federal-State-Industry partnership to build a multi-State health data system for health care research and decision making. HCUP is sponsored by the Agency for Healthcare Research and Quality (AHRQ) as part of its mission to improve the quality, safety, efficiency, and effectiveness of the Nation's health care system.

HCUP databases bring together the data collection efforts of State data organizations, hospital associations, private data organizations, and the Federal government to create a national information resource of patient-level health care data. HCUP includes the largest collection of longitudinal hospital care data in the United States, with all-payer, encounter-level information beginning in 1988. These databases enable research on a broad range of health policy issues, including cost and quality of health services, medical practice patterns, access to health care programs, and outcomes of treatments at the national, State, and local market levels.

The Lister Hill Center for Health Policy at CCTS HUB (Muntner, Director) has HCUP National [Inpatient Sample \(NIS\)](#) data through [2015](#). It is available to all Lister Hill scholars and trainees through a sponsoring Lister Hill Scholar. Kilgore has expertise and experience mentoring trainees using this data.

13. Atlanta Census Research Data Center (ACRDC)

Located at the Federal Reserve Bank of Atlanta, the Atlanta Census Research Data Center (ACRDC) seeks to provide qualified researchers in Atlanta, and around the Southeast, with the opportunity to perform statistical analysis on non-public Census microdata. The ACRDC, established 2011, is 1 of 8 centers in the United States and is a partnership between the U.S. Census Bureau and a consortium that includes Georgia State University, the Federal Reserve Bank of Atlanta, the Centers for Disease Control and Prevention (CDC), Emory University, Georgia Tech, the University of Alabama at Birmingham, and the University of Georgia. There are four general categories of data on which qualified researchers may perform statistical analysis inside the secure ACRDC: 1) Economic Data; 2) Demographic Data; 3) Mixed Data; and 4) Health data.

14. OsteoArthritis Initiative (OAI)

The Osteoarthritis Initiative (OAI) is a nationwide, multi-center, longitudinal, prospective observational research study of men and women. The overall aim of the OAI is to develop a public domain research resource to facilitate the scientific evaluation of biomarkers for osteoarthritis as potential surrogate endpoints for disease onset and progression. Osteoarthritis (OA) is the most common form of arthritis and the major cause of activity limitation and physical disability in older people.

Four clinical centers and a data coordinating center conducted the Osteoarthritis Initiative (OAI), a public-private partnership that brought together new resources and commitment to help find biochemical, genetic and imaging biomarkers for development and progression of OA. The OAI established and maintain a natural history database for osteoarthritis that will include clinical evaluation data, radiological (x-ray and magnetic resonance) images, and a biospecimen repository from 4,796 men and women ages 45-79. The seven-year

project enrolled participants who have, and those who were at high risk for developing, symptomatic knee osteoarthritis. All data and images collected is available to researchers worldwide to help quicken the pace of biomarker identification, scientific investigation and OA drug development. Access to biospecimens is by application to the National Institute of Arthritis, Musculoskeletal and Skin Diseases (NIAMS).

15. Cohort Study of Medication Adherence among Older Adults (CoSMO)

The mission of the Tulane led Cohort Study of Medication Adherence among Older Adults (CoSMO) is to lay the groundwork for interventions to improve medication adherence and clinical outcomes in older adults with hypertension and will increase our understanding of factors contributing to therapeutic outcomes in the use of medications by these patients. The goal of Cohort Study of Medication Adherence among Older Adults (CoSMO) with essential hypertension (HTN) in a managed care setting is to investigate the multiple factors that influence antihypertensive medication adherence (via validated self-report and pharmacy fill measures). The specific aims of this cohort study are as follows:

1. to assess the impact of psychosocial, behavioral, health, quality of life, sexual function, medication class, and clinical factors measured at baseline on subsequent change in antihypertensive medication adherence over 2 years of follow-up
2. to assess health care system issues (perception of primary care provider, satisfaction with access and communication), use of prescribed and over-the-counter and unconventional medications and lifestyle modifications on anti-hypertensive medication adherence and change in adherence
3. to determine the relationship of antihypertensive medication adherence at baseline with future medical and psychosocial outcomes such as blood pressure control, cardiovascular disease incidence and all-cause mortality, quality of life, utilization
4. to explore differences in aims 1-3 with regards to gender and race.

To address these specific aims, a random, race-and gender-diverse sample of 2194 HTN patients > 65 years of age who met the study eligibility requirements from the pool of all hypertensive patients enrolled in a large southern managed care organization. Study participant's medication adherence, demographic, behavioral, treatment (i.e. medication class), quality of life, duration of hypertension, psycho-social factors and perceptions of primary care provider, and satisfaction with access to care were assessed at baseline and after 1 and 2 years of follow-up via telephone-administered surveys.

Rigorous quality control procedures have been implemented to assure high quality data. Blood pressure control, severity of hypertension, cardiovascular outcomes, healthcare utilization at baseline and follow-up have been collected. Models predicting change in medication adherence, blood pressure control, utilization, and cardiovascular events are under development. Krousel-Wood and Muntner have experience mentoring trainees using this cohort.

16. Cooperative Human Tissue Network (CHTN) –Southern Division

The CHTN –Southern Division at the CCTS Hub is one of six member institutions funded by the National Cancer Institute to prospectively collect, process and distribute remnant human tissue specimens to IRB-approved biomedical researchers. The CHTN operates through a shared networking system which allows investigators greater access to available research specimens. CHTN offers a variety of preparation and preservation techniques to ensure investigators are receiving the quality specimens needed for research. Remnant human tissue specimens (including normal, benign, malignant, or diseased) from routine surgical resections and autopsies are procured to the specifications of the investigator. Frozen aliquots of fluid (serum, plasma, buffy coat, urine, saliva) as well as paraffin blocks and/or slides may also be made available. Although the CHTN operates as a network, each CHTN division is responsible for primary coordination and intake of applications from investigators based upon the investigator's geographic location. The Southern Division encompasses Kentucky and all states south and west from the Carolinas to Texas.

17. Rheumatology Arthritis Database And Repository (RADAR). The Rheumatology Clinic at UAB facilitates urgent clinic appointments for patients with suspected or established rheumatologic diseases. RADAR, UAB's Rheumatology Arthritis Database And Repository, was established in 2009 to optimize patient care, to enhance education of house staff, and to create a database and repository of samples (DNA, serum, plasma, RNA, synovial fluid). The purpose of collecting these data and biological samples is to facilitate

patient-oriented research in rheumatology and to share research findings and biological samples with investigators at UAB and other institutions. RADAR seeks to provide rheumatologists with the resources to better understand not only the pathogenesis of rheumatologic disease, but also the mechanisms of treatment response, for the advancement of the personalized medicine model and “treat to target” recommendations. Rheumatologists and clinical nurse coordinators at UAB conduct consent interviews, and collect data and specimens, during routine clinic visits. Patients who have a diagnosis of lupus, juvenile arthritis, psoriasis or psoriatic arthritis, or chronic hepatitis C infection are excluded. Patients participating in the RADAR cohort consent to provide biological samples and clinical data at each clinic visit, up to 6 visits, and then once annually, thereafter. During FY 2014, there were 821,316 total patient visits, and 321,861 diagnostic procedures performed at The Kirklin Clinic, where > 3800 unique gout patients are seen annually. RADAR currently has an enrollment of 400 RA patients and 104 gout patients, which are 77% female, 80% white, and mean age of 61 yrs. The study maintains Human Subjects Research approval by the UAB Institutional Review Board (Protocol #: X080317004).

18. Veterans Affairs (VA) Administrative Databases (inpatient, outpatient, and pharmacy datasets)

VA administrative databases (inpatient, outpatient, and pharmacy datasets)- VA administrative data documenting utilization of care and patient characteristics are available as computerized VA administrative databases, including patient treatment file (PTF) and outpatient clinic (OPC) tables, through the Austin Automation Center, a national VA data warehouse. These data are reliable for demographics and most common diagnoses, and valid for specific diagnoses. Data are available from fiscal year 1998. The PTF covers four main categories of care: (1) acute (inpatient admissions); (2) extended (domiciliaries, VA nursing homes, or community nursing homes); (3) observation (hospital stays (generally less than 24 hours); and (4) Non-VA (care funded by the VA and provided in non-VA hospitals). The OPC files have two components, visit file which contains one day’s services for a patient (date, patient demographics, codes for each clinic stop (up to 15) for the day etc.) and event file which contains one ambulatory encounter by a patient (date, appointment type (e.g., regular, employee, research), procedure done (up to 15), surgeries performed (up to 15), provider type etc.). These datasets have been used extensively to perform clinical research in veterans for decades.

- *VA VistA. Veterans Affairs Medical Centers (VAMC)*- VAMCs use 128 Veterans Health Information Systems Technology & Architecture (VistA) implementations to provide longitudinal electronic health record services nationwide for more than 25 million veterans historically. The aggregate content of these 128 VistA systems includes just over 1.03 Billion documents (e.g., Progress Notes, Discharge Summaries, Reports) accumulating at a rate of 638,000 each workday; 1.65 Billion orders (+955,000 each workday); 590 Million images (+884,000 each workday); 1.06 Billion vital sign measurements (+729,000 each workday) and 850 Million medication administrations (+607,000 each workday).
- *Informatics and Computing Infrastructure (VINCI)*- As part of the mission of the VA Informatics and Computing Infrastructure (VINCI), data sources collected both locally and nationally through various initiatives are aggregated and prepared for research use. In addition to data available from individual VistA systems, data from the Regional Data Warehouses for all 4 VA regions, the VA Corporate Data Warehouse, and the VA Health Data Repository are included. Other data sources collected and published from the VHA Decision Support System (DSS) and Inpatient and Outpatient Medical SAS (MedSAS) can be requested through VINCI. VINCI does not grant use of the data, but facilitates the process through VA National Data Services and other data stewards as needed. VINCI’s physical environment is at the VA Automation Center in Austin, Texas. It has 20 high-performance servers and 72 terabytes of fast storage. This environment is a secure enclave within the VA and has multiple technologies and procedures in place to prevent data loss.
- *The VA Pharmacy Benefits Management (PBM) database*- is a national database of information about all prescriptions dispensed within the Veterans Health Administration (VHA) System beginning with fiscal year 1999. The PBM system is a longitudinal database including VA pharmacy data for each individual patient. PBM data have been used more extensively for pharmacy utilization studies, and validation on PBM data is more complete than for other VA data sources, such as the Decision Support System, which only includes data to 2002. The PBM Database is a Microsoft SQL Server™ database maintained by the PBM Service located at Hines, IL. Outpatient prescription orders filled at a VA Pharmacy or Consolidated Mail Outpatient Pharmacy (CMOP) are extracted monthly from each VistA site and loaded into the PBM Database. The data elements available for each prescription order

dispensed for a patient include: product name, ordering provider, drug product costs, dosing instructions, National Drug Code (NDC) where applicable, quantity dispensed, formulary status, and VA drug class. Other data elements are available depending on whether the order was an IV, unit dose, or outpatient prescription order. These VA databases will be linked with each other using scrambled Social Security Numbers (SSNs), or in some cases, real SSNs, as has been done in previous VA studies.

19. Arthritis Patient Partnership with Comparative Effectiveness Researchers (AR-PoWER)

In recognition of the importance of filling evidence gaps in inflammatory arthritis-related research, CreakyJoints (CJ) arthritis patient network, a network of approximately 55,000 arthritis patients and caregivers in all 50 U.S. states, and the University of Alabama at Birmingham received funding from the Patient-Centered Outcomes Research Institute (PCORI) to establish the Arthritis Patient Partnership With Comparative Effectiveness Researchers (AR-PoWER) patient-powered research network (PPRN). Partnered with the UAB CCTS, UAB DSAM CERTs, the American College of Rheumatology (ACR), and the Consortium of Rheumatology Researchers of North America, Inc. (CORRONA) the AR-PoWER PPRN is translating a high-impact patient advocacy and education-focused organization into an equally high-impact patient-centered network able to conduct research (additional details of active research provided in the scientific plan).

20. Cancer Care Outcomes Research and Surveillance Consortium (CanCORS)

The CCTS HUB serves as a Primary Data Collection and Research (PDCR) site in the NCI-funded Colorectal and Lung Cancer CanCORS consortium (Fouad, PI). This research consortium of eight grantees measures the quality of cancer care and associated health outcomes in the United States. The project supports prospective research in a cohort of approximately 10,000 patients with newly diagnosed lung cancer or colorectal cancer recruited from geographically diverse populations and health care systems. The CCTS HUB PDCR site is for newly diagnosed cases of both lung and colorectal cancer with special emphasis on African Americans.

Fouad is an author of the publication that introduced the goals and methods of the Consortium to the broader community of cancer researchers and clinicians; several manuscripts elucidating the findings of the consortium with regards to ovarian cancer and the recruitment of patients to cancer clinical trials are in the process of being submitted for publication. Fouad has mentored trainees using this cohort.

21. UAB Health System Cancer Community Network (CCN)

The UAB Health System Cancer Community Network, developed by the UAB Comprehensive Cancer Center and UAB Medicine, is a network of hospitals across Alabama, Florida, Georgia and Mississippi that emphasizes collaboration between UAB and community cancer centers on evidence-based guidelines for cancer treatment to patients in local communities. The UAB Health System Cancer Community Network provides a structured program to support community-based oncology services to foster collaborative physician relationships, provide continuing medical education and offer local patients the opportunity to enroll in clinical trials managed by leading scientists and physicians, and access to UAB's best practices in cancer care at a local level.

22. Alabama Regional Quality Management Group

The Alabama Regional Quality Management Group (ALRQG) initially formed in response to the Ryan White Treatment Modernization Act of 2006, which instructed quality leaders in Part C and D clinics to implement a continuous quality improvement program with activities particularly focused on the HIV Care Continuum. The ALRQG is comprised of Ryan White Part C and D clinics and represent all 67 counties in Alabama. After UAB CFAR members shared study findings that missed HIV clinic visits are linked to a three-fold increased mortality risk,^{4,5} a risk level equivalent to a CD4 count <200, the ALRQG decided to add missed visits as a quality indicator to quarterly reports. As these missed visit data have now been shared quarterly for several years, a number of participating sites have questioned what can be done in response to the observed high clinic-wide missed visit rates.

CLINICAL CARE AND MEDICAL TRAINING

UAB Medicine

Partnering with UAB and the School of Medicine to provide resources for clinical care and training for medical professionals, the entities listed below highlight the diversity of the UAB network and showcase the advances made since its inception. UAB Medicine unites UAB Hospital, The Kirklin Clinic, UAB Health Centers, the Callahan Eye Foundation, and VIVA Health (a health maintenance organization and subsidiary of Triton Health Systems, LLC, owned by UAB Medicine that provides quality, reliable health care).

Facilities - Partnering with UAB and the School of Medicine to provide avenues for clinical care and training for medical professionals, the entities listed below are part of the broad patient care network on the UAB campus

- *UAB Medicine's* flagship facility is the 1,157-bed UAB Hospital, one of the nation's largest public hospitals. It includes the UAB Women & Infants Center, Spain Rehabilitation Center, the Center for Psychiatric Medicine, and the freestanding UAB Hospital-Highlands. As Alabama's only Level 1 Trauma Center (as designated by the American College of Surgeons), UAB Hospital provides care for many of the most serious injuries that occur anywhere in the state through its emergency department, operating rooms, Trauma/Burn Unit, and Spain Rehabilitation Center, which is one of the Southeast's foremost providers of comprehensive rehabilitation care. The Women & Infants Center offers advanced services and the latest medical technology to care for healthy and high-risk pregnant women, healthy and high-risk newborns, and women receiving care for a variety of gynecological problems, including gynecological cancers. It includes UAB's Regional Newborn Intensive Care Unit (RNICU), the state's largest. Together with Children's of Alabama, UAB offers the only Level IV NICU in Alabama – designated by the American Academy of Pediatrics as the highest and most comprehensive level of care available. UAB Hospital-Highlands is a general acute care component adjacent to campus that provides an emergency department for non-traumatic and non-catastrophic cases, comprehensive surgical and nonsurgical treatment for bone and joint disorders, a specialized unit for fragility fractures, and the UAB Sleep-Wake Disorders Center. It also houses the Acute Care for the Elders (ACE) Unit, the region's first model patient unit for coordinated geriatric care, and the UAB Pain Treatment Clinic, which serves patients with acute and chronic conditions including intractable cancer pain.
- *The Kirklin Clinic* - The Kirklin Clinic® (TKC) opened in 1992 as a premier outpatient facility to provide examination and treatment rooms for physicians representing nearly three dozen specialties in adult medicine. The five-story facility covers a full city block with 454,000 square feet, more than 30 distinct clinical units of multidisciplinary teams, and an adjacent covered parking deck that accommodates 1,450 vehicles. The Kirklin Clinic® at Acton Road provides a wide array of patient care services south of Birmingham, established in the suburban community. The Whitaker Clinic of UAB Hospital opened in the summer of 2017. The two clinics serve more than 2,000 patients per day.
- *1917 Outpatient AIDS Clinic* - The 1917 Clinic provides care to individuals infected with HIV. The Clinic's mission is to provide comprehensive and compassionate health care for people with HIV infection by: 1) delivering world-class, state-of-the-art primary HIV treatment; 2) offering specialty clinics for HIV patients with needs in dermatology, oncology, neurology, addiction recovery, and palliative care; 3) providing social service support; 4) offering chaplain services; 5) facilitating interactions between laboratory scientists and the Clinic by providing clinical specimens from well-characterized patients; 6) providing ongoing medical education; 7) establishing a vital link between the activities of the Clinic and the community; and 8) conducting clinical trials of new approaches to treatment
- *Spain Rehabilitation Center* - As one of the Southeast's premier providers of comprehensive rehabilitation care, the nationally recognized programs available at Spain Rehabilitation Center are designed to address every aspect of a patient's rehabilitation, including physical, social and psychological health. Specialists are devoted exclusively to the practice of rehabilitation medicine, utilizing advanced research, technology, and expertise to provide the highest level of patient care. Interdisciplinary treatment integrates specialists from all areas of the UAB Health System to bring together unique skills and expertise to form care teams that evaluate and treat each patient. These efforts result in a comprehensive care plan that coordinates treatment to meet each patient's individual needs.

- *UAB Women and Infants Center* - UAB's newest facility, the UAB Women and Infants Center is a world-class health care facility dedicated solely to the care of women and infants. Whether it is inpatient surgical care or a routine outpatient office visit, the Center provides complete care, all under one roof. The 400,000-square-foot-hospital is one of the first in the Southeast with all private neonatal intensive care nursery and continuing care nursery rooms. It also offers private labor, antepartum, postpartum, and gynecology patient rooms. The private room design enhances maternal, family, and infant bonding. Specialized isolation rooms and rooms designed for twins and triplets further enhance the family atmosphere. UAB's highly-trained and compassionate physicians, nurses and other health professionals utilize advanced services and sophisticated state-of-the-art medical technology dedicated to the care of healthy and high-risk pregnant women, healthy and high-risk newborns, and women receiving care for a variety of gynecological challenges, including gynecological cancers.

Health Services Foundation

UA Health Services Foundation is a nonprofit, group physician practice including The Kirklin Clinic and The Kirklin Clinic at Acton Road. The HSF was founded by pioneering heart surgeon John W. Kirklin, M.D., in 1973. Since that time, the Foundation has achieved national prominence for high quality patient care services and the unique knowledge, dedication and compassion of its employees.

- *HSF General Endowment Fund* - The University of Alabama Health Services Foundation (UAHSF) General Endowment Fund (GEF) provides capital on a competitive, peer-reviewed basis, to enhance the infrastructure of the UAB academic health center for laboratory research, patient-oriented efforts, clinical care program development, and medical education initiatives. In general, funds from the HSF-GEF are invested in research, educational, and clinical programs that are deemed in the best interest of the UAB Medical Center and for UAB university-wide projects which are consistent with institutional priorities.

UAB Eye Care - Exemplary patient care is provided in the recently renovated clinic "UAB Eye Care," a 34,000 square foot state-of-the-art facility that covers everything from primary eye care, including the dispensing of glasses and contacts, to the treatment of ocular disease, as well as low vision rehabilitation and pediatric vision care.

Callahan Eye Foundation Hospital - The UAB Callahan Eye Hospital (CEH) is the state's only facility dedicated to providing quality medical and surgical eye care to the people of Alabama and the Southeast. Callahan's primary business consists of outpatient ophthalmology and ambulatory surgery, making it one of the busiest ophthalmology surgery centers in the country. Moreover, the hospital offers a 24-hour, 7 day a week eye emergency room and is the region's only Level I Ocular Trauma Center. With exceptional healthcare professionals, dedicated surgery suites, and state-of-the-art equipment, more than 11,000 surgeries per year. The hospital offers nine superbly equipped ophthalmology operating rooms and provides the full spectrum of specialized eye care. UAB Callahan Eye Hospital is also home to a comprehensive eye research program via partnership with the UAB Department of Ophthalmology and provides the state's only accredited (Accreditation Council for Graduate Medical Education, ACGME) ophthalmology training program.

Affiliated Hospitals Involving UAB Faculty

In addition to the UAB Medicine components listed above, two additional hospitals are physically part of UAB's main campus in Birmingham, and the UAB faculty provides both clinical and investigative expertise.

- *Children's Hospital of Alabama* - Since 1911, Children's of Alabama has provided specialized medical care for ill and injured children. Ranked among the best pediatric medical centers in the nation by U.S. News & World Report, Children's provided care for youngsters from every county in Alabama, 45 other states and six foreign countries last year, representing more than 677,000 outpatient visits and more than 15,000 inpatient admissions. With more than 2 million square feet, including dedicated space for the Center for Clinical and Translational Science (CCTS) Child Health Research Unit, it is the third largest pediatric medical facility in the U.S. In 2012, Children's opened two additional facilities, strengthening its ability to serve pediatric patients statewide. The Benjamin Russell Hospital for Children, a 12-story, 760,000-square-foot, \$400 million expansion allowed Children's to increase its licensed beds from 275 to 332, ranking Children's in the top 10 pediatric medical centers based on bed

count. The hospital also opened the Joseph S. Bruno Pediatric Heart Center, which includes a 20-room cardiovascular intensive care unit, two dedicated surgical suites, three heart and vascular catheterization labs and four dedicated extracorporeal membrane oxygenation (ECMO) rooms. The floor connects directly via skywalk to the University of Alabama at Birmingham (UAB) Women and Infants Center to provide quick and efficient access for physicians and surgeons to pediatric patients, as well as immediate transport of newborns requiring specialized care for congenital heart ailments. At the cornerstone of the Bruno Heart Center is its innovative pediatric hybrid catheterization suite, the only one of its kind in the state of Alabama. The hybrid cath lab is equipped with \$3 million worth of state-of-the-art technology that allows it to be immediately converted to a cardiovascular surgical suite, eliminating the need to bring children out of anesthesia for a second procedure in a different room.

- *Birmingham VA Medical Center* – Also situated in the heart of the UAB academic research center and interconnected with UAB research and health care delivery facilities since 1975, the Birmingham Veterans Affairs Medical Center (BVAMC) is an acute care facility with 313 beds currently in operation. The facility provides acute tertiary medical and surgical care to veterans of Alabama and surrounding states. It provides health care services to eligible veterans in the VA Southeast Network Veterans Integrated Service Network. Recent construction provides state-of-the-art facilities and equipment in all clinical programs. Care is provided in practically all medical and surgical specialties and subspecialties. Most staff physicians have joint appointments with VA and its primary affiliation, UAB. The BVAMC operates eight Community Based Outpatient Clinics in North Alabama.
- *Lakeshore Foundation*- The Lakeshore Foundation is a non-profit 501c3 organization that promotes independence for persons with physically disabling conditions and provides opportunities to pursue active, healthy lifestyles. Lakeshore Foundation offers a wide range of rehabilitation, fitness, recreation, athletic and education programs to children and adults who experience diagnostic conditions including spinal cord injuries, cerebral palsy, multiple sclerosis, stroke, amputation, and visual impairment. The Foundation also serves persons who have been diagnosed with arthritis, diabetes, chronic pain, cardiac conditions, and many other related disorders. The University of Alabama at Birmingham (UAB) and Lakeshore Foundation established a formal collaboration in 2011 to advance research and training in promoting the health of people with disabilities. The primary aim of the Collaborative is to create a unique and focused research program that capitalizes on Lakeshore Foundation's success in promoting the health of people with physical disabilities, with UAB's advanced research expertise in exercise, nutrition, disease prevention and health promotion. The Collaborative explores research topics on exercise, physical activity, sport, recreation and rehabilitation science. Interventions examine the dose-response relationship between exercise and obesity, health and function, secondary conditions, quality of life and health care expenditures across the lifespan. The UAB-Lakeshore Research Collaborative began with a \$10 million research investment funded by the Lakeshore Foundation with additional support from UAB for startup costs. Two million dollars funded an Endowed Chair's position in the School of Health Professions, and the remaining funds will be used to support UAB researchers interested in disability, exercise, nutrition, and rehabilitation science. James H. Rimmer, Ph.D., is the first Lakeshore Foundation Endowed Chair in Health Promotion and Rehabilitation Sciences and Director of the Research Collaborative.

Lakeshore is located on a 45-acre campus in Homewood, Alabama. In 2001, due to growing community need, Lakeshore opened one of the nation's world-class fitness, recreation and education facilities for persons with physically disabling conditions. A highly trained and experienced staff of more than 100 full and part-time employees provide programs in this state of the art facility which includes: Aquatics Center with two heated pools; Fieldhouse with three hardwood courts and a 200-meter Mondo surface track; 7-lane Marksmanship Range; 6,000 sq-ft. Fitness Center; Research Laboratory; Climbing Wall; The Cottages of Lakeshore; and Athletic Dormitory. These facilities serve the fitness, recreation, and athletic needs of youth and adults with physically disabling conditions from across the Southeast. Since 2003, Lakeshore has also served as an official U.S. Olympic & Paralympic Training Site and is the official home of USA Wheelchair Rugby. In addition to these amenities, the Lakeshore campus is home to an outdoor tennis facility with eight championship lighted hard courts, the Birmingham office of the Alabama Department of Rehabilitation Services (ADRS), and the HealthSouth Lakeshore Rehabilitation Hospital.

Lakeshore Foundation has more than 30 years of experience as a community-based service provider of fitness, recreation, sport, and health promotion programs for approximately 3,500 people with disabilities, chronic health conditions and aging-related health issues. Lakeshore staff play key leadership roles in local, national and international organizations that are important assets to the Research Collaborative.

The UAB/Lakeshore Research Collaborative is home to two federally funded Centers, the National Center on Health, Physical Activity and Disability (NCHPAD) and the Rehabilitation Engineering Research Center on Exercise and Recreational Technologies for People with Disabilities (J. Rimmer is PI of these centers). Both Centers focus on improving the health and wellness of adults and seniors with disabilities including MS through the medium of physical activity, technology and lifestyle health promotion. The opportunities are provided to individuals with disabilities residing in Alabama and across the country through information, programs, services and research interventions that target improvements in healthy lifestyles and reduction of secondary conditions. The Collaborative receives federal funding from the National Institutes of Health (NIH), Centers for Disease Control and Prevention (CDC), Department of Defense (DOD), Patient-Centered Outcomes Research Institute (PCORI), and the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR).

- *Lakeshore Foundation Facilities-* Lakeshore Foundation maintains one of the nation's premier fitness, recreation and research facilities for people with physically disabling conditions. The Foundation provides a state-of-the-art universally designed community health and fitness facility to address numerous barriers associated with physical activity participation for people with disabilities. Lakeshore offers more than 60 ongoing inclusive activities and classes each week for children and adults with disabilities, including classes in aquatics, fitness, dance, competitive athletics, general recreation and transition support. Facility support for these various activities include three hardwood courts, a 200-meter Mondo surface track made of soft materials to ease the impact on joints, an outdoor tennis center, a seven lane archery and marksmanship range, a 23-foot indoor climbing wall, an Aquatics center that houses an accessible warm water therapy and 8-lane 25-yard lap pool, and a 6,000 square foot fitness center.
- *Information and Communication Technology (ICT) Support-* ICT manages 40 desktops and 12 laptops, which are connected to a central administrative server run by the School of Health Professions at the University of Alabama at Birmingham or at Lakeshore Foundation, enabling a very secure and stable environment. All computers run on a minimum of a dual core processor and have a minimum of 4 gigabytes of memory and Windows 7 operating system. The computers and the network receive a double layered support mechanism with UAB's AskIT providing the highest level of network routing, AD authentication, policy administration and a secure file server support. ICT staff provides application level and basic tech support. All files are saved to a secure file server. The collaborative also houses several Linux-based servers where the IT team performs all development operations for the various applications. All production level applications are then hosted from an 8 Gig Ram cloud-based server with a 99.99% SLA, enabling our applications to be able to handle any spike in network and hardware requirements. In addition to regular desktops, ICT also employs professional video processing workstations (Macs) with Adobe Master Collection CS6, which is used by the graphics staff in the collaborative to produce high quality videos

Regional Networks of Clinical and Translational Research

- *Dental Practice-based Research Network -* The UAB-led Dental Practice-Based Research Network (DPBRN) is a consortium of participating practices and dental organizations committed to advancing knowledge of dental practice and ways to improve it. The Network strives to improve oral health by conducting dental practice-based research and by serving dental professionals and their patients through education and collegiality. It assists in the translation of scientific discovery into clinical practice. DPBRN's major source of funding is the National Institute of Dental and Craniofacial Research (NIH/NIDCR). Clinical studies embrace four approaches: studies that may involve practitioners and/or their patients: retrospective studies using dental records; observational studies of routine care activities, case-control studies, and clinical trials comparing alternative treatment

strategies. Practitioner-investigators help design clinical studies, assess the implications of study results for practitioners and patients in different practice settings, and disseminate research results.

- *Deep South Network for Cancer Control (DSN)*– Mindful of the elevated risk of cancer and lower outcomes in the African American community, UAB has established the Deep South Network for Cancer Control, which builds on an established community and institutional capacity in order to eliminate cancer health disparities by conducting community-based participatory education, training and research. The goals of the DSN are to improve access to and utilization of proven beneficial cancer interventions. DSN serves two underserved rural areas - the Black Belt of Alabama and the Delta of Mississippi - and two urban underserved areas - Jefferson County, Alabama, and Hattiesburg/Laurel Metro, Mississippi.

GRADUATE EDUCATION AND POST-GRADUATE TRAINING

Graduate School (est. 1970; L. McMahon, PhD, Dean)

Established in 1970, the UAB Graduate School offers doctoral programs in 40 areas, post-masters education specialist programs in 8 areas, and master's level programs in 55 areas, spanning across the disciplines. There are multiple support systems – administrative, financial, health care and career counseling. To facilitate the wide spectrum of ongoing research, state-of-the-art facilities are found all over campus. UAB's research centers, lecture halls, labs, classrooms, dorms, greenways, hospitals, libraries, student center, recreation center and performing arts center occupy 82 city blocks inside Birmingham, Alabama. The Graduate School supports graduate students and post-doctoral fellows with an extensive Professional Development Program, as well as monthly Discoveries in the Making events connecting students to the community. UAB Graduate School is very dedicated to diversity, equity and inclusion, and provides recruitment and ongoing mentoring programs for students from all backgrounds.

Office of Postdoctoral Education- The University of Alabama at Birmingham Office of Postdoctoral Education is committed to the development and success of outstanding postdoctoral scientists. Nearly 250 postdocs are training currently in a variety of disciplines, including but not limited to engineering, medicine, natural sciences & mathematics, public health, and optometry. The UAB Office of Postdoctoral Education and the UAB Postdoc Association work together to develop career opportunities that enhance and define the training experience for all postdoctoral scholars at UAB. Past and continuing events include courses in grant writing, lab management, translational science, & job skills, structured programs in teaching and business entrepreneurship, and awards for career enhancement, travel, grant incentives, and internships.

Graduate Biomedical Sciences Program (D. Schneider, PhD, Associate Dean) - The Graduate Biomedical Sciences (GBS) program at UAB encompasses approximately 350 graduate students and 375 faculty. Trainees participate in multiple interdisciplinary thematic programs that integrate more than 25 departments in the School of Medicine; partner schools throughout the university; Southern Research, an affiliated drug discovery and development institute; and HudsonAlpha Institute for Biotechnology. UAB is consistently among the top 25 institutions in the US for NIH research funding. The GBS program provides its graduate students the flexibility, guidance, resources, and training to become highly competitive for outstanding postdoctoral and professional positions. UAB offers eight interdisciplinary training pathways in the Graduate Biomedical Sciences, including: Biochemistry, Structural, and Stem Cell Biology; Cancer Biology; Cell, Molecular, and Developmental Biology; Genetics, Genomics, and Bioinformatics; Immunology; Microbiology; Neuroscience; and Pathobiology and Molecular Medicine. Working closely with the GBS Program, the CCTS has been instrumental in developing a Translational & Molecular Sciences certificate program to enhance the graduate curriculum.

UAB Division of Continuing Medical Education (R. O'Beirne, EdD, MBA, MSEE, Director)

The Division of Continuing Medical Education (CME) at UAB strives to be a national leader in defining and delivering meaningful learning opportunities for healthcare professionals to improve patient and community health. The Division's CME program strengthens the UAB Health System through the quality, scope, and diversity of its educational activities. Topics include traditional areas of basic science, clinical medicine, patient care, and public health, as well as more contemporary themes of quality improvement, patient-centered care, leadership, and others within the Accreditation Council for Graduate Medical Education's professional core

competencies. The mission of the Division of CME is to develop and provide a professional development program for physicians and physicians-in-training that is effective in increasing knowledge, awareness, and competence; enhances physician performance; and improves patient and community health. The CME group supports the broader School of Medicine's tri-part mission of research, education, and clinical practice, working together with other units within the spectrum of medical education, faculty development, and quality improvement.

EXAMPLE ELECTIVE MINI-SABBATICAL OPPORTUNITIES ACROSS CCTS PARTNER NETWORK

Short-term rotations are designed to enrich career development through experiences complementary to those offered at an investigator's home institution. They can include partnerships with not only other academic institutions, but also industry, regulatory agencies, non-profit, and other organizations. The goal of the short-term rotation experience is to acquire added competencies in specific areas of HSR, with the experience tailored to meet a fellow's individual training needs. Our initial experiences have demonstrated that short-term rotations can serve as incubators for new ideas, lead to new collaborative mentoring and peer relationships, provide access to new data, exposure to novel research skills, foster collaborations and/or potential opportunities for strengthened grant proposals, particularly career development awards and team science. As part of a soon to be funded supplemental award to our parent CTSA award, we will be developing a national online catalog of short-term rotation offerings. This will expand existing short-term rotations (see examples below) and to develop new short-term rotations.

Mini-sabbaticals/Externships/Short-term Rotation Offerings at the HUB

Rotation Name(Supervisor(s)/Institution)	Learning Objectives
CCTS Hub	
Alliance for Innovative Medical Technology (AIMTech)/medical device development (R. Hergenrother, PhD)	1) Managing clinical trial and FDA approval processes; 2) Market and user assessments; 3) Steps towards establishing small companies, and how to raise venture capital for medical device development.
Cochrane Musculoskeletal Review Group – US Cochrane Satellite focused on network meta-analysis (J. Singh, MD)	1) Develop and refine research questions and analytic frameworks; 2) Conduct literature review; 3) Develop and test data abstraction forms; 4) Learn methods of abstracting data into evidence tables; 5) Develop summary tables and prepare synthesis reports
Clinical Informatics / medical systems (J. Willig, MD)	1) Learn how to collect structured data at the point of care; 2) Learn how to export data to warehouse containing genomic and other biological information; 3) Use data for CTR
Phase I clinical trials/public-private partnerships (M. Saleh, MD)	1) Develop knowledge of clinical trial implementation, including feasibility & study design; 2) Work w/ multidisciplinary team to fulfill project milestones; 3) Learn the basic approaches to evaluate safety, to determine a safe dosage range, & to identify side effects.
Center for AIDS Research (CFAR) Network of Integrated Clinical Systems (CNICS) (M. Mugavero, MD, MHSc)	1) Learn benefits of CNICS' integrated system of clinical/ behavioral/biological data versus other medical records; 2) Understand how to successfully retrieve/critically evaluate/design study w/ CNICS data
UAB Pharmacoepidemiology and Economic Research (PEER) Unit (M. Kilgore, PhD and J. Curtis, MD, MSPH, MS)	1) Understand problems/limitations of administrative data & methods to minimize these problems; 2) Specify & implement methods to validate claims-based algorithms, link claims to EMR data; 3) Analyze data for a particular project and present results.
UAB/Children's pediatric simulation center (N. Tofil, MD, MEd)	1) Increase knowledge, hone skills, and practice teamwork in the context of real life patient scenarios; 2) Understand the breadth of care scenarios that are applicable to simulation; 3) Enhance ability to rapidly improve care provision
UAB/Children's of Alabama/School of Health Professions (S. Buchalter, MD and L. Hayes, MD)	1) Develop enhanced expertise and experience in quality improvement and patient safety methodology; 2) Develop and Implement a quality improvement and or patient safety project

	applicable to the Scholar's interests and care delivery environment
I-Corps: bridging biomedical innovation and the market (M. Wasko, PhD)	1) Take a biomedical innovation from your research & learn how evaluate its commercial potential & successfully build a business model around your innovation; 2) Develop a go-to market strategy; 3) Qualify to participate in I-Corps Program (up to \$50k in funding)
Other CCTS Affiliates and Collaborators (example rotations)	
Alabama Public Health Institute (N. Dunlap, MD)	1) Learn how public health agencies implement/evaluate programs; 2) Gain experience in linking data from multiple sources to assess the impact risk factors & exposures on health outcomes; 3) Determine impact of health interventions for vulnerable populations
Alacare home health and hospice (S. Waits, RN, BSN and Tina Reed, RN)	1) Understand the strengths and limitations of home health care data for conducting health system research; 2) Examine impact of new care plans on patient care and staff workload; 3) Develop effective models for translating research findings
Ochsner health system (E. Price-Haywood, MD, MPH)	1) Understand the use of an integrated health system for conducting research; 2) Understand CER and clinical epidemiology on quality, safety; 3) Develop effective models for translating research findings into practice (evidence implementation research)
REACHnet (T. Carton, PhD)	1) Understand the strengths/weakness of PCORnet data for conducting research; 2) Examine impact of new approach to conduct patient and stakeholder engagement; 3) Develop effective strategies for disseminating results to diverse stakeholders
Applications of Innovative Methods in Health Equity Research: Health, Behavior, and Society Summer Institute (Johns Hopkins; Lisa Cooper, MD, MPH)	1) Understand methods for overcoming challenges to conducting disparities research in underserved communities; 2) Learn new tools for data collection around hypertension disparities in African Americans; 3) Expand research network for studies related to hypertension management among African Americans
Center for Health Services Research Effective Health Communication Program (CHSR-EHCP) (Vanderbilt; R. Rothman, MD)	1) Understand the basis of health literacy research; 2) Learn new methods for addressing low health literacy; 3) Expand collaborations for studies related to African-Americans with IBD
Collaborative models of Care (University of Iowa, Dept of Psychiatry; Karin Hoth, PhD)	1) To observe collaborative models of internal medicine and mental health care; 2) To develop a working model of primary palliative care in COPD
Behavioral Treatment Approaches Targeting Executive Function (Drexel University; Evan Forman, PhD)	1) To receive mentored, hands-on training in behavioral treatment approaches targeting executive function including acceptance-based behavioral treatment for weight management
NHLBI/OBSSR Summer Research Training Institute on Randomized Clinical Trials with Behavioral Interventions (Warrenton, VA; Kenneth Freedland, PhD)	1) Identify the unique challenges posed by behavioral randomized clinical trials (RCTs); 2) Select appropriate strategies for enrollment, randomization, and retention of participants; 3) Evaluate the quality of behavioral RCTs and interpret their results.

CCTS Partner Network Institutions

AUBURN UNIVERSITY

HUDSONALPHA INSTITUTE
FOR BIOTECHNOLOGY (HAIB)

LOUISIANA STATE
UNIVERSITY HEALTH
SCIENCES CENTER

PENNINGTON BIOMEDICAL
RESEARCH CENTER

SOUTHERN RESEARCH

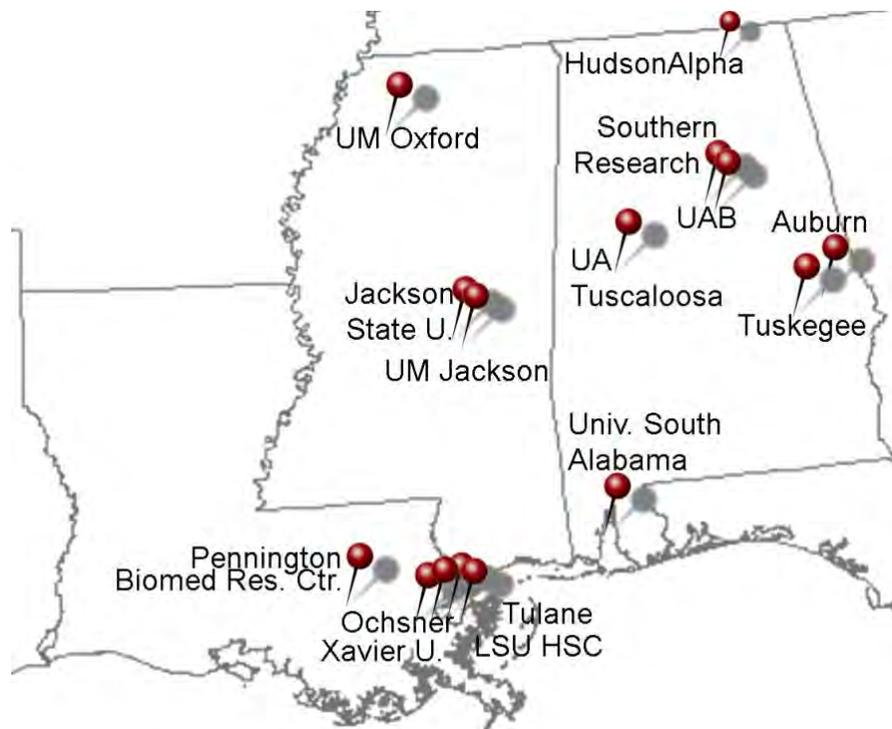
TULANE UNIVERSITY

TUSKEGEE UNIVERSITY

UNIVERSITY OF ALABAMA AT
TUSCALOOSA

UNIVERSITY OF MISSISSIPPI

UNIVERSITY OF SOUTH ALABAMA



CCTS Network Partnerships – In synergy with the resource strengths available at UAB, the CCTS has established Institutional Partnerships to improve and accelerate translational research. Partners’ resources are described on the following pages.

CCTS Affiliations – The CCTS also has established several collaborative relationships across the region to advance clinical and translational science. The CCTS has engaged leadership of NIGMS-sponsored Institutional Development Award Program Infrastructure for Clinical and Translational Research (IDeA-CTR) initiatives in Louisiana and Mississippi as well as Research Centers in Minority Institutions (RCMI) at Tuskegee, Jackson State and Xavier Universities (*CTR/RCMI Affiliates*) to provide important, mission-oriented guidance and to identify and pursue programmatic synergies that can bring further value to our region. Similarly, the CCTS’ Southeast Health Alliance for Research (SHARe) has engaged Ochsner Health System in New Orleans to advance the translation of discovery to improve health and health care delivery via multi-site studies and clinical trials.

The first land-grant college in the South, Auburn University was established in 1856. Over 200 years since its founding, the University has developed into one of the largest institutions in the region with an enrollment over 25,000 selecting from 140 degree options in 12 schools and colleges at the undergraduate, graduate and professional levels.

INSTITUTIONAL RESEARCH ENVIRONMENT & EXPERTISE IN CLINICAL AND TRANSLATIONAL SCIENCE

Auburn MRI Research Center

The Auburn University MRI Research Center (AUMRIRC) is located in the Auburn University Research Park. The AU MRI Research Center focuses on the broad application of magnetic resonance imaging (MRI) in basic science research, technology development, and clinical applications in both humans and animals. The AUMRIRC has a 3 Tesla (T) open-bore whole-body MRI scanner and a 7T whole-body MRI scanner with multi-nuclear imaging capability. Faculty and staff at the AUMRIRC have expertise in cardiovascular MRI, image analysis, brain imaging, magnetic resonance spectroscopy, and pulse sequence development. In addition to humans, the AUMRIRC has infrastructure and experience to image animals from rodents to larger animals such as dogs, pigs, and sheep.

Auburn University College of Veterinary Medicine (AU-CVM)

Auburn University College of Veterinary Medicine (AU-CVM) is now in its 120th year of service to animal health in the state, region and nation. In fall semester 2012, 418 students were enrolled in the Doctor of Veterinary Medicine (DVM) degree program. Additionally, the college has 75-80 graduate students pursuing Master of Science (MS) and Doctor of Philosophy (PhD) degrees through the AU-CVM Biomedical Sciences (BMS) graduate program. In 2011, the Veterinary Medical Teaching Hospital handled more than 16,000 clinical cases involving both small and large animals. The AU-CVM is fully accredited by the AVMA Council on Education and AAALAC, International. Details of physical facilities available at the AU-CVM can be provided upon request. (See: <http://www.vetmed.auburn.edu/>)

Auburn University Research Initiative in Cancer (AURIC)

The AURIC was established to improve both human and animal health by fostering an environment of excellence in cancer research. An interdisciplinary program, AURIC promotes research that enhances competitiveness in order to advance the understanding of the biology of cancer, and to foster the translation of novel technologies from the laboratory to the clinic.

Boshell Diabetes and Metabolic Diseases Research Program

The Boshell Diabetes and Metabolic Disease Research Program at Auburn seeks to enhance opportunities for diabetes research at Auburn University by facilitating cross-disciplinary scientific discussion, supporting the study of new ideas, fostering the development of investigators new to the field of diabetes, and expanding the overall base of diabetes investigation at the University. More than 40 investigators from across the AU campus are members of the program and actively involved in diabetes research. Specifically, these investigators are addressing many facets of both type 1 and 2 diabetes, with particular focus on the cardiac, neurological and metabolic aspects of the disease.

Auburn University Harrison School of Pharmacy

Established in 1885, the Harrison School of Pharmacy (HSOP) is Alabama's only public institution charged to educate pharmacists in the appropriate drug treatment of human disease. The HSOP's primary role is the preparation of competent primary care clinicians who can provide patient-focused, pharmaceutical care. The HSOP's curriculum is grounded in service-based, community practice that is collaborative with other health disciplines. The HSOP is actively engaged in research programs designed to stimulate scientific discovery and to develop new knowledge and applications in the pharmaceutical sciences and pharmacy practice. With its state-of-the-art facilities, the HSOP is well positioned to drive novel drug and protein products from discovery to development to clinical trials.

Capabilities and expertise available in the HSOP include high-throughput screening infrastructure (robotics and plate readers) as well as clinical pharmacology resources (operated in collaboration with AU-CVM) that feature a state-of-the-art ultra-performance liquid chromatograph linked to a triple-quad mass spectrometer (UPLC-QQQ-MS), a system ideal for performing PK-PD analyses of experimental agents in pre-clinical and clinical settings. AU-HSOP also possesses a health care outcomes research group that possesses rich experience in using electronic medical records and payer claims data to evaluate the effectiveness and cost of health care strategies and systems. Finally, AU-HSOP clinical faculty are embedded in practice sites in Columbus, GA and throughout Alabama, making them ideal for participating in multi-site clinical trials.

Auburn Pharmacy Health Services and the Community Pharmacy Research Network

The Auburn University Harrison School of Pharmacy operates two ambulatory clinics and three pharmacies to serve the Auburn, AL and Montgomery, AL communities. These facilities are connected to more than 40 full-time clinical pharmacists practicing in regional hubs throughout Alabama, Mississippi, and Georgia. Training is the core mission of these clinics; this network provides a regional footprint with a large network of community research sites. This is supplemented by formal agreements with community pharmacies to provide an extensive cohort of community sites to conduct research providing a unique opportunity for KL2 Scholars

Auburn Laboratory for Imaging Animal Systems (Project ALIAS)

ALIAS contains a surgical suite and instrumentation for proof-of-concept experiments using small animal models. ALIAS consists of an animal preparation area for complex small animal surgery, anesthesia and monitoring (~160 sq. ft.) and an adjacent imaging and holding room (~140 sq. ft.). The front surgery room contains a surgical bench and two large stainless steel sinks. The backroom contains the IVIS Lumina XRMS and Multispectral Optoacoustic Tomography (MSOT) model 256-TF systems. There is a dedicated Nikon AZ100 with a motorized Z-stage for automated scanning equipped with a Multi-Spectral Nuance FX Camera (PerkinElmer).

The IVIS Lumina XR can perform photographic, bioluminescent, fluorescent, X-ray and Cherenkov imaging. Our system has the standard, mid-high and high filter sets for near-infrared imaging and spectral un-mixing applications. Our system has been upgraded to simultaneously image the sides of subject animal and either the front or back of the animal using specialized 45° angle mirrors platform and accompanying Dynamic Contrast Enhancement (DyCE™) software using CRi-based technology. This upgrade will reduce the overall required for imaging of a given animal as a dataset containing three-sides is collected at once. The software can also calculate a pseudo-3D volume for the given region of interest. The X-ray stage has also been upgraded to accommodate multiple species including rats, so called IVIS Lumina XRMS platform. The Multispectral Optoacoustic Tomography MSOT-256-TF (iThera Medical) offers the only optoacoustic imaging system with real-time whole-body imaging capability. Biological processes and the effect of pharmacological substances can be observed *in vivo*, in deep tissue, in real time, and in high resolution. Endogenous chromophores, such as oxygenated and deoxygenated hemoglobin, as well as extrinsically administered probes can be differentiated from tissue background by tuning the excitation laser wavelength. The collected optoacoustic signal acquired at multiple wavelengths is spectral un-mixing and based on the absorbance spectrum of the agent or species. ****Note: Auburn University is only 1 of 5 sites in the United States with this technology.****

AU Research Instrumentation Facility (Harrison School of Pharmacy)

The Auburn University Research Instrumentation Facility (AURIF) under the direction of Dr. Michael Miller is foremost a campus-wide research instrumentation and service. Its services and resources are available to AU faculty, staff, and student researchers; other in -state and out-of-state institutions; and to businesses and private industry. The facility is used extensively for research in the areas of life science, engineering, veterinarian medicine, pharmacal sciences and in nanotechnology. Complete individual training, familiarization with the instrumentation, and assistance with experimental design, grant and manuscript preparation, and specimen preparation and processing are available in the facility upon request.

Within AURIF, a number of instruments are available to researchers including the following: a Zeiss EM 10 Transmission Electron Microscope operated at 60KeV equipped with a digital camera system, a JEOL 200CX Scanning Transmission Electron Microscope with diffraction capability with an operating range of 60KeV to 200KeV, a Zeiss EVO 50 Variable Pressure Scanning Electron Microscope equipped with Energy Dispersive

Spectroscopy (EDS), a Zeiss Axiovert 200 Inverted Epi-Fluorescence Microscope, a GE Image Quant LAS 4010 Imaging system with a variety of filter and light sets for non-radioactive imaging, a Thermo Scientific Nanodrop 2000 Spectrophotometer, an ABI 7500 Real Time PCR unit, and a multitude of additional specimen preparative support equipment.

The most recent acquisition to the facility was the upgrade of our Nikon A1 Confocal Scanning Laser Microscope to a multiphoton system. In addition to the A1's standard 4 laser, 7 laser line imaging and environmental chamber setup, the multiphoton upgrade now allows for much deeper sample penetration especially in dense tissues (up to ~2mm) and less sample damage due to the IR excitation source. Moreover, we are now able to excite a greater variety of probes and multiphoton imaging can be done using the resonant scanner which allows for high speed scanning of living and moving samples.

Auburn Drug Safety Work Group (DSW)

The DSW (PI: R. Hansen) is a forum for researchers and Scholars in pharmacy, nursing, systems engineering, informatics, and computer science aimed at improving the safe use of pharmaceuticals. Since 2012, DSW PhD students and trainees have successfully competed for more than \$6 million in federal funding. This resource extends key research and training opportunities to KL2 Scholars, including access to multiple large CMS, cancer, and adverse event data sets used by past Scholars.

EXAMPLE ELECTIVE MINI-SABBATICAL OPPORTUNITIES AT AUBURN

Mini-sabbaticals/Externships/Short-term Rotation Offerings

Rotation Name(Supervisor(s)/Institution)	Learning Objectives
CCTS Network Partners (example rotations)	
Drug safety and surveillance (R. Hansen, PhD, J. Qian, PhD, R. Sesek, PhD, D. Umphress, PhD; Auburn University)	1) Understand the application of methods like machine learning to drug safety research and signal detection; 2) develop strategies to apply human factors and systems engineering methods to real-world healthcare problems
Magnetic resonance spectroscopy / MRI research center (A. Bashir, PhD, T. Denney, PhD, Auburn University)	1) Learn the basics of MR Imaging, including the opportunities/ limitations of different MR technologies; 2) work w/ investigators to evaluate MR data; 3) ID ways to incorporate MRI technology into research w/ special emphasis on human subjects research
Advanced brain network analysis / MRI research center (T. Denney, PhD, G. Deshpande, PhD, J. Robinson, PhD, Auburn University)	1) Learn principals of functional & effective brain connectivity & how to implement them in neuroimaging data; 2) learn the basics of complex network analysis & graph theory; 3) ID opportunities for incorporating brain connectivity into human subjects research
Advanced cardiovascular imaging and image analysis / MRI research center (R. Amin, PhD, T. Denney, PhD, Auburn University)	1) Understand the issues involved in acquiring cardiovascular MRI data in both humans and animals; 2) work with investigators to acquire and analyze cardiovascular MRI data; 3) learn to identify opportunities for cardiovascular MRI in translational research.
Auburn pharmacy health services (K. Braxton Lloyd, PharmD, C. Erwin, PhD, Auburn University)	1) Observe how to improve quality of medication use and reduce costs; 2) explore models for conducting HQS research within community pharmacies; 3) develop effective models for coordinating medications across multiple providers and pharmacies
Advanced pharmacotherapy at Auburn (J. Starr, PharmD, C. Jackson, PharmD, Auburn University)	1) Improve knowledge in pharmacotherapy; 2) understand how to implement strategies to increase the use of guidelines and/or best practices in medication selection; 3) understand how pharmacy services can be used to reduce medication errors & adverse events

HUDSONALPHA INSTITUTE FOR BIOTECHNOLOGY (HAIB)

HudsonAlpha was founded in 2008 as a nonprofit Institute, committed to improving human health and quality of life through its unique four-fold mission: sparking scientific discoveries that can improve human health and well-being; bringing genomic medicine into clinical care; fostering life sciences entrepreneurship and business growth; and encouraging the creation of a genomics-literate workforce and society. The HudsonAlpha campus consists of 152 acres nestled within Cummings Research Park, the nation's second largest research park. Designed to be a hothouse of life science research and innovation, HudsonAlpha's state-of-the-art facilities co-locate nonprofit scientific researchers with entrepreneurs and educators. The relationships formed on the HudsonAlpha campus encourage collaborations that produce advances in medicine and agriculture. Under the leadership of Richard M. Myers, PhD, a key collaborator on the Human Genome Project, HudsonAlpha has become a national and international leader in genetics and genomics research and biotech education.

HudsonAlpha is home to the Genomic Services Laboratory, the Genome Sequencing Center (formerly the Stanford Human Genome Center) – one of the few centers in the world that specializes in *de novo* eukaryotic whole genome sequencing, assembly and analysis – the CAP accredited and CLIA licensed Clinical Services Lab, and the Smith Family Clinic for Genomic Medicine. More than 30 diverse biotech companies, all of which are involved in research, development or production related to life sciences are located on the same campus as the Institute. The four-story, 270,000 square foot main building has the capacity to serve 500-600 scientists and staff. A conference center is located across the street from the main building, which offers 13,000 square feet of meeting space. The third addition to the HudsonAlpha campus is the 88,000 square foot building that also houses The Smith Family Clinic for Genomic Medicine.

INSTITUTIONAL RESEARCH ENVIRONMENT & EXPERTISE IN CLINICAL AND TRANSLATIONAL SCIENCE

Expertise.

HudsonAlpha is led by Richard M. Myers, PhD, President and Science Director, whose laboratory contributed more than 10% of the results to the original Human Genome Project and pioneered key genomic techniques that continue to yield insights into human health and disease. Under his leadership, the Institute has assembled a diverse and highly regarded faculty.

HudsonAlpha Institute's research and teaching missions are focused on genomics and genetics for truly individualized medicine, developing new and sustainable energy sources, and understanding the normal function of cells and organisms. HudsonAlpha is home to 15 faculty investigators whose research interests and expertise span the genetic basis for biodiversity, computational and statistical strategies for understanding how genomic variants shape phenotypic variation, high-throughput sequencing strategies and technology, the genetic and epigenetic basis of human diseases, deep analysis of the immune system, including rapid and accurate measurements of the immune repertoire, *de novo* genome sequencing of economically valuable plants and other organisms, and metabolomics. Gene expression and other functional genomics projects, and genome-wide and targeted DNA sequencing technologies are extensively studied at HudsonAlpha, and the faculty have been directly involved in large-scale projects such as The Human Genome Project, The Cancer Genome Atlas (TCGA), the Encyclopedia of DNA Elements (ENCODE) Project, very large studies of the genetics of ALS and bipolar disorder, and numerous other consortia. In addition, HudsonAlpha is home to the Genomic Services Laboratory, the Genome Sequencing Center, the CAP accredited and CLIA licensed Clinical Services Lab, and the Smith Family Clinic for Genomic Medicine. The social, ethical and psychological ramifications of incorporating genomic data into patient care are also active areas of research.

HudsonAlpha faculty investigators cultivate a rich network of collaborations around the globe with leading research universities, medical schools, health centers, and industry partners. The Institute has formalized several joint ventures to discover, co-develop and commercialize technologies and methods and to integrate genomics into medical state-of-the-art. With the University of Alabama at Birmingham, HudsonAlpha created the Center for Genomic Medicine and, with its Comprehensive Cancer Center, the Alabama Cancer Consortium. With Auburn University, HudsonAlpha launched a research center with its veterinary medicine and

agronomy colleges, focused on comparative genomics and translational research in plant and animal genomics.

Under the direction of Neil Lamb, PhD, the mission of the HudsonAlpha Educational Outreach team is to cultivate a genetically literate citizenry by creating engaging activities that connect scientific concepts to their application in our changing world. The team creates engaging experiences that minimize barriers to access for students, educators and the public. These range from school activities to camps and internship programs, HudsonAlpha-led college courses with our university collaborators, online educational resources and apps, and an ongoing series of presentations, tours and workshops for the adult life-long learning audience. Since January of 2015, the Educational Outreach group offers a series of Continuing Medical Education (CME) courses that are approved for CME credits by the Medical Association of the State of Alabama (MASA). The series, titled "Genetics in your practice", is aimed at physicians and nurse practitioners and consists of three courses per year. The first course will be an introduction to genetics and genomics in medical practice, including available tests and interpretation of results. Subsequent courses will focus on pediatric specialties, such as undiagnosed pediatric disorders (aimed at physicians that refer patients to the CSER project) and cancer.

In 2015 HudsonAlpha recruited five new faculty members, established a Personalized Medicine Program and inaugurated the Smith Family Clinic for Genomic Medicine. Unlike other genetic clinics, this is the first clinic in the world to exclusively practice genomic medicine. Under the direction of David Bick, MD, the clinic sees patients with rare and undiagnosed diseases and applies whole genome sequencing to provide a diagnosis. In 2016 HudsonAlpha recruited one new faculty member and one junior fellow.

Facilities

The Institute, which opened in April 2008, provides an exceptionally high-quality research environment. It is housed in a four-story, 270,000 square foot building that has the capacity to serve 500-600 scientists and staff. HudsonAlpha is located at 601 Genome Way in Huntsville, Alabama, in Cummings Research Park, a half-mile from the University of Alabama in Huntsville and adjacent to a NASA field center and more than 280 engineering and computer science firms. The building houses well-equipped state-of-the-art laboratories, numerous small- and medium-sized conference rooms, as well as a library, auditorium and cafeteria. A conference center associated with the Institute is located across the street. The Institute has nine large laboratories with space for 12 to 16 Faculty Investigators, situated in the North Wing of the building and comprising half the square footage. The labs have all the standard equipment for molecular biology, genetics, and genomics work, including refrigerators, freezers, centrifuges, incubators, water baths, microscopes, etc. The labs share this equipment along with a two-room tissue culture suite that houses two sterile hoods and eight incubators, a cold room, a darkroom, computational resources, and conference rooms.

The South Wing of the building houses the HudsonAlpha Genome Sequencing Center and more than 30 biotechnology companies, all of which are involved in research, development or production related to genomics. HudsonAlpha has dedicated more than 7,000 square feet of classroom and teaching/training laboratories, as well as substantial resources and personnel, to support an extensive education outreach program. Distance learning equipment facilitates access to HudsonAlpha's experts and high-definition video conferencing is placed throughout the building to connect the scientists and educators with collaborators, colleagues, teachers and students around the world. The third addition to the HudsonAlpha campus is the 88,000 square foot "Building 3", which offers additional lab and office space to biotech companies of various sizes. Building 3 provides additional spaces for new organizations on campus, while also providing options for existing tenants to expand. Residents of Building 3 can take advantage of the business expertise of other for-profit HudsonAlpha associate companies, as well as the close proximity of Institute scientists, educators, and other valuable resources.

Genomic Services Lab

Located on the third floor of the North Wing, the Genomic Services Laboratory (GSL) is a dedicated experimental and data analysis infrastructure that centralizes all high-throughput genomic experimentation and efficiently leverages equipment capacity and expertise to generate the highest data quality in a production environment. The GSL produces the highest quality genomic data for HudsonAlpha's scientists as well as for more than 700 collaborators and clients from around the world. With 30 DNA sequencing instruments

representing all major technologies and investment in the Illumina HiSeq X Ten system, the GSL distinguishes itself with highly optimized workflows and methods to handle hundreds of projects, thousands of samples and produce quality data. The Illumina HiSeq X Ten provide HudsonAlpha with an exponential increase in the breadth and depth of data while reducing its sequencing costs by as much as 85%. Additionally, it enables the comparison of whole human genome data across tens of thousands of samples and gives HudsonAlpha the capacity to conduct large-scale whole-genome sequencing projects by increasing our sequencing capacity from around 5,000 genomes per year to as many as 18,000 genomes per year. HudsonAlpha is in the process of adding ten Illumina NovaSeq 6000 instruments to its sequencing operations. When this transition is complete, the acquisition will more than triple the sequencing capabilities of the institution to nearly 70,000 whole-genomes per year.

The GSL is directed by Shawn Levy, PhD (who operated all genomic core facilities at Vanderbilt University from 2000-2009), with substantial contributions and strategic input by Drs. Myers, Devin Absher, Greg Cooper, Greg Barsh and the other HudsonAlpha faculty. A professional staff with more than 70 years of combined genomics and informatics experience continually advances its technical capabilities and routinely collaborates with many of the major technology vendors to improve the performance and efficiency of genomic technologies. With the faculty, the GSL has the extensive experience, equipment, and infrastructure needed to analyze the results of large-scale genomics and genetics measurements. This includes raw data analysis and interpretation of whole genome, whole exome, and targeted sequencing projects (which includes immune repertoire determinations), RNA-seq, DNA methylation and other epigenetic determinations, ChIP-seq, genotyping and high-throughput functional studies.

The resources available in the GSL include:

- Two large, dedicated equipment rooms house two Illumina NovaSeq 6000 instruments, 10 Illumina HiSeq X instruments, 10 Illumina HiSeq sequencing instruments, two Illumina MiSeq sequencers and a Life Technologies Ion Torrent sequencer. All sequencing equipment is connected directly to the computational resources described below in the Computational section. HudsonAlpha will add an additional eight Illumina NovaSeq 6000 instruments in late 2017 through 2018.
- Neighboring GSL laboratory space houses the sequencing support equipment including four Illumina cBots and a Life Technologies EZBead system.
- Two 10X Genomics GEMCode instruments compatible with the early-access Chromium chemistry. The 10X Genomics GEMCode platform is a novel platform that produces libraries for the Illumina platform that allow the reconstruction of very long phase blocks from short-read sequencing data, allowing greater than 95% of variants in whole genome sequencing experiments to be phased.
- Full sample preparation and quality control equipment is located in the GSL laboratory space. HudsonAlpha has been a key partner with both Beckman-Coulter and Caliper Life Sciences on the development of automated scripts for a wide variety of sequencing sample preparation protocols, including ChIP-seq and RNA-seq. Two Beckman-Coulter BioMek FX⁹ and one Caliper Sciclone NGS liquid handling platforms are located in the GSL laboratory.
- For sample and library quality control, the GSL laboratory contains two Agilent Bioanalyzers and one Caliper LabChip GX along with three Life Technologies 7900HT real-time PCR machines, Molecular Dynamics multiwell plate fluorometer/spectrophotometer and several PCR instruments, including thermocyclers located on the robotic decks.
- Three Illumina Beadstation genotyping systems with associated automation, a complete iScan system for data collection and analysis, and associated robotics and hybridization equipment are located in a dedicated equipment room adjacent to the sequencing rooms. These are used for a variety of genotyping, copy number variation testing, gene expression profiling and the array-based technique for DNA methylation profiling experiments. Our genotyping capacity is ~20,000 whole genome scans per year and more than 30,000 smaller-scale platforms such as Illumina MethylationEPIC BeadChips, genotyping and other assays.
- All instrument monitoring, sample tracking and project management is supported by an in-house developed LIMS system.

Clinical Services Lab

In 2015 HudsonAlpha's Clinical Services Lab (CSL) acquired a Clinical Laboratory Improvement Amendments (CLIA) license and a College of American Pathologists (CAP) accreditation and began offering licensed clinical sequencing services in addition to research ones, enabling the Institute to impact more directly patient care with genomic information and remain the Southeast's epicenter of genomics research and sequencing. HudsonAlpha is one of only five nonprofit organizations with the X Ten capability and enjoys privileged, collaborative relationships with most sequencing technology development companies, established and emerging.

Genome Sequencing Center

The Genome Sequencing Center (GSC) has a dedicated 14,000 square foot facility of combined laboratory and office space. Under the direction of Jane Grimwood, PhD and Jeremy Schmutz, a group of about 25 laboratory and computational staff generates genome sequence data and creates resources for researchers worldwide.

With funding from the Department of Energy (DOE), the GSC is a partner in the Joint Genome Institute (JGI), a virtual organization with laboratories throughout the United States. The primary focus of research is in the field of bioenergy, supporting DOE initiatives related to clean energy generation. Sequence data produced at HudsonAlpha will be applied to the problem of reducing the U.S. dependency on imported oil by improving biomass yield and the efficiencies of processes used to convert plant materials into liquid fuels. Through additional funding from the National Science Foundation (NSF), the United States Department of Agriculture (USDA) and the National Human Genome Research Institute (NHGRI), just to name a few, the GSC is also building a foundation for further genomic and functional research in plants, fungi, algae and model organisms.

Information Technology and Computation

HudsonAlpha Information Technology Operations

The responsibility for the HudsonAlpha campus network, compute resources, and information security platforms resides with HudsonAlpha Technology Group (HudsonAlpha-IT). HudsonAlpha-IT personnel are located in offices in building 1 (601 Genome Way, Huntsville, AL) and building 3 (701 McMillian Way, Huntsville, AL) on the HudsonAlpha campus. Production, development and tenant systems are located in the HudsonAlpha Data Centers in building 1, building 3, and 56 Marietta (leased carrier neutral colocation facility in Atlanta, GA). HudsonAlpha private cloud and public cloud services are leveraged for scale up, scale out, and high availability requirements. All are monitored 24 hours a day, 7 days a week.

Computer Equipment

HudsonAlpha-IT operates servers, storage systems, clouds (private, public, & hybrid), workstations, laptops and peripherals for research and production workloads. Production sites, databases (MongoDB, hBase, MySQL, SQL Server, Oracle), data entry interfaces, and curation systems are managed/maintained distinctly separate. Production environments benefit from service level agreements for service availability, backup, and failovers. R&D systems still benefit from core infrastructure availability SLAs, but allowances are made in some aspects (not security) for added flexibility of the environment for development/research. Currently HudsonAlpha-IT utilizes a mixture of dedicated hardware and private cloud-based Virtual Machines with a combination of Windows, Linux, Solaris, and Macintosh operating systems. Public cloud services are accessed over virtual private gateways via our datacenter colocation agreement with DigitalRealty Trust and internet service provider interconnection/peering agreements. These gateways provide a seamless and coherent network topology for on premise and cloud apps to communicate. This encrypted/secure tunnel affords us a fast "direct connect" mechanism.

HudsonAlpha Network Infrastructure

- **Campus High Speed Network Connectivity** The campus internet service is composed of multiple fiber paths onto the campus. Two 10 Gigabit redundant network connections provide high availability access to colocation at Telx 56 Marietta (ATL1). At ATL1 private and public peering is available with cloud providers and federal research networks like ESNNet and Internet2. Additionally, the campus has multiple 1Gbps commodity internet connections. Each section of a floor in the campus buildings have their own switches, which are connected to the core using 80 Gigabit Ethernet (GE) links over single mode optical fiber. Category 5 or better unshielded twisted pair wiring is used to connect desktops to

the network. Computer server clusters are connected to the core switches using redundant 10 Gigabit/40 Gigabit connections. The campus wireless network covers the campus office buildings, and is segregated into a public and private Wi-Fi.

HudsonAlpha High Performance Computing Resources

- HudsonAlpha-IT provides its researchers with shared software and hardware infrastructure along with the necessary support for the high performance parallel and distributed computing, numerical tools and computing environments. The core compute resources for the Research Computing System is Morgan, a compute cluster with four generations of hardware totaling 2,096 physical cores with 1 GigE, 10 GigE and 40 GigE networks. The five generations of hardware include:
 - HPE BL460c: 16 2x16 core (512 cores)/32 2x14 core (896 cores) 1,408 total physical cores 2.30 Ghz Intel Xeon Haswell compute nodes with 512/384 GB RAM per node, 2x10 GigE to a high-performance General Parallel File System (GPFS) running disk arrays totaling 3.6PB usable.
 - iDataPlex 360 M4: 8 2x6 core (96 cores total) 2.00 GHz Intel Xeon Sandy Bridge compute nodes with 64GB RAM per node (5.33GB per core), 2X1 GigE to high-performance GPFS.
 - iDataPlex 360 M3: 32 2x6 core (384 cores total) 2.66 GHz Intel Xeon Westmere compute nodes with 48GB RAM per node (4GB per core), 2X1 GigE to a high-performance GPFS.
 - iDataPlex 360 M2: 16 2x4 (128 cores total) Intel 2.93 GHz Intel Xeon Nehalem compute nodes with 96GB RAM per node (12GB per core), 2X1 GigE to a high-performance GPFS.
 - iDataPlex 340: 10 2x4 (80 cores total) Intel 2.33 GHz Intel Xeon Harpertown compute nodes with 48GB RAM per node (6GB per core), 2X1 GigE to a high-performance GPFS.

Network Security

Access to the HudsonAlpha network is strictly controlled. As a general policy, all inbound connections are explicitly denied with specific exceptions. Exceptions are controlled by IT staff and are only allowed to hosts located in DMZ networks directly connected to a pair of redundant Cisco ASA firewalls. Outbound connections are allowed with specific restrictions (i.e. outbound SMTP is controlled). External access to HudsonAlpha networks is allowed via IPSec client or L2L (LAN-to-LAN) IPSec tunnel. Internal VLANs logically separate functional groups and tenant companies in the building. VLAN to VLAN access is explicitly denied with exceptions allowed via layer 3 ACLs (access control lists). Wireless access to HudsonAlpha networks is controlled by 802.1x authentication. Public Wi-Fi access is controlled via a pre-shared key and is restricted to the internet only. Critical core network equipment is centrally located in a controlled access (badge reader) data center that is UPS/generator protected. Access to IDF closets is controlled by lock and key and limited to IT staff and facilities. Login access to critical network equipment is controlled and logged with TACACs. Access to shared data is controlled through AD (active directory) authentication. Critical business software is primarily hosted (e.g. email, HR, purchasing) utilizing LastPass for password management.

Software Licenses

A variety of software packages are available through the individual laboratories or institutional licenses maintained by HudsonAlpha-IT. Those maintained by HudsonAlpha-IT include:

- Individual license for Microsoft Products, including Office, Server software & SQL Server.
- Individual “cloud” licenses for Adobe Products, including Adobe Creative Cloud & Adobe Professional.
- Individual license for Trend Micro Anti-Virus software.

Software Development and Informatics

Since its founding, HudsonAlpha has been strongly committed to developing new ways to handle, analyze, and integrate large genomic datasets to advance our knowledge of biological systems. Early on, bioinformaticians, statisticians, and software developers were consolidated into the Analytical Core, which served the informatics needs of the Institute. Under the direction of Elizabeth Worthey, PhD, the core grew into the Software Development and Informatics (SDI) team in 2015. The mission of the team is to provide an analytics platform for researchers. The team designs software to analyze large datasets and also handles clinical informatics to support the interpretation of genomic data. This group is interested in both clinical and translational genomics, along with personalized medicine, computer science and system design. SDI is made up of 15 team members, consisting of software developers and clinical analysts. Collectively, the team has more than 80 years of software development experience and 25 years of clinical analysis experience. The software developers are

skilled in multiple programming languages, including Java, JavaScript, PERL, HTML, CGI, Python, SQL, Oracle, Bash Scripting, C, C++, C#, AJAX, Unix Shell Scripting, JSP, JSON, MATLAB, FORTRAN 77/90, Scala and MongoDB. They are proficient in UML software documentation and design, XML data design, SOAP web communications, along with Linux/Unix-based operating systems, MAC OS X, Microsoft Windows, Office, Exchange, BWA, GATK, CATK QUEUE, Genologics Clarity LIMS, Plink, Mega Suite, Velvet, and many others. With the guidance of a dedicated project manager, the team coordinates with end-users and develops analysis pipelines for clinical research use. These already include a variety of tools for analysis of next generation sequence data and analytical workflows to the researchers who use the Institute's computational infrastructure. These tools are available cluster-wide and include software for quality control (fastQC, Picard Tools), alignment (BWA, bowtie), variant calling (GATK, SnpEff), RNA-seq analysis (Cufflinks, Tophat, DESeq), ChIP-seq analysis (MACS, Meme, SPP, PeakSeq, GEM, IDR), methylation analysis (Bismark), genome assembly (Velvet, Abyss), microbiome and metagenomic analysis (QIIME, HUMAnN, MEGAN), and exon and whole genome variant calling (GATK). A local Galaxy cluster and local instance of the UCSC Genome Browser are also available. In addition to the aforementioned third party tools, an automated data pipeline is employed that runs primary analyses on genomic data. This includes a variant calling pipeline that generates annotated VCF files from FASTQ files and a ChIP-seq pipeline that produces peak calls and motif analysis from FASTQ files, as examples. Project-level variant databases are available that allow researchers to load their results so they can query and filter based on variant annotations (such as minor allele frequencies and GERP scores, for example).

Office

The Faculty Investigators' laboratories are arranged so that there are multiple offices and "dry-lab" spaces for each laboratory. Each Faculty Investigator has an office suite that includes a secondary office and cubical and open space for as many as 20 personnel. A large suite of 20 offices for the staff that administer the entire Institute is situated on the first floor. Office and computer space is available for visiting scientists to work at HudsonAlpha.

In addition to the offices, the building's layout encourages interactions throughout the Institute. Each floor has multiple conference rooms and two refreshment/coffee meeting areas, and the 1st floor atrium has a large auditorium, library, lounge area and cafeteria that is used by all occupants of the building (the HudsonAlpha Faculty laboratories, the associate companies, and the education group).

EXAMPLE ELECTIVE MINI-SABBATICAL OPPORTUNITIES AT HUDSONALPHA

Mini-sabbaticals/Externships/Short-term Rotation Offerings

Rotation Name(Supervisor(s)/Institution)	Learning Objectives
CCTS Network Partners (example rotations)	
High throughput genetics/genomics; whole genome sequencing; ENCODE (R Myers PhD, D. Absher PhD, HA)	1) Understand key methods for high-throughput genetic and/or genomic assay, with special emphasis on human models; 2) Design studies on disease pathobiology that inform personalized medicine approaches; 3) Learn how to manage and interpret large data sets

LOUISIANA STATE UNIVERSITY HEALTH SCIENCES CENTER (LSUHSC)

The Louisiana State University Health Sciences Center – New Orleans includes the Schools of Medicine, Public Health, Dentistry, Nursing, Allied Health Sciences and the Graduate School. The downtown New Orleans campus trains 70% of state's health care professionals. The School of Medicine, which was just re-accredited by LCME, manages multiple residency and fellowship programs in New Orleans, Baton Rouge, Bogalusa, Lafayette and Lake Charles. LSUHSC – NO serves patients throughout Southern Louisiana and surrounding areas through the LSUHSC Health Sciences Network of outpatient clinics and its public-private partnership with University Medical Center, a newly opened 446-bed academic hospital located across the street from the main campus, where LSUHSC physicians and staff see patients in a hospital setting. LSUHSC physicians also see patients at other hospitals in the same system, Louisiana Children Medical Center.

INSTITUTIONAL RESEARCH ENVIRONMENT & EXPERTISE IN CLINICAL AND TRANSLATIONAL SCIENCE

All LSUHSC Schools have active research programs, with the most active being in the Schools of Medicine and Public Health. LSUHSC is part of the NIGMS-funded Louisiana Clinical and Translational Sciences Center, which includes LSU Pennington, Tulane University, Xavier University, Children's Hospital, LSU A&M Baton Rouge, Ochsner Clinic, the Southeastern Louisiana Veterans Health Care System and University Medical Center (<https://lacats.pbrc.edu/>). LACaTS provides a shared clinical and translational science infrastructure, including clinical research, regulatory support, biomedical informatics, biostatistics and study design, professional development, health literacy and community engagement. Specific to LSUHSC, the Clinical/Translational research environment includes:

Clinical and Translational Research, Center (CTRC) and the Core Laboratory

Located in the Seton Building and in the LSUHSC campus. The CTRC provides staffing for conduct of research protocols, including nursing staff, nutritional support, administrative assistance, and biostatistician support. The Core Laboratory develops and performs laboratory assays for clinical research projects.

GS-MU-NCORP

Separate from the CTRC, The Gulf South-Minority Underserved-NCI Community Oncology Research Program (GS-MU-NCORP) is the largest and only state-wide cancer clinical trials research consortium encompassing the state of Louisiana and southern Mississippi. The GS-MU-NCORP has three major component sites, LSU Health Sciences Center – New Orleans (which includes the only Children's Hospital in the state), LSU Health Sciences Center – Shreveport and Mary Bird Perkins Cancer Center (Baton Rouge), each with several subcomponent sites for a total of 26 clinical centers participating in this clinical trials consortium. The major goal of this public-private partnership is to bring cutting edge cancer clinical trials to patients in our state. The integrated leadership team works closely with clinical investigators to ensure a coordinated selection of clinical trials and the implementation of these trials at multiple sites. All sites recognize the NCI's central IRB as the IRB of record, and for non-CIRB protocols, all sites are under the LSUHSC IRB. This structure allows for the rapid selection and deployment of clinical trials throughout the various clinical sites of this NCORP. This program also discusses and selects investigator initiated trials and pharmaceutical trials. Its ultimate goal is to provide a closely integrated cancer clinical trials program throughout state of Louisiana, in close association with academic and community physicians dedicated to bringing cutting edge trials to their patients. Currently, the NCORP has over 60 cancer-related studies open.

LCRC Tissue/Biospecimen Repository

The mission of the Biospecimen Core is to collect high quality samples of fluids (i.e. whole blood, cellular blood components, plasma, serum, urine) and tissue from patients with tumors, with the tissue's corresponding pathological variables. This material is available to qualified researchers at the Louisiana Cancer research Consortium (LCRC) and LSU Health Sciences Center and will enable them to reduce costs and minimize risks associated with alternative banking practices. High quality refers not only to the biological quality of tissue and accompanying pathological data, but also to the ethical and legal status under which donors are enrolled and consented. This core is the primary interface with the clinical sites at which donors are enrolled and tissue samples and clinical data are collected. The core utilizes caBIG's Tissue Suite for biospecimen inventory, tracking, and basic annotation. This database permits researchers to track the collection, storage, quality

assurance, and distribution of specimens as well as the derivation and aliquotting of new specimens from existing ones. Dr. Arnold Zea is the co-director at LSUHSC and can be contacted at azea@lsuhsc.edu. A collaborative effort to construct a clinically annotated “virtual biorepository” from LCRC Biospecimen Repository data is funded by the LACaTS parent grant and led by Dr. Miele. This effort is being pursued in close partnership with the CCTS Hub, with the ultimate goal of developing a regional virtual biorepository with shared data ontology.

The Louisiana Tumor Registry

The Louisiana Tumor Registry has high-quality data covering the entire State of Louisiana including This cancer types (morphology, grade, and behavior), anatomic location, stage at the time of diagnosis, treatment, and outcomes (survival and mortality). This data is being leveraged by the LACaTS Biomedical Informatics Key Component, directed by Dr. Miele, to construct “virtual cohorts”, limited datasets including clinicopathological information on cancers related to health disparities along with EHR-derived additional clinical information from the PCORI-funded REACHnet clinical data repository (for which Dr. Miele serves as LSUHSC coPI). (<http://sph.lsuhs.edu/louisiana-tumor-registry>)

Clinical Informatics Resources

The LSU Health Sciences Campus uses EPIC (<http://www.epic.com/>) throughout its clinical operations within the University Medical Center. EPIC is also used to manage non-cancer clinical trials. EPIC is one of the most commonly used EHR systems in academic medical centers, and readily amenable to health information exchange in the context of clinical/translational research. The LSU Health Care Network of outpatient clinics use Allscripts (<http://www.allscripts.com/>). Inter-operability with EPIC to match patients is under development. The Minority-Based NCI Community Oncology Research Program led by LSUHSC (A. Ochoa, PI), uses CREDIT (http://www.ddots.com/credit_overview.cfm) a web-based CTMS which is more amenable to collaborative clinical research in the context of multiple community hospitals. LSU as a whole and LSUHSC New Orleans maintain a comprehensive privacy and information security program that protects the confidentiality, availability, and integrity of all information assets (i.e., patient, research, customer, business data). The LSU System Information Security Policy is [PM-36](#), the LSUHSC-NO Information Technology Infrastructure policy is [CM-42](#), our Information Security policy is [EIS-100](#), and the LSUHSC-NO HIPAA policy is [CM-53](#). Our health system follows HIPAA policies and undergoes review by the Joint Commission on Accreditation of Healthcare Organizations. LSU and LSUHSC-NO comply with Family Educational Rights and Privacy Act controls for student information. Our security policies are overseen by an appointed HIPAA Entity Security and Privacy Officer. Compliance with IT Security policies and local and federal laws and regulations is further ensured through review by our institutional health system internal audit organization. The [Office of Compliance website](#) has additional information on HIPAA and FERPA compliance SOPs.

Bioinformatics Resources

The newly created Bioinformatics and Genomics Program (<https://www.medschool.lsuhs.edu/bioinformatics/>), led by Dr. Chindo Hicks in the Department of Genetics and staffed with two full-time analysts, develops and applies statistically rigorous solutions for the design of studies, analysis and mining a wide variety of "omics" and other biological data, and integration of these data with clinical information to facilitate translation of genomic discoveries to the bedside and to accelerate the realization of Precision Medicine. The BIG program integrates the research, education and service missions of LSUHSC. The laboratory is equipped with up to 15 Dell work stations, A LINUX cluster, mass storage for database and data mining application, graphics workstations for visualization and popular bioinformatics and genomics software packages. The BIG program is connected by high-speed data links (the Louisiana Optical Network Infrastructure or LONI) to super-computers in the Center for Computational Technology (CCT) at LSU Baton Rouge (<https://www.cct.lsu.edu/>). Among the services provided by the program staff include but are not limited to:

- Bioinformatics and computational genomic analysis of “omics”, genotype, sequence, methylation and other biological data
- Data analytics with application to analysis of big data in a biomedical setting
- Software development and deployment with application to database design and management of large-scale research data
- Providing education and training seminars on bioinformatics to students, medical professionals and biomedical investigators
- Integration of multiplatform-multiscale biological data with clinical information

- Development and application of novel methods and software tools to emerging biological questions and technologies
- Support in planning and design of grant applications, manuscript and abstracts
- Pathway prediction and modeling gene regulatory networks driving human diseases
- Quantitative modelling and prediction of disease progression and outcomes
- Maintenance of large-scale genomics and other biological databases
- Drug discovery and repositioning

Research Action for Health Network (REACHNet)

LSU has access to a vast clinical informatics data warehouse through the PCORI-funded Research Action for Health Network (REACHNet). The REACHnet clinical data repository includes 1.7 million active records, soon to increase to 2.3 million with the inclusion of the UMC clinical data warehouse. These data can be accessed through LSU's Biomedical Informatics (BMI) or REACHnet teams. The data are currently in the PCORnet Common Data Model 4.0. Data elements not included in CDM 4.0 can be added for specific projects. Both REACHnet and the BMI maintain interconnected i2b2 instances, where research datasets are created. Queries can be submitted through the BMI Core, which has a process for prioritization and optimization of data science projects through the formation of Project Development Teams, including at least a biomedical informatician, a biostatistician and a subject matter clinical research expert. The BMI Core is tasked with creating "virtual biorepositories", including active records specific to conditions that disproportionately affect Louisiana patients. To date, it has created Diabetes and a Breast Cancer virtual cohorts, with 8 more (4 cancer and 4 non-oncologic conditions) virtual cohorts planned. The time table and prioritization will depend on the needs of new projects, including CCTS projects. In order to harmonize data resources, the BMI Core and the CCTS hub are sharing data ontologies, and Dr. Cimino has agreed to serve as External Advisor for LACaTS. The BMI Core, also in collaboration with the CCTS hub, is also creating "virtual biorepositories" for at least 3 biospecimen collections: the LCRC Biospecimen repository, the Ochsner Biorepository and the Pennington biobank including biospecimens, anthropometric measurements and laboratory values for several thousand participants in diabetes/obesity registries.

Innovation and Entrepreneurship Resources

The LSUHSC Office of Technology Management (<http://www.lsuohsc.edu/administration/academic/otm/>) offers comprehensive support to LSUHSC investigators, including negotiating Material Transfer Agreements, Non-disclosure Agreements, Inter-institutional Agreements, licensing agreements etc. The OTM also offers training sessions for investigators planning to commercialize their findings and/or to collaborate with industry partners.

Bioinnovation Center

The Bioinnovation Center (<http://www.neworleansbio.com/>) is a state of the art incubator facility for startup companies in Louisiana, most of which are spinoffs from LSUHSC or Tulane discoveries. The Center, located on Canal Street within walking distance of LSUHSC, Tulane and University Medical Center, provides space and licensing assistance to startup companies. To date, it has raised approximately \$93 million in private funding for health care product and technology development.

TRANSLATIONAL RESEARCH INFRASTRUCTURE

University Medical Center (UMC) Clinical Trials Unit

In addition to the CTTC described above, which primarily serves outpatient clinical studies and trials, UMC supports a broad searchable portfolio of clinical trials (<http://www.umcno.org/umcclinicaltrials>) and includes a clinical trials unit where LSUHSC physicians can enroll participants for inpatient clinical trials.

Centers of Excellence

LSUHSC New Orleans houses 7 dedicated Centers of Excellence in translational research. These include:

- The Alcohol and Drug Abuse Center
- The Cardiovascular Center
- The Epilepsy Center
- The Eye Center
- The Neuroscience Center
- The Oral and Craniofacial Biology Center
- The Stanley S. Scott Cancer Center

CLINICAL CARE

The Health care enterprise at LSUHSC consists of the LSU Healthcare Network, the LSUHSC partnership with UMC and other Louisiana Children Medical Center (LCMC) hospitals and additional clinical locations throughout Southern Louisiana where LSUHSC providers treat patients.

The LSU Healthcare Network

The LSU Healthcare Network (<http://www.lsuhn.com/Default.asp>) includes 175 providers and 9 clinics in the Greater New Orleans area, offering services for over 30 specialties. Appointments can be made through a web-based patient portal, which also allows for secure communication between patients and providers and the creation of easy to access health summaries for LSUHN patients. LSUHN uses Allscripts as its EHR. The University Medical Center New Orleans (UMC-NO). UMC-NO (<http://www.umcno.org/>) is a 3-years old, 1.1 billion dollar, 2.3 million square foot hospital. Its facilities cover 37 acres across the street from LSUHSC, and include three patient towers with 446-acute care beds including 60 behavioral health beds, 19 operation rooms, 76 pre-op and post-op bays, 56 emergency department exam rooms, nine acute treatment rooms and five trauma rooms. UMC also features a state of the art Conference Center where CME events and research conferences take place. Its patient population is approximately 43% European-American, 40% African-American and 10% Hispanic/Latino, with other minorities such as Vietnamese-Americans also prominently represented. Outlying clinical locations served by LSUHSC providers including family medicine clinics and residency programs include Baton Rouge Our Lady of the Lake Hospital, the Bogalusa rural family medicine clinic, Lafayette General Hospital and the Lake Charles family medicine clinic.

GRADUATE EDUCATION AND POSTGRADUATE TRAINING

The LSUHSC School of Graduate Studies (<http://graduatestudies.lsuhs.edu/>), directed by Dr. Joseph Moerschbaeche, III, includes the following Ph.D. Graduate Programs:

- Biochemistry and Molecular Biology
- Cell Biology and Anatomy
- Genetics
- Microbiology, Immunology and Parasitology
- Neuroscience
- Pharmacology and Experimental Therapeutics
- Physiology
- Interdisciplinary Studies (consisting of a one-year integrated curriculum for students who will then choose a specific doctoral program)
- MD/PhD Program, which accepts 6 new applicants per year

Additionally, a M.S. program in Biomedical Sciences is offered, and a new M.S. Program in Bioinformatics will be offered in the fall.

Applicants are recruited from the U.S. and other countries through a competitive admissions program that involves a pre-screening followed by in-person or electronic interviews. Incoming Graduate students participate in an orientation program that includes descriptions of each Graduate Program by individual Graduate Program Directors and/or Department Heads.

Two levels of Postdoctoral training are offered at LSUHSC. Postdoctoral fellows must have less than 2 years of post-graduation experience, while Postdoctoral Research Associates require more than 2 years of post-graduation experience. A specific training plan must be prepared and submitted by primary mentors for each postdoctoral scientist. Mentoring committees are highly encouraged. A number of training and career development opportunities are available through the LACaTS Professional Development Core, co-led by Dr. Gregory (<https://lacats.pbrc.edu/key-components/clinical-research-education-mentoring-and-career/>)

Louisiana Clinical and Translational Science Center (LACaTS) Roadmap Program

(Co-Director: P. Gregory). The LACaTS Center is comprised of three primary collaborating institutions who are part of the CCTS Partner Network including: LSU's Pennington Biomedical Research Center in Baton Rouge, LSU Health Sciences Center in New Orleans, and Tulane University. The LACaTS Center's vision encompasses the strengths and capacities unique to each member institution and represents a unified,

comprehensive approach for targeting prevention and research of chronic diseases in underserved populations. The proposed KL2 training program will leverage these resources to support the training and research specifically with chronic diseases in Louisiana, which consistently ranks at the bottom on the Commonwealth Fund's health care score card. 43 The LACaTS Scholars program only appoints faculty from PBRC, LSUHSC at New Orleans, and Tulane with only one Scholar per institution selected annually leaving many exceptional candidates out.

LSUHSC INSTITUTIONAL CORE FACILITIES

LSU Health Sciences Center in New Orleans has numerous core facilities that are available to our investigators. Operationally, they can be divided into Cores that are run by the School of Medicine, and those that are administered through Departments/Centers. Regardless of their organization, these core facilities are available to all LSUHSC faculty and staff on a fee per use basis. These services are also available to outside institutions. Basic, translational and clinical resources at LSUHSC SOM can be found at <http://www.medschool.lsuhschool.edu/research/>. A searchable database of faculty scientific interests is available on the SOM research portal. The Cores include:

The Molecular Histopathology and Analytical Microscopy Core

The Molecular Histopathology and Analytical Microscopy Core (MHAM), directed by Luis Del Valle, MD, works in concert with the CIM and TGC Cores (see below). The primary mission of the MHAM is to provide advanced detection, imaging, and analysis of gene and protein dynamics in cellular models of normal and cancer tissues from research animals or from patients. The MHAM has state-of-the-art histochemical and immunohistochemical methodologies to determine protein expression, localization, and interactions between viral and cellular proteins. Molecular histopathology, including in situ hybridization, is used to provide investigators with information regarding cellular and viral DNA and/or RNA. This core is led by a trained pathologist who, in addition to imaging services, also provides histopathological information on patient tissues and provides access to clinical samples that are crucial to investigating the molecular and cellular pathways correlating with human disease. Finally, the MHAM core provides investigators with training on tissue processing and management and helps investigators develop the necessary imaging and data for the submission of manuscripts and grants.

Cancer Center Translational Genomics Core (TGC) Facility

The Cancer Center Translational Genomics Core (TGC) Facility, directed by Jovanny Zabaleta, PhD with senior supervision by Dr. Miele, is a core resource of LSU Health Sciences Center, sponsored jointly by the Cancer Center, the Gene Therapy Program and the School of Medicine that is dedicated to supporting the research projects of investigators associated with the Cancer Center, the LSUHSC system, the Louisiana Cancer Research consortium (LCRC), and the research community in general. The Core has two very efficient Facilities: (1) The Sequencing Facility dedicated to Sanger-based sequencing requests from our investigators. In this Facility we have access to two 3130X sequencers from Applied Biosystems, which in addition to DNA sequencing, can be used for DNA fragment analysis and SNP validation by direct sequencing. This Facility is also equipped with several PCR machines, centrifuges, heat blocks and other support equipment. The Sequencing Facility is staffed by two dedicated technicians who provide detailed sample analysis and troubleshooting guidance as necessary. (2) The Illumina Facility includes a BeadStation 500 with a BeadScanner that allows the genotyping of DNA from 94 to more than 1 million SNPs from only 200ng of DNA. The format of the chips used for DNA analysis depends on the number of SNP analyzed: the Sentrix Array Matrix or SAM, allows the analysis of 48 up to 1,536 SNPs in a platform of 96 samples simultaneously. In the glass chips more than 1 million SNPs can be investigated with formats of 2 (1 million SNPs) or 4 (660 thousand SNPs) samples per chip, allowing faster results, higher coverage, and higher multiplexing, at a lower price. The DNA analysis also allows the investigation of the methylation status of 1,530 to 27,000 CpG islands distributed throughout the genome. Linkage analysis to study the association of specific markers to disease can also be done using the Linkage Panel from Illumina, using our BeadStation 500. The African American Admixture Panel is used in our platform when genetic admixture is suspected in a population or to adjust the association analyses of certain studies in one specific population. Our Illumina Core has also a BeadExpress reader which can also be used for most of the analyses described above. Our system also allows the simultaneous analysis of up to 12 samples per chip (two chips per assay) of the whole transcriptome (mRNA, more than 37,000 transcripts) and the continuously growing microRNA (miRNA, up to more than 1,300) panel, in studies aiming to determine the levels of gene expression. Our Facility has a TECAN robot to maximize

liquid handling accuracy and reduce hands-on staff time. Two separate rooms are used for the pre- and post-PCR reactions in order to reduce the possibility of contamination. Next Generation Sequencing (NGS) capabilities include a NextSeq, a MiSeq, and a Genome Analyzer 2X (GA2X) from Illumina for sequencing of DNA, RNA, miRNA/lncRNA, bisulfite modified libraries and products of chromatin immunoprecipitation (ChIP). Shakers, incubators, hybridization ovens and heat blocks are also part of the Illumina Core. A NanoDrop and an Agilent 2100 allows the accurate quantitation and the fast determination of the quality of the nucleic acids and generated libraries. The Core also has systems for real-time PCR from both Applied Biosystems and Bio-Rad which are used to confirm the results obtained with the microarray technology of the Illumina system.

Proteomics.

The LSUHSC Proteomics Core Facility, supported by The LSUHSC School of Medicine and The Louisiana Cancer Research Consortium, offers proteomic services and resources to investigators both within and outside of LSUHSC, and throughout Greater New Orleans. The facility personnel consult in the design and implementation of experiments for the advancement of investigators' projects. The main laboratory occupies ~1300 sq. ft. of laboratory space to house several advanced mass spectrometers, 2-Dimensional gel electrophoresis and 2-Dimensional Liquid Chromatography. An additional 500 sq. ft. of laboratory space is dedicated to 2-Dimensional gel electrophoresis. 2-Dimensional gel electrophoresis (2DGE) separates proteins in high resolution to survey the proteome of cells or tissues. The Proteomics Core Facility is highly experienced in protein extractions from cells and tissues for 2DGE. Currently, the new generation fluorescence-tag based 2DGE, differential gel electrophoresis (DiGE), is the choice of the Facility. DiGE eliminates gel variations by running differentially tagged control and treated samples in the same gel. The uniquely labeled protein samples are separated using an IPGphor IEF and a Dalt6 PAGE cell from GE Healthcare. Following electrophoresis, a GE 9400 Typhoon scanner image is analyzed with DeCyder image analysis software. This software provides investigators with statistically accurate and sensitive protein quantification. A GE Ettan spot handling workstation cuts and digests gel spots automatically for sequential protein identification by mass spectrometry. In addition, traditional 2-dimensional gel electrophoresis utilizing the Bio-Rad system (PDQuest software, ProteomeWorks spot cutter and GS800 scanner from Bio-Rad and MultiProbe spot handling system from Perkin-Elmer) is also offered for investigators when needed. The Proteomics Core Facility possesses two modern tandem mass spectrometers for a variety of analyses. For protein identification of 2D gel spots, the Proteomics Core Facility utilizes an ABI 4700 Proteomics Analyzer MALDI TOF-TOF mass spectrometer which offers both high throughput (40 samples per hr) and high resolution (< 100 ppm). The 4700 Proteomics Analyzer can analyze the tryptic digest samples at a low nanogram level. For the analyses requiring higher sensitivity, the Proteomics Core Facility uses a Thermo-Fisher LTQ-XL linear ion trap electrospray ionization mass spectrometer coupled with an Eksigent 2d nanoLC, which offers high picogram sensitivity. LTQ-XL LC-MS also is capable of identifying multiple proteins from 1D gel bands of immunoprecipitation samples, pull-down experiment eluates and more. LTQ-XL is equipped with versatile tandem mass analysis, such as single ion monitoring in detecting expected post-translationally modified peptides. The staff works with investigators at all levels, including experimental design, data collection, and data analysis, customizing the experiments to the needs of the investigator. Two additional classic mass spectrometers in the Facility are available to people with samples which require medium sensitivity (ca. sub-mM level). An Agilent 1100 LC-MSD is an integrated LC-MS system; it is excellent for QC and MW determination of synthetic peptides and organic compounds. This system and an ABI classic Voyager DE MALDI -TOF mass spectrometer are excellent for simple MW determinations of larger proteins/peptides. Dionex Ultimate 3000 was recently installed for developing LC-based shotgun proteomics, an alternative to 2DGE-based method. The LC-based method is complementary to the gel-based method. Standardized protocols are in development which will offer the identification of proteins in a wider molecular weight range than 2DGE. An in-house IBM 10-node parallel processor server furnishes the demanding computing speed for database searches. The Proteomics Core Facility has two powerful database search engines, SEQUEST (Thermo-Fisher) and Mascot Server (matrix Sciences, Landon, UK), to analyze data from Thermo LTQ and ABI 4700 mass spectrometers. While The Proteomics Core Facility routinely utilizes NCBI and SwissProt databases, specific customized databases can be set up upon request. In addition to protein identification searches, these programs also facilitate sequence blast, and modification determination. A programming expert in Biochemistry supports the Facility in bioinformatics in adopting open-source programs, for data validation, integration, etc.

Cellular Immunology and Immune Metabolism (CIM).

The Cellular Immunology and Immune Metabolism (CIM) Core Facility (Associated with the Stanley S. Scott Cancer Center and the Louisiana Cancer Research Consortium; Director – Dorota Wyczzechowska, Ph.D.) is a customer oriented service dedicated to supporting the research needs of the investigators of the Louisiana State University Health Sciences Center. It provides state-of-art instrumentation and expertise for addressing experimental issues related to single cells, nuclei and chromosomes. In addition to the most powerful cell sorter, the BD FACSAria, the facility owns advanced flow cytometry instrumentation, including the BD LSR II and BD FACSCalibur. The Core is able to sort human as well as animal cells under aseptic conditions at high speed with high purity and yield. BD LSR II is suitable for (not limited to) immunophenotyping, intracellular cytokine and signaling pathway study, cell cycle determination and apoptosis detection by several different ways. Additional capabilities include an Auto MACS cell sorter, a BioRad Bio-plex system, and AID Elispot reader. The auto MACS separator is a computer controlled magnetic cell sorter for isolation of virtually any cell type. There are several separation programs available allowing different cell selection strategies. Employing the MACS magnetic cell separation technology the auto MACS separator is capable of sorting more than 10 million cells per second from samples of up to 10⁹ total cells. The BioRad Bioplex system is a fully integrated system combining hardware, Bio-Plex Manager software, system validation and calibration tools, assays, and beads. The system ensures accurate and reproducible results. The AID Elispot Reader System is a combination of classic AID reader unit and the AID EliSpot software to acquire, analyze, and quantify the spots according to the user's settings. In addition to instrumentation, the Facility collaborates with the investigators and contributes to all aspects of the research process. This includes consultation in experimental design, technical assistance in the operation of instruments, trouble shooting, data analysis and storage, interpretation of results and preparation and production of presentation graphics. The Facility is also communicating with investigators in other institutions and is devoted to introducing and developing new applications on our flow cytometers. In this way, investigators are provided with unlimited possibilities to answer questions regarding nature and function of cells by flow cytometry.

EXAMPLE ELECTIVE MINI-SABBATICAL OPPORTUNITIES AT LSU

Mini-sabbaticals/Externships/Short-term Rotation Offerings

Rotation Name(Supervisor(s)/Institution)	Learning Objectives
CCTS Network Partners (example rotations)	
Special populations, human genetics, and informatics (L. Miele, MD, LSU-HSC)	1) Understand impact of social, economic & environmental factors on disease prevalence; 2) Learn culturally sensitive approaches; 3) Obtain core competencies in genetics and genomics, including assay techniques & ability to interpret genetic results

PENNINGTON BIOMEDICAL RESEARCH CENTER (PBRC)

The Pennington Biomedical Research Center (Pennington Biomedical) is a 234 acre campus located in Baton Rouge, Louisiana containing more than 570,000 square feet (ft²) of building space dedicated to research and education in nutrition and preventive medicine. This total square footage houses basic research, comparative biology, clinical research, population science, education, and administration.

INSTITUTIONAL RESEARCH ENVIRONMENT & EXPERTISE IN CLINICAL AND TRANSLATIONAL SCIENCE

Outpatient Clinical Research Facility

The outpatient-based clinical research facility of PBRC is located in Clinical Research Building No. 1, a four-story, 90,000 GSF building dedicated to the support of clinical trials led by PBRC faculty. The unit is designed for easy access and convenience of research volunteers, including covered drive-up entry and spacious free parking. Accommodations for on-site dining and convenient take-out food service and a food delivery service facilitate feeding studies. The Outpatient Clinical Research Facility includes:

- 18 general examination rooms, 2 EKG procedure rooms, one room equipped for determination of height, weight and anthropometrics, 3 private interview rooms and a secured pharmacy storage room. This space also supports blood draws, with 6 phlebotomy chairs with 4 connecting specimen collection facilities.
- The medical records library houses 3 offices and a secured storage space for medical records.
- The clinical unit also contains administrative office space, reception and waiting areas, 6 recruiting offices and 3 offices for physician personnel.
- An Imaging Core Laboratory with DXA instrumentation, an ECHO MRI and Ultrasound testing rooms is also located on the ground floor. In the Imaging Laboratory there is also office space for 2 technicians. This Core is complemented by a 30,000 SF Imaging Center that accommodates Magnetic Resonance Imaging, x-ray and other imaging equipment as well as faculty offices and support space.
- In addition, an exercise lab for conducting ECG monitored maximal exercise testing (i.e. VO₂ Max) is found on the ground floor. The exercise lab has men's and women's locker rooms and facilities.
- A psychology behavioral area that accommodates 5 eating monitors and offices for the personnel. Since the second floor connects directly to first and second floors of Clinical Research Building No. 2 at the Research Kitchen area, all participants eating and undergoing monitored eating are conducted adjacent to the Research Kitchen. There is a participant dining area located on the 2nd floor which accommodates approximately 30 people.

Outpatient Pediatric Research Unit

The outpatient pediatric research unit includes exam and treatment areas, procedure rooms, a metabolic cart room, meeting room and demo kitchen, indoor play and observation area, outdoor play area, exercise room, medical records storage for pediatric charts only, lab and phlebotomy area, administrative and other office support. The pediatric research area is 14,150 square feet.

TRANSLATIONAL RESEARCH INFRASTRUCTURE

Clinical Trials Unit (CTU)

The Clinical Trials Unit is overseen by Chief Medical Officer is Frank Greenway, M.D. and the Medical Director is Kishore Gadde, M.D. The unit is staffed with an additional medical doctor, physician's assistant, nurse practitioner, registered nurses, licensed practical nurses, registered dietitians, project managers and study coordinators. The unit is responsible for the oversight and coordination of all clinical trials performed at the center for both adult and pediatric studies.

CTU Outpatient Clinic

The outpatient clinic of the Clinical Trials Unit is open Monday through Friday from 7:00 am until 4:30 pm. The Outpatient Unit provides the following services but is not limited to: screening of potential study participants, completion of protocol specific clinic visits, regulatory oversight for all studies, study specific coordinators and back-up coordinators, dispensing of study medications, completion of case report forms and quality assurance of source documentation. The unit is comprised of the general examination rooms, interview rooms, phlebotomy area and pharmacy previously mentioned.

CTU Inpatient Clinic

The inpatient clinic of the Clinical Trials Unit is open seven days a week including holidays, with the exception of the Christmas break. The inpatient clinic provides the following services but is not limited to: euglycemic clamps, oral glucose tolerance tests, lumbar punctures, frequently sampled insulin glucose testing, meal tolerance testing, feeding studies, pharmacokinetic testing (including phase I-IV medication trials), muscle and fat biopsies, and overnight stays. The unit is able to perform extended inpatient testing as necessary. All licensed medical personnel are BLS certified, with MD, NP and PA staff also ACLS certified. The unit has ten inpatient rooms (twenty subject capacity), three euglycemic clamp rooms, a large procedure room, biopsy room, satellite pharmacy, blood specimen processing room, and functional nurses' station equipped with a telemetry system. The procedure statistics by year are listed above.

CTU Interventional Resources Department

The interventional resources department of the Clinical Trials Unit provides services seven days a week as required by the specific research study. This department is responsible for conducting orientations, run-ins, randomization assignments, and setting-up and conducting physical activity interventions in Intervention based studies within the Unit. This work is performed both on the campus of Pennington Biomedical Research Center and offsite in community-based settings.

Recruiting Core

Recruitment services for clinical trials and other human research studies conducted at PBRC are coordinated by the Recruitment Core. The Recruitment Core manages all community outreach and recruitment services for human research studies at PBRC, such as screening all incoming calls to determine study eligibility; assisting in partnership development, specifically with local community groups, physicians, and healthcare facilities; and serving as the first line of contact for all human research study participation. Incoming calls are directed to a call center that is operated by 3 full time recruiters and is equipped with a Uniform Call Distributor (UCD) system. A UCD system expands the capability of a traditional phone system and allows multiple individuals to call simultaneously and be directed to the next available recruiter. The core utilizes an electronic message tracking application that tracks the outgoing phone call activity and a "smart" electronic phone screen system that screens potential participants upon initial phone contact and seamlessly matches them to alternative studies when deemed ineligible for the original study that the participant called. The Core also supports a web-screener for participants to be able to go online, choose a study that are interested in and complete a preliminary screening. The system is able to tell the participant upon completion whether they are eligible at that point in the screening process and if they are ineligible the screener will alert them to other studies that they be eligible for and at that point could continue to screen for those studies. If the participant is eligible they are then contacted by a live recruiter to complete the screening process and schedule their first screening appointment if they are eligible. The Core's web-screener supports over 5000 total queries annually.

Communications and Marketing

For the purposes of clinical trial recruitment and marketing, the communications office works in tandem with the recruiting core and provides for the design and development of all marketing collateral materials for clinical research studies. The department secures and places paid advertisements for clinical trials, based upon study budgets and regulatory guidelines, and aligned with central marketing strategies. The department also utilizes strategic e-mail campaigns to aid the recruiting department in targeting the 24,000+ subscribers who have requested regular information and updates regarding clinical trials and research at Pennington Biomedical.

Biostatistics and Analysis Capabilities

The Pennington Center Biostatistics Core is headed by William Johnson, Ph.D. and resides in the Population Science research program at PBRC. The Core is staffed by two additional Ph.D. and three master level

biostatisticians. Together, this team serves the research design and analysis needs for 85 faculty members at PBRC. The Core is housed in the Clinical Research Building and there are spacious offices for faculty and adjacent cubicles for support personnel. The Core is equipped with Pentium computers and the E-mail and data transfer needs are supported by the PBRC Technology Services Group. The standard software used for statistical analysis is the most recent version of SAS, presently Version 9.4. Other software, such as spreadsheets and word processing packages, are used routinely. All computers used by statisticians are connected with the HP 990Cse color printer.

The Biostatistics Core seeks collaborations that lead to a smooth transition from hypothesis formulation to efficient research study design and execution through quality-controlled data management, statistical analysis and summary presentations. Our overarching goal is to create electronic datasets that accurately describe research outcomes and provide state-of-the-art statistical techniques for the objective interpretation of research findings that are captured in the observed data.

Data Management Core

The data management core team is comprised of 5 full time employees with approximately 60 years combined experience working with Pennington Biomedical Research Center clinical trials. The data management team serves as a comprehensive clinical data coordinating facility. Their primary responsibility is maintaining the clinical research database and bespoke applications that interface with that database. The team works with researchers to ensure the efficient and accurate transfer of data from observation to electronic files for storage and analysis; monitors the data processing throughout each study's duration; and provides investigators with study specific data sets via web-based desktop data access. The team has developed custom applications for expedited creation of study specific data sets that may contain both PBRC data and Non-PBRC data. This development and data storage paradigm allows the team to work with both intramural and extramural researchers. In addition to supporting and maintaining custom applications, the core administers a local install of REDCap (Research Electronic Data Capture). REDCap is a secured web-based application created at Vanderbilt University. REDCap development and support services are also provided by the core. Guidelines for Good Clinical Practices as they relate to data handling have been documented and implemented in daily tasks. The group maintains current HIPAA Security Rule training and works closely with the Director of Intellectual Property, Legal and Regulatory Affairs. Programmers are provided with the latest software and hardware which allow them to perform their work efficiently.

Clinical Chemistry Core Laboratory

The laboratory also participates in the lipid standardization program offered by the Centers for Disease Control and operated within the guidelines of Good Clinical Practices. The Clinical Chemistry Core Laboratory performs analyses for PBRC clinical trials, for basic researchers at the Center, for the US Army Institute of Environmental Medicine (USARIEM), and for other contracting clients and is staffed by licensed medical technologists, licensed phlebotomists, and research project assistants. Department within the Clinical Chemistry Core include Phlebotomy, Accessioning, Chemistry, Hematology, Urinalysis, Special Chemistry (RIA, HPLC, Immunochemistry, Automated Immunochemistry) and Point-of-Care Testing. The laboratory currently offers more than 350 different assays and is well-equipped to perform both routine and specialized testing, including the development of new methodologies when required.

Mass Spectrometry Core

Energy Expenditure/Body Composition

This section focuses on the measurement of energy expenditure using the doubly labeled water technique. Additionally, measurements of total body water are performed using either deuterium or oxygen 18. This section has five Finnigan isotope ratio mass spectrometers (a Delta S, a Delta XP, two Delta Vs and a MAT 252). The laboratory also has automated sample preparation devices interfaced to the mass spectrometers. Three gas benches are used for ^{18}O sample preparation and five H devices are used for the sample preparation of deuterium (^2H). With these instruments, we can accurately and precisely measure the amount of heavy isotopes, such as ^{18}O and deuterium, in relation to the common isotopes, ^{16}O and ^1H , for the measurement of energy expenditure in studies of obesity. The instruments are also used to measure ^{18}O and deuterium as measures of total body water. The Delta XP is also used for analysis of ^{13}C in breath samples as a marker of gastric motility.

Metabolism

This section focuses on the measurement of stable isotopes that are used to examine lipid, protein, and carbohydrate metabolism. This section has three gas chromatograph/mass spectrometers (Agilent 6890 GC/5975 MS, Agilent 6890 GC/ 5975b MS and an Agilent 7890GC/5975c MS). All three mass spectrometers have EI and CI capabilities, and positive or negative ion monitoring, for measurement of any stable isotope labeled (e.g. ^2H , ^{15}N , ^{13}C) organic compound. This equipment is used to examine cholesterol metabolism in studies of cardiovascular disease, and glucose, amino acid and fatty acid metabolism in studies of obesity and diabetes.

Nutritional Epidemiology, Dietary Assessment and Counseling Core

The Nutritional Epidemiology Diet Assessment and Counseling Core serves two main needs at the Pennington Center: 1) processing of dietary data collected via food frequency questionnaires, 24-hour dietary recalls, or food records and 2) delivery of lifestyle interventions which follow defined protocols via single site or multi-center trials.

Moore Extended Nutrient Database (MENU v6.0)

The Moore Extended Nutrient Database (MENU) is overseen by Catherine Champagne and guides the development of menus and recipes for multi-center feeding trials as well as school lunches in Louisiana. The primary datasets used by MENU are from USDA and other sources. To complement MENU 6, studies may also use the Food Diary Program, which utilizes the MENU 6 Food Composition Files to analyze dietary intakes of individuals in research studies.

Food Intake Questionnaires

Food Frequency Questionnaires (Block FFQ)

Pennington Biomedical Research Center uses the Food Frequency Questionnaire (Block FFQ) to collect information about an individual's eating habits over a 12-month period (or modified to a specific study timeframe). The FFQ contains approximately 105 items grouped by categories and is completed for both frequency of consumption as well as portion size selections by the individual. This is a scannable questionnaire with coding and file locations of the variables set by the DIETSYS technical support staff of the National Cancer Institute in conjunction with National Computer Systems, Inc (NCS) personnel.

USDA Automated Multiple Pass Method

PBRC dietary assessment personnel have been trained by USDA in the use of the Automated Multiple Pass Method (AMPM), a computerized method for collecting interviewer-administered 24-hour dietary recalls either in person or by telephone. It is a research-based, multiple-pass approach employing 5 steps designed to enhance complete and accurate food recall and reduce respondent burden.

NCI Diet History Questionnaire (DHQ II)

DHQ II is the current version of the questionnaire distributed by the NCI. PBRC has developed an online version of this questionnaire and with the Diet*Calc software developed by NCI can analyze files to interpret the DHQ data to provide nutrient and food group estimates.

Dietary Counseling Activities

For those studies in which subjects are asked to follow structured meal plans or exchange options in order to adhere to the dietary targets, PBRC supports dietary counseling. Research dietitians/interventionists play a key role in working with these participants by conducting both group and individual sessions utilizing nutrition information and behavior change messages. The dietary counseling activities can be extensive and the interventionists involved have a breadth of experience in dietary interventions which include lifestyle/behavioral change. These interventionists have received significant training in motivational interviewing and theories of behavioral change and can support both face-to-face and virtual discussion formats.

Ingestive Behavior Laboratory

The Ingestive Behavior Laboratory (IBL) specializes in the assessment of energy intake and has developed and validated methodology for use in free-living conditions and controlled laboratory settings. The IBL includes three separate eating rooms that are each equipped with Universal Eating Monitors (Kissileff, Klingsberg, &

Van Itallie, 1980) that allow analyses of cumulative food intake throughout the course of the meal, and each of the eating rooms includes a desktop computer that participants use to rate their subjective levels of appetite with VAS. The Laboratory also includes a monitoring room that houses desktop computers and closed-circuit video equipment to record food intake behavior in the adjacent eating rooms. Lastly, the laboratory includes a taste testing area and prep area, which allows food intake to be quantified by weighing food before and after participants' meals.

The laboratory also developed and validated a Smartphone-based approach called the Remote Food Photography Method and SmartIntake smartphone app, which accurately measures energy and nutrient intake in near real-time in participants' natural environment. The SmartIntake app allows users to enter Price Look-Up (PLU) codes of produce, scan barcodes on food packages, and record voice or send text descriptions of foods images captured. These data are packaged together with the food images, sent to IBL staff in real-time, and are used by IBL registered dietitians to quantify energy and nutrient intake.

Psychological Assessment Laboratory

The Psychological Assessment Laboratory (PAL) is responsible for data collection and data management of psychological and behavioral questionnaires. The PAL creates and prints paper questionnaire packets, scans and scores completed questionnaires, manages scoring algorithms of questionnaires, and imports data to a database. The PAL works in conjunction with Computing Services to set up scoring algorithms and ensure the proper upload of data.

Metabolic Kitchen and Food Preparation

The PBRC metabolic kitchen is located above the Outpatient Clinical Research Facility and has 2,622 SF of working space. The kitchen area is divided into four fully-equipped individual kitchen areas, ideal for simultaneously conducting various protocols. Each individual kitchen area is equipped with a refrigerator, freezer, microwave, cook-top, one-quart blender, toaster, and electronic balances. The 440 SF large quantity food preparation area contains state of the art convection ovens, steam ovens and kettle, bake ovens and cook-tops, microwave, food warmers, food chopper, slicer, food processor, one-gallon blender, and a large capacity electronic balance. There is a tray service area, a dish room, and approximately 800 SF for receiving and storage including dry storage, a walk-in refrigerator, and a walk-in freezer. Located just outside of the Research Kitchen is the participant dining space. This includes a reception desk where meal trays can be requested by phone or buzzer. Meals that are taken for later consumption are stored in the refrigerator/freezer room. An additional food storage area with space for dry storage, refrigeration and freezer storage is located adjacent to the service road. Approximately 225 meals per day can be prepared in the facility. Study participants consume their meals in the 850 SF dining area, and meals may be provided for take-out.

Energy Metabolism Core Laboratory

The energy metabolism core consists of four Respiration Chambers (whole-room indirect calorimeters) for the assessment of 12 and 24 hour energy expenditure and substrate oxidation, and nine portable ventilated hood systems (7 MaxII, AEI Technologies, Naperville, IL; 3 Deltatrac Metabolic Monitors, Datex-Ohmeda) for the assessment of resting energy expenditure and substrate oxidation and the thermic effect of feeding. The respiration chambers are located in the inpatient area of Clinical Research Building No. 2. Three of the chambers measure approximately 12' x 10' with 8' ceilings corresponding to a total volume of about 27000 L. The fourth chamber is approximately 7' x 9' for a total volume of about 16000 L (including sealed ductwork). Each chamber is provided with furnishings and equipment necessary to perform metabolic studies on research volunteers over extended time periods in a precisely controlled environment. The three large chambers are comfortable enough for individuals to live for periods up to one week. They are equipped with a bed, chair, desk, toilet, sink, refrigerator, TV, VCR/DVD, computer with internet access, treadmill, and motion sensors. The smaller chamber is equipped with a treadmill, roll away bed, chair, and is used for short term energy expenditure testing. The respiration chambers and the ventilated hood systems utilize air that is drawn through the unit at a known flow rate. The oxygen and carbon dioxide concentrations of incoming and outgoing air are measured for the calculation of oxygen consumption and carbon dioxide production from which energy expenditure is calculated from the Weir equation. If nitrogen excretion in urine is also measured, substrate oxidation rate can be calculated as well.

Imaging Core

The Imaging Core is designed to provide in vivo measurements of anatomy, biochemistry, metabolism, and tissue function for clinical research. Key Imaging Core instruments include two 3T MRI machines (a 70cm-bore GE Discovery 750 and 60cm-bore GE Signa HDxT), two DXA instruments (GE Lunar iDXA and Hologic Discovery), two ECHO MRI [ultra-low field strength NMR] instruments (one designed for adults and one designed for infants), BodPod and PeaPod systems by Cosmed, two ultrasound devices (Toshiba Aplio SSA-770 and GE LogiqE9), and a GE diagnostic X-Ray system. Researchers also have access to a 64-slice CT scanner and PET scanners through collaborative agreements with Baton Rouge General Hospital– Bluebonnet campus and the Mary Bird Perkins Cancer Center.

Both MRI systems have full multinuclear spectroscopy capabilities (31P, 13C with proton decoupler, and 1H RF and a proton decoupler). A spectrum of coils is available for spectroscopy (4cm, 6cm, and 8 cm singly and doubly tuned 31P transmit/receive), as well as standard pulse sequences. Spectroscopy analysis software (jMRUI) is installed on workstations in the scanner suites.

An array of coils is also available on both systems for volumetric imaging including head, head-neck, body, spine, and knee coils. A 32-channel phased array head coil is also available on the Discovery system for brain applications. A set of volumetric imaging sequences are available for body composition including the IDEAL-IQ water-fat sequence on the Discovery and LAVA on both systems. The increased bore size (70 cm) of the Discovery system and the resulting increased field of view (50cm x 50cm x 50cm) allows the Core to accommodate larger subjects for all scan types. Standard T1-, T2-, T2*-, perfusion-, and diffusion-weighted sequences are available for brain applications. Specific state of the art sequences of interest include high-angular-resolution diffusion imaging (HARDI), echo planar imaging with blood oxygenation level dependent contrast (EPI-BOLD), partial continuous arterial spin labeling (PCASL) for perfusion imaging, and fluid attenuated inversion recovery (FLAIR). Visual and audio stimulus presentation hardware and software are available for fMRI studies. Image analysis software includes Analyze (Analyze Direct), a suite of structural brain imaging tools originally developed in the IDEA Lab at UC Davis, and SPM and FSL for structural and functional MRI analysis.

The Biomedical Imaging Center includes two subject waiting rooms, two subject dressing rooms, and two subject preparation rooms. The Center also contains office space for researchers and administrative staff, reception and waiting areas, three registration desks, two conference rooms, a large medical records storage room, computer and data closets, and an open-plan meeting and social area. Core personnel currently includes 3 licensed radiological technologists (an MR technologist, a CT technologist, and a DXA technologist), an ultrasound technologist, and a biomedical engineer and core manager (M.S.). Each of these individuals are cross-trained to perform analyses of MRI data; ultrasound data analyses are performed in-house by the ultrasound technologist as well. Baton Rouge Radiology Group serves as a consultant for interpretation of scans as needed. Analyzed data is entered into a centralized database where it is fused with other participant records such analyzed on-site and is directly transferred to the Pennington Biomedical Research Center database.

Exercise Testing Core

The Exercise Testing Core is equipped to perform electrocardiogram (ECG) monitored sub-maximal and maximal cardiovascular exercise performance testing and musculoskeletal strength and endurance assessments. The Core includes two Parvomedics True One™ metabolic carts for the performance of metabolic testing (i.e. VO₂), two Trackmaster treadmills TMX425C and a Lode Excalibur Sport™ bicycle ergometer. The Lode Excalibur Sport ergometer is capable of singular wattage increments ranging from 0-1000 W. The Core has 2 ECG machines including a Quinton Q-Stress and wireless Mortara X-Scribe system. The Core also includes a System 4 Biodex™ isokinetic strength dynamometer to perform constant velocity muscular strength and endurance testing. The Biodex system interfaces with computer microprocessors to measure torque, power, and endurance for resistance throughout a joint's range of motion (ROM) of most musculoskeletal joint areas. Resistance is provided using a servo-controlled mechanism and a user-defined constant velocity.

PBRC Pharmacy Operations

When a study medication arrives at the Center, the shipment is verified by the pharmacist and all records are kept according to each specific study protocol. If a study medication arrives in bulk form, the pharmacist is responsible for counting and labels the medication in the study-appropriate fashion before it is dispensed to study subjects. An accountability form is completed when a study medication is packaged to keep a record of which subjects received placebo or active. This form records the amount of medication remaining in the pharmacy as well as expiration dates. Accurate accounting for the dispensing of a study drug is maintained by the pharmacist. When a drug leaves the pharmacy for dispensing to a subject, the study coordinator is required to complete a dispensing log. This record requires documentation of: the subject identification number, subject initials, coordinator who dispensed, number of bottles/tablets dispensed, date dispensed and if applicable the amount of drug returned. When study medication is ready for distribution, it will be transported by the pharmacist to the locked pharmacy storage area.

EXAMPLE ELECTIVE MINI-SABBATICAL OPPORTUNITIES AT PENNINGTON

Mini-sabbaticals/Externships/Short-term Rotation Offerings

Rotation Name(Supervisor(s)/Institution)	Learning Objectives
CCTS Network Partners (example rotations)	
Molecular and clinical nutrition II (Casie Lindsly, PhD, Pennington)	1) Explore interactions between basic & clinical sciences in nutrient effects; 2) Outline appropriate experimental approaches for design of molecular research studies; 3) Understand gene/environment interactions in maintenance of health/development of disease

Drug Discovery Division (DDS)

DDS laboratories and offices are primarily located on SR's main campus in Birmingham, AL, which includes more than 450,000ft² of office and laboratory space. The DDS is home to scientists working in a variety of fields including Biological Sciences (Oncology, Infectious Diseases, Neuroscience, Chemistry, and High-Throughput Screening (HTS)). A number of core facilities are available for use by the faculty, including biosafety level (BSL) -1, -2 and -3 laboratories. A campus diagram (Above) illustrates the buildings, which are located within close proximity to allow ease of communication between various disciplines, departments and staff.

DDS Infectious Diseases

The Infectious Diseases Department maintains advanced, well-established research programs focused on seeking effective antiviral and antibacterial drugs and vaccines, in addition to elucidating novel disease-causing mechanisms for a diverse array of microbial pathogens. The Department is dedicated to identifying novel mechanisms, druggable targets, and strategies for prevention and treatment of both bacterial and viral infectious diseases throughout the world. The bacteriology program is focused on the study of the molecular pathogenesis of relevant fastidious, emerging, re-emerging, and multidrug-resistant bacteria to develop new treatments using novel approaches. The virology program focuses on viruses of global health significance, including Influenza, Ebola, and Flaviviruses such as Zika, concentrating on several critical areas including viral pathogenesis at the cellular and molecular levels, target identification and development of novel target-based assays, discovery of small molecule antivirals, and development of contemporary vaccines.

The Infectious Diseases Department is located on the main SR campus and houses several fully-equipped research laboratories for molecular and cellular biology, each approximating 800-1500ft². Research is performed in the laboratories of the contiguous Frueauff (F), Daniels (D), and Kettering-Meyer I (KMI) buildings on the 4th and 5th floors. These laboratories are designated as BSL-2, and include separate rooms for virology, bacteriology, molecular biology/biochemistry work, tissue culture, and cellular imaging. Separate tissue culture rooms with biological safety cabinets, environmental rooms, dark rooms, a walk-in cold room (250ft²), and dishwashing and autoclave facilities are located in close proximity. In addition, there is a modern, state-of-the-art A/BSL-3 facility available to the Department located on the 3rd Floor of the Daniels Building, which is capable of select agent handling for CDC-designated Tier 1 BSL-3 level containment research.

DDS Oncology

The Oncology Department has been internationally recognized for its cancer research and oncology drug discovery since its inception in 1946. Continuously funded by the NIH and other federal and private organizations, the Department has experienced long-standing success in anticancer drug discovery, boasting discovery of seven FDA-approved anticancer drugs: lomustine, carmustine, dacarbazine, fludarabine, clofarabine, pralatrexate, and amifostine (a cytoprotective agent), with additional anticancer drugs advancing to clinical trials. Over the last two decades, the Oncology Department has received more than \$90 million in NIH funding, surrounding broad research interests in tumor cell biology, mechanism of action of chemotherapeutic drugs, and development of molecular-targeted therapeutics. Faculty of the Department are actively involved in research programs in the National Cancer Institute (NCI)-designated Comprehensive Cancer Center at the UAB, and serve as adjunct faculty at the UAB School of Medicine. Since its establishment in 2009 as the discovery engine for the NCI Experimental Therapeutics Program (NExT), the Cancer Program at SR has been designated by the NCI as a Chemical Biology Consortium (CBC) Center, serving to accelerate the discovery and development of new cancer therapeutics.

The Oncology Department is comprised of independent investigators, headed by the Chair who oversees the grant-based cancer research program focusing on cancer biology and oncology drug discovery. The Department is located on the main SR campus, and houses a total of approximately 7,000ft² of fully-equipped laboratory space dedicated to individual investigator's research agenda. Research is performed in the laboratories of the contiguous Frueauff (F) and Daniel (D) buildings on the 4th and 5th floors. Each of the five independent labs has all necessary instrumentation for molecular and cellular biology, and translational research, including all basic molecular biology and biochemical methods.

DDS Neuroscience

The Neuroscience Department is a collaborative locus of diversified scientific expertise, devoted to discovering effective central nervous system therapies to prevent, treat, or cure neurological diseases and mental health disorders. Investigators within the Department and the related Departments of Oncology, and Infectious Disease and Chemistry Core are exploring the underlying mechanisms of neuronal cell death and dysfunction in Parkinson Disease, Huntington Disease, Alzheimer's Disease, Amyotrophic Lateral Sclerosis, schizophrenia, and pain. Researchers within the Department and across the Division collaborate extensively with investigators from UAB (within walking distance) and are involved in mentoring graduate and undergraduate trainees. Furthermore, Neuroscience Department faculty are actively involved in neuroscience-related drug development projects managed by the Alabama Drug Discovery Alliance, a program specifically designed to leverage the unique expertise of SR and UAB faculty to develop successful small molecule-based treatments for disease.

The overarching missions of investigators in the Neuroscience Department are:

- To maintain nationally competitive research programs in the mechanisms of neurodegeneration and neuropsychiatric illness
- To work together to conceptualize novel approaches and drug targets for neurological and psychiatric disease
- To work with intramural and extramural collaborators to promote advancement of novel drug discovery and development efforts

DDS Chemistry Department

The Chemistry Department within SR's Drug Discovery Division houses a team of chemists with extensive experience in both medicinal chemistry and synthetic organic chemistry. Comprised of a director, three senior investigators, one senior computational investigator, one senior bioanalytical investigator, one structural biology investigator, twelve bench chemists, five post-doctoral fellows, and two associates, current research and drug discovery programs within the Department cover a large range of various disease areas including cancer, antivirals and emerging pathogens, Parkinson's and Alzheimer's disease, amyotrophic lateral (ALS), diabetes, and neurologic disorders. One of the Chemistry Department's main goals is to identify and bring forth compounds that can be classified as potential preclinical candidates and then collaborate with partners to advance these compounds into human clinical trials. Additionally, compounds are used as tools to investigate novel targets. Several existing collaborative relationships exist between the Department and external partners, such as universities, research centers, and the NIH. The Department encompasses various disciplines in addition to synthetic chemistry, including structural biology and protein crystallography, computational chemistry, bioanalytical, high-throughput synthesis and purification capabilities, as well as informatics tools to process and track data. Synthetic chemistry is performed in laboratories of three contiguous buildings, Kettering-Meyer I (KM-I), KM-II, and Daniel Laboratories which are within close walking distance to the Bioanalytical Drug Discovery (BDD) Laboratory (in the Ingalls Central Building) on SR Campus. The Department houses 18 fully-equipped chemistry laboratories, as well as one laboratory for microwave-assisted synthesis, one laboratory for parallel synthesis, one laboratory for a walkup LC-MS, and one laboratory for a walkup NMR. There is also a six-man Preparative Scale Synthesis Laboratory (Prep Lab) that contains specialized scale-up apparatus (up to several kilograms) for the production of intermediates and final target compounds, several networked 3D molecular graphics facilities with state-of-the-art molecular modeling hardware and software, informatics software, a protein X-ray Crystallography Laboratory and associated crystallographic software and workstations, several protein crystallization laboratories, two walk-in cold rooms, a notebook/records archive, three Repository laboratories for long-term sample storage, and a glassware washing laboratory. In addition, there are sufficient offices proximate to the laboratory space to accommodate all senior staff, other offices dedicated to specialized project uses, general conference and meeting rooms, and ample storage space. Other units of the Drug Discovery Division (e.g., the Biochemistry and Molecular Biology Department) have facilities reciprocally available to the Chemistry Department as needed. As an aggregate, SR has superb facilities for the design, synthesis, isolation, purification, identification, characterization, scale-up, modeling, and assay of synthetic compounds.

DDS High-Throughput Screening Department

There is access to a state-of-the art HTS Center, equipped with advanced robotic equipment and served with expertise of a well-trained staff. The HTS Center maintains a collection of over one million compounds and has the capacity to run a wide variety of assay types, including cell-based and biochemical assays, and to perform assay reformatting on fully automated robotic platforms, with capacity to screen up to 100,000 samples per day. The research team is also experienced in running yeast-based assays, as well as assays that require BSL-2 or BSL-3 containment. The Department incorporates scientists who perform secondary assays to support and drive lead generation efforts arising from HTS hits.

Various facilities and laboratories comprise the HTS Core. The Central HTS Facility consists of a suite of three rooms operating at the BSL-2 level, located in the Kettering-Meyers (KM) II Building, Floor 6. The Yeast and Bacterial Facility is a 325ft² laboratory designated for yeast and bacterial culture that is available for yeast and bacterial assays. This lab is located across the hall from the main HTS Facility and is the main laboratory (KMII 603A) for BSL-1 and -2 yeast and bacterial assays from the development stage through HTS screening campaigns. Separate facilities, located in the same building complex, that support the HTS lab include, storage space for management of materials and supplies, a separate compound handling facility, and a compound storage facility. The Compound Preparation Laboratory, located in the Daniels Building, Sixth Floor (Room 603), houses equipment to facilitate plate handling for compound prep. The Compound Storage Facility, located in the Frueauff Building, Floor 2 (Rooms 209 & 211) is designed specifically to house -80°C freezers. It comprises two rooms totaling 775ft². The facility currently maintains a collection of nearly one million compounds. Freezers are monitored 24 hours per day, 7 days per week by SR Security through the Edstrom Watchdog system. Any freezer alarm is reported immediately to the HTS staff. This ensures that the integrity of compound libraries will not be adversely affected by freezer failures. The Supply Storage Facility serves to manage the volume of materials and supplies required for an HTS facility to operate efficiently. This facility is a 616ft² storeroom located in the same building complex. Commonly used supplies are maintained in quantities required for three-to-six weeks of operation. This is done to avoid scheduling disruptions associated with backordered supplies from manufacturers. Just-in-time inventory management is not practical for an HTS operation and supply interruptions can be costly during a screening campaign. Sufficient inventory of all supplies are ordered and received before a screening campaign has begun to prevent disruption. This storage space provides room to manage HTS materials and supplies effectively without using or cluttering the automation lab space. The HTS Informatics group provides housing, maintenance and security for the HTS Center's primary file, Oracle database, and emergency backup servers. Critical systems are replicated to a disaster recovery site located in Huntsville, AL.

Computer-Based Information Technology and Data Management System

Briefly, the research efforts and administrative operations at SR are supported by a diverse platform of advanced computer resources. This computing infrastructure provides significant flexibility for responding to research needs in a timely, cost effective manner.

IT Infrastructure

SR's network consists primarily of Microsoft Windows servers and workstations that are members of our main campus Microsoft native mode Active Directory Domain. The system supports over 500 personal computers and client workstations connected to the SR local and wide-area networks. SR utilizes a combination of both virtual and physical servers. The virtual environment consists of VMware ESX Servers that use EMC Storage Systems for disk storage. These virtual and physical servers provide application, file, print, data, and e-mail services.

Servers located on the main campus are housed in a compliant computer room equipped with motion detectors and a Clean Agent fire suppression system. All servers are connected to 20-minute UPS equipment. In addition, auxiliary power is provided by a permanent natural gas powered generator with automatic switch-over. Access to the computer area is strictly limited to authorized personnel by key-card access. Similarly, Frederick servers are housed in secure, complaint computer rooms equipped with a fire suppression system and backup.

Information security is established through a wide variety of both operational (policy driven) and physical features. The core network consists primarily of Cisco Adaptive Security Appliances, Cisco Routers and Cisco Switches that provide redundant firewall support, intranet, internet, remote access, and VPN services to our local staff and to several off-site locations. Additionally, we employ an Intrusion Detection System (IDS) that continuously monitors and alerts the appropriate staff of any possible threats. All ingress and egress e-mail is filtered through an e-mail spam and virus firewall. Workstations have antivirus protection and eradication software installed and they are continuously updated through a managed definition server. We utilize RSA token based two factor authentication for gaining access to network resources. Core IT policies include the prohibition of access to personal computers and files without express managerial consent, requirement for users to change their network passwords quarterly, not reusing the previous 24 passwords, to lock/log-off their workstation when leaving the area/premises and workstations automatically lock after 15 minutes of inactivity.

All electronic and information technology (EIT) products and services developed, acquired, maintained, or used under this contract will comply with the "Electronic and Information Technology Accessibility Provisions" set forth by the Architectural and Transportation Barriers Compliance Board in 36 CFR part 1194, pursuant to Section 508 of the Rehabilitation Act of 1973 (29 U.S.C. 794d), as amended by the Workforce Investment Act of 1998. We will provide a written Section 508 conformance certification as required. We will comply with all provisions of the Security Requirements for Federal Information Technology Resources (January 2010). All security deliverables will be submitted within the specified timeframe.

Data Management

Good documentation practices are key to GLP compliance and the ability to reconstruct studies. The documentation practices of SR are detailed in a general record keeping practices SOP for manually recorded entries and within system-specific SOPs for automated data collection systems. Quality control of data is accomplished through adherence to SR's SOPs for recording, reviewing, and correcting raw data. Manually recorded data are recorded in indelible blue or black ink at the time of the observation and are initialed or signed and dated on the date of entry by the individual responsible for the entry.

For automated data collection, the individual responsible for direct data input is identified at the time of input. Any changes to original entries must be made in a manner not to obscure the original entry (i.e., a single line through), shall indicate a reason for the change, and shall be initialed and dated by the individual making the change. In addition to being verified by the technician who collects the data, all data entries go through a series of reviews that may include a second technician, the department supervisor/manager, the appropriate scientist, and/or the study director. All data are reviewed at various stages for completeness, accuracy, clarity, and compliance with SOPs. An additional quality control step is performed when raw data are entered into tabular format for report generation. The Quality Assurance Unit (QAU) reviews study records to assure that all data entries are original recordings, attributable, legible, contemporaneous, and accurate.

Laboratory Systems

The Provantis® application (Version 8; Instem Life Sciences Systems, Ltd.; Staffordshire, United Kingdom) will be used for the direct on-line capture of most in-life data. In addition, Provantis will interface with the clinical chemistry, hematology, coagulation, and urine chemistry analyzers. Environmental monitoring of animal rooms (i.e., temperature/humidity and light/dark cycles) will be performed using the Edstrom Watchdog system (Version 5; Edstrom Industries, Inc.; Waterford, WI). The remainder of the data will be collected manually or by the appropriate automated system. The Provantis® system is 21 CFR Part 11 compliant allowing for real-time capture of data, electronic signature of recorder, and audit trails for data corrections. Provantis® data can be exported into Excel for transfer to other systems if required; reports can be saved as text or Microsoft Word files. Study directors have immediate access to the data and review it on a routine basis.

EQUIPMENT

Core equipment available across the Division includes an IntelliCyte iQue screener PLUS flow cytometer equipped with 3 lasers (405, 488 and 561nm) that can detect up to 13 fluorescent parameters, Nikon A1 confocal microscope with image acquisition and analysis software (Harmony, Velocity and Columbus), Thermoscientific Nanodrop 2000 spectrophotometer for RNA quantitation and quality control, HPLC and FPLC systems, Beckman RC2B high speed centrifuge with SS34, GSA and HB-4 rotors, Illumina MiSeq Sequencing System (to be upgraded to a NextSeq 500 instrument in 2017), GE ImageQuant gel documentation system,

Operetta high-content imaging system (Perkin-Elmer), two Evos epifluorescence microscopes with 4-color digital image acquisition capability, and an Octet RED96 System.

In addition to miscellaneous small equipment, larger and/or specialized equipment includes: multiple class II A/B biological safety cabinets, Milli-Q water purification system, gradient and non-gradient PCR thermocyclers, BioRad IQ5 RT PCR system, PCR clean room, sonic dismembrator, Qiagen TissueLyser-LT, Leica DMLB Epifluorescence microscope, Nikon SMZ800N Stereomicroscope, laser capture microdissection system, Invitrogen Countess Cell Counter, Alpha Innotech FluorChem HD2 Imager, GE 2-D gel electrophoresis system, BioRad I-Mark Microplate Reader, a BioTek 405LS Microplate Washer, MagPix Multiplex Instrument, and an Eppendorf Biophotometer.

GRADUATE EDUCATION AND POSTGRADUATE TRAINING

SR has been actively participating in training the next generation of scientists since its founding in 1941. The research laboratories in the Drug Discovery Division accept trainees including graduate students and postdoctoral fellows, as well visiting scholars.

SR provides interdisciplinary training experiences for the UAB Graduate Biomedical Sciences (GBS) Program, which encompasses approximately 440 graduate students and 350 faculty. SR is a part of a broad network of multiple interdisciplinary thematic programs which integrates more than 25 departments and 20 research centers at UAB, as well within the biotechnology institute, HudsonAlpha. SR offers the students of the GBS Program a broad spectrum of research opportunities related to drug discovery. This partnership to-date has allowed for numerous graduate students to complete their doctoral thesis research in SR labs. Various faculty members in SR's Drug Discovery Division hold academic appointments in departments at the UAB School of Medicine as well as serve as training members of the UAB Graduate School. Collectively, the synergy generated through this partnership has the capacity to nurture the next generation of scientific leaders.

In addition, postdoctoral training is a major training mission for SR. For individuals with a doctoral degree (PhD, MD, DDS, or the equivalent), SR offers a number of postdoctoral training opportunities in the areas of Oncology, Infectious Diseases, and Medicinal Chemistry. These opportunities allow the trainee to be engaged in mentored research and/or scholarly training for the purpose of acquiring the professional skills needed to pursue a career path of his or her choosing. As such, this position allows the research trainee to enhance and develop research competencies through participation in planning, designing and conducting highly technical and complex research projects under the supervision of a Principal Investigator. The trainee also participates in all aspects of data collection, analysis and interpretation, often resulting in peer-reviewed publications. Postdoctoral experiences offered by SR equips the trainees to lead scientific discovery as the next generation of scientific leaders. Many SR postdoctoral trainees have advanced their scientific careers to become independent researchers in both academia and industry.

In October 2013, in collaboration with the American Immigration Council, we initiated the International J-1 Visa Training Program for international trainees. The program allows international scholars to learn in SR's Drug Discovery Division laboratories for up to 18 months of training on biomedical research. As such, SR's mission of education fosters international collaborations for future research in precision medicine.

Moreover, SR offers a Research Internship program to college students from across the U.S., which provides firsthand experience with the innovative work conducted within the institution. Interns from Princeton University, Emory University, the University of Virginia, Birmingham-Southern College, the University of Alabama, and UAB are among those who have participated and gained experience similar to that found in potential future careers. Throughout the term, the students work with a mentor and do a presentation or write a research report at the end of the term. For the interns, the experience offered real-world work experience in a lab setting. The internship program also helps SR attract more talented people to join the non-profit. In general, most students do research for course credits. SR also has paid interns during Summer months which allows the students to gain additional experience outside of the classroom. The internship program within each department at SR offers a variety of opportunities. Upon completion of the internship, the trainees learn how to design, execute, and analyze hypothesis-driven experiments in the field of drug discovery.

Tulane is a proud member of the prestigious Association of American Universities, a select group of 62 universities with “pre-eminent programs of graduate and professional education and scholarly research.” Tulane is ranked by the Carnegie Foundation as a university with “very high research activity”, a classification shared by only 2 percent of more than 4,300 higher educational institutions rated by the foundation nationwide. Tulane was ranked among the top 50 national universities for 2016 by U.S. News and World Report.

INSTITUTIONAL RESEARCH ENVIRONMENT & EXPERTISE IN CLINICAL AND TRANSLATIONAL SCIENCE

This program will build on the research expertise within the Tulane health sciences. The health sciences at Tulane include several main components, i.e., the School of Public Health and Tropical Medicine-SPH and the School of Medicine-SOM (including the Tulane National Primate Research Center). Together, these units provide a broad array of opportunities for education and research from the bench sciences to the population sciences. Tulane SPH is the only school of public health and tropical medicine in the United States, with approximately 125,000 square feet of floor space comprising large classrooms, small conference seminar rooms, newly renovated computer and research laboratories and classrooms, almost all of which are equipped for state-of-the-art distance education. Tulane SOM is the 15th oldest medical school in the nation and was the first medical school in the Deep South. It has a rich tradition of research excellence, including two Nobel Laureates. The SOM facilities are physically located on the Tulane health sciences downtown campus adjacent to the Tulane University Hospital and Clinic, and provide more than 550,000 square feet of floor space. Included in the medical school complex are research and teaching laboratories, the medical library, a large auditorium, various conference rooms and classrooms, and administrative offices.

Tulane Center for Cardiovascular Health

The Tulane Center for Cardiovascular Health is located within the Department of Epidemiology, SPH. A main component of this center is the widely recognized “Bogalusa Heart Study”. The Bogalusa Heart Study has been a long-term epidemiologic study. The investigators have identified and followed Black and white children for nearly 35 years, and have described the incidence and prevalence of biologic and behavioral cardiovascular disease risk factors in these children. Their population has enabled them to not only document differences between males and females, but also between Blacks and whites. The results from the Bogalusa Heart Study have clearly documented that the genesis of atherosclerosis has its basis in childhood, and that prevention can and must begin at the early ages. The data available from this study are unique, and several protocols on Women’s Health perspectives on CVD, hypertension and diabetes are under development.

Tulane Hypertension and Renal Center of Excellence (THRCE)

Tulane Hypertension and Renal Center of Excellence (THRCE) grew out of the significant research in hypertension and renal disease being performed on the basic and clinical levels in the Departments of Medicine, Pediatrics, Physiology and Epidemiology in both the Tulane SOM and the Tulane SPH. This multidisciplinary Hypertension and Renal Center of Excellence is under the leadership of Dr. Lee Hamm, SVP and Dean of the SOM and Dr. L. Gabriel Navar, chairman of the Department of Physiology another BIRCWH mentor. Dr. Jiang He is Chairman of the Department of Epidemiology in the SPH and is Director of its hypertension research program.

The Tulane and Xavier Universities Center for Bioenvironmental Research (CBR)

The Tulane and Xavier Universities Center for Bioenvironmental Research (CBR) began in 1989 with a \$33 million grant from the U.S. Department of Defense to establish a program of basic and applied scientific and policy research in bioenvironmental research. Under the auspices of the CBR, a wide variety of disciplines (medical, scientific, legal, economic and managerial) work together to better understand how human, industrial and agricultural processes affect the environment with a focus on human health. Featured in the CBR space and occupying 3 floors in the J. Bennet Johnston Health and Environmental Research Building, are state-of-the-art laboratories used for core areas of research, including environmental and occupational diseases, toxicology, environmental health sciences and experimental pathology. The CBR represents a solidly established and well-developed collaboration between a major research university and one of the nation’s leading historically black universities. The CBR’s faculty and students are drawn from disciplines as diverse as

anthropology, biochemistry, computer science, disease prevention, ecology, economics, engineering, English, epidemiology, geology, mathematics, molecular biology, philosophy, pharmacology and toxicology, for multidisciplinary basic and applied environmental research and education. Strength of the partnership between Tulane and Xavier Universities is its ability to leverage funds and optimize investments in minority institutions by combining the research capabilities of Tulane University with educational resources at Xavier University. The value of this partnership has been recognized through numerous grants and cooperative agreements funded by many federal agencies including the U.S. Departments of Energy, Defense, and Agriculture; the National Institute of Environmental Health Sciences; the National Science Foundation; and the national Aeronautics and Space Administration. Current priority areas in research focus on women's health, ecosystem research, biomonitoring/bioremediation program and a laboratory dedicated to environmental endocrinology.

Prevention Research Center

Prevention Research Center is funded by CDC and conducts prevention research, develops partnerships with the local community, communicates research insights within the local community and among communities, and provides training for future prevention researchers and community members. The theme of the Tulane University Prevention Research Center is the Impact of the Physical and Social Environment on Obesity. The PRC has been actively engaged in trying to rebuild New Orleans in ways that promote physical activity and healthy eating. PRC projects are planned jointly with a Community Advisory Board consisting of representatives of health-related, environmental, and community organizations in New Orleans.

Center for Evidence Based Global Health (CEBGH)

The mission of the Center for Evidence Based Global Health (CEBGH) is to promote and support evidence-based research addressing today's most critical global health issues. The center supports this goal by providing methodological expertise to Tulane faculty in designing, conducting and analyzing cluster randomization and practical trials, as well as by offering administrative and logistical support to faculty in preparing grant proposals and in coordinating international trials. Research projects under the center's auspices have included: the Latin American Perinatal Health Training Program, which is funded by the John E. Fogarty International Health Center; a Trial for Improving Perinatal Care in Latin America, funded by the National Institute of Child Health and Human Development; the Tulane-Xavier Minority Training in International Health program, funded by the National Center on Minority Health and Health Disparities; and Increasing the Impact of Maternal and Neonatal Health Systematic Reviews, a grant funded by the Agency for Healthcare Research and Quality.

Tulane Center for Aging

Tulane Center for Aging, established in 2007, is a NIH-funded, university-wide center, physically located at the downtown health sciences campus. Its goal is to harness the multidisciplinary resources at the three campuses of Tulane University on behalf of the aging population. This is achieved through innovative research, education, and service. The purpose of the Tulane Center for Aging is to enhance existing programs and to create new ones where the need and opportunity arises. A Distinguished Lecture in Aging series was instituted, and this was followed by a seminar program. The Center for Aging hosts a monthly Aging Interest Group meeting that alternates between the uptown and downtown campuses. These gatherings have fostered the development of several interdisciplinary research groups and new funding possibilities. The Tulane Center for Aging is dedicated to the strengthening of training and service in the areas of geriatric medicine and gerontology in cooperation with the Section of General Internal Medicine and Geriatrics in the Department of Medicine and the School of Social Work, respectively.

The Center for Medical Informatics (CMI)

The Center for Medical Informatics (CMI) helps the Tulane Medical Center plan, develop and implement computer/communications systems to support its missions in medical education, clinical practice, and research. It provides expertise in technologies important in education, electronic publishing, and research and clinical data management. It also provides consultative support, expert assessment of commercial hardware and software, training opportunities, internal software development, and shared equipment and software resources.

Tulane Stress and Environment Research Collaborative on Health Disparities (SERCH)

The Tulane Stress and Environment Research Collaborative on Health Disparities (SERCH) focuses on *Preventing Health Disparities: from genes to neighborhoods*. Basic, biomedical and social science research methods are applied to increase mechanistic understanding of the pathways through which stress, defined at multiple socioecological levels and across the life course, is biologically and behaviorally embedded to affect health in women and men and girls and boys. The goal is to foster novel prevention programs that build on psychosocial strengths of individuals and communities with an aim is to alter these negative trajectories with a focus on sustainable implementation and successful dissemination of such programs, using community-based participatory research (CBPR) and ownership as a key ingredient to successful sustainable programs. The interdisciplinary team brings select skill sets and experiences that are highly synergistic. Specifically, the team has expertise in social epidemiology, environmental epidemiology, reproductive epidemiology, genetics and epigenetics, allergy and immunology, sociocultural psychology, social work and community health sciences, with a focus on violence prevention. This new collaborative was made possible through an NIH Interdisciplinary Infrastructure Development grant (NIH 1C06RR029949-01) that supports renovation for interdisciplinary research. This specific collaborative includes 19 faculty representing Tulane University Schools of Public Health and Tropical Medicine, Social Work, Medicine, Science and Engineering. The SERCH collaborative is housed in the J. Bennett Johnston Building on Tulane's downtown campus. The J. Bennett Johnston Health and Environmental Research (JBJ) Building, located on Tulane Avenue, is a seven story, state-of-the-art facility which houses the Center for Bioenvironmental Research and other Tulane research activities. The 184,000 square foot building is designed to encourage interdisciplinary collaboration. The laboratories are configured in 360 square foot modules. Modular design permits economical reconfiguration of the lab space as research activities and needs change. The SERCH research space, located on the first floor and with approximately 1500 square feet of space, includes a biophysiology lab, observation and interview rooms, focus group room, and a GIS computing lab.

Tulane Brain Institute

Tulane Brain Institute represents a new era of discovery, learning, and public influence in the brain sciences at Tulane. Researchers are working to understand sex differences in the brain and how hormones such as estrogens and androgens impact the brain across the lifespan. Such work has implications for understanding mechanisms by which males and females have different biological vulnerabilities to brain disorders. The Tulane Brain Institute, founded in 2016, builds upon the over 30 years of success of the Tulane Neuroscience Program. The University-wide Brain Institute, created as a transdisciplinary entity to coordinate and oversee neuroscience-related endeavors at Tulane, brings together over 400 faculty and students from across the University including from the Main Campus, the Health Sciences Campus, and the Tulane National Primate Research Center. The three pillars of the Brain Institute are research, education and training, and community outreach and engagement.

Tulane Building Interdisciplinary Careers in Women's Health (BIRCWH K12).

The BIRCWH Program provides mentored career development for junior faculty to increase the number of highly trained independent investigators in sex/ gender differences and women's health in the field of cardiovascular and related diseases. The program is dedicated to promoting research and the transfer of findings related to Women's Health by promoting research independence among junior investigators. In order to improve the quality and increase the quantity of Women's Health research, Tulane BIRCWH bridges the period between advanced training and research independence, as well as links professions, scientific disciplines and areas of interest for selected scholars. The common theme running throughout the various research areas is interdisciplinary research on cardiovascular disease, hypertension, and renal disease. In addition to our long-term goal of increasing the number of skilled, independent interdisciplinary investigators, we are also committed to promoting, through the BIRCWH Program's illustration, the awareness of the need to ensure a strong pipeline when fostering entities; establishing institutional and individual renown both nationally and internationally for the BIRCWH Program's findings on CVD and Women's Health and improving the cardiovascular health of Louisiana women across the lifespan, particularly African American women, by effectively training the next generation of conscientious, culturally competent and independent academic Women's Health researchers.

Women's Health Resource Laboratory (WHRL)

The WHRL It provides technical support, guidance and mentoring in the areas of study design, data collection instruments, maintaining and updating study databases and statistical analyses. Lydia Bazzano MD, PhD, Associate Professor of Epidemiology and Medicine directs the WHRL. WHRL is housed at the SPH and has space that includes a data training "laboratory" with computers and fosters interdisciplinary interactions of Tulane and other investigators. The WHRL serves not only as a service laboratory for Women's Health research at Tulane, but also a nexus of integration of sciences such as epidemiology, biostatistics, economics, and behavioral and basic sciences.

Tulane Center of Biomedical Research Excellence (COBRE) in Hypertension and Renal Biology

Tulane Center of Biomedical Research Excellence (COBRE) in Hypertension and Renal Biology was established by a COBRE grant of more than \$10 million, in the third phase of funding that supports the core laboratory and facilities. Dr. Navar is PI and Director of the COBRE. Current investigators represent departments in SOM and SPH. The current junior investigators supported by this program include basic scientists, clinician/scientists and population scientists. The Center is a multidisciplinary and interdisciplinary research center for which the foundation is basic science research. Over the last few years there has been a rapid growth in clinical research and epidemiological collaborative studies in hypertension related areas. Ongoing projects that use the COBRE resources include studies investigating health care delivery in hypertension, lifestyle factors, including dietary nutrients (high sodium, low potassium, low vegetable protein, low carbohydrate and low water-soluble fiber), overweight, physical inactivity, hypertension in minority populations and alcohol consumption as risk factors for hypertension in over 20,000 study participants living in Southwestern China. Another key example is the CRIC study (chronic renal insufficiency cohort), which is a seven-center, NIH-funded, multi-year project exploring the relationship between kidney disease and cardiovascular disease. The two principal investigators (Drs. He and Hamm) also serve as leaders of the Tulane Hypertension and Renal Center.

Animal (Department of Comparative Medicine)

The Department of Comparative Medicine ensures high-quality, humane care and use of all laboratory animals at the vivarium located on the 9th floor of the Building for Environmental Research, accredited by AAALAC and under the supervision of veterinarians and trained staff. All faculty and staff with access to the vivarium are trained in accordance with related laws and guidelines of all federal and state agencies. All precautions are taken regarding the safety of animals and staff, and to maintain the integrity of scientific experiments. Appropriate transportation regulations and quarantines are strictly observed, and import/export and anesthesia/euthanasia procedures are performed according to the specific guidelines approved by the Institutional Animal Care and Use Committee (IACUC). In addition, animal care practices are based on the NIH Guide for Care and Use of Laboratory Animals. Access to the vivarium is restricted to qualified personnel, each with a unique security entrance code in the Edstrom Watchdog system. Codes are not shared by departments, and each individual's code is restricted to those areas in which he or she has documented expertise.

Shared Facilities and Research Cores

Clinical Laboratory

The clinical laboratory in the Tulane University Office of Health Research is approximately 500 square feet and is equipped with a chair for phlebotomy work, facilities and supplies for the appropriate storage of blood and urine specimens, a protected disposal for sharps, and two refrigerated centrifuges for processing blood and urine specimens. It occupies 800 square feet of space in the Tulane SPH building (23rd floor). The laboratory is equipped with an Olympus AU400e Chemistry-Immuno Analyzer (Olympus America Inc. Melville, NY), a Perkin Elmer 1470 Automatic Gamma Counter (PerkinElmer, Waltham, MA), an ASYS Expert Plus Microplate Reader (Biochrom, UK), Dionex Ultimate 3000 HPLC Systems (Thermo Fisher Scientific Inc., Sunnyvale, CA), an Abbott Laboratories IMX Automated Immunoassay Analyzer (Abbott Laboratories, Abbott Park, IL), a Hitachi 902 Chemistry Analyzer (Roche Diagnostics, Holliston, MA), an Abbott AxSYM® System (Abbott Laboratories, Abbott Park, IL), a Helena QuickScan 2000 (Helena Laboratories, Beaumont, TX), Beckman L5-75 and 1-2-60 Ultracentrifuges (Biostad™, Québec, Canada) and regular centrifuges. In addition, a TM Analytical Gamma Counter, a Tecam Microplate Washer and Reader, an electrophoresis apparatus, a colorimeter and analytic balances are available. Available laboratory services include sample processing, storage, shipping, molecular

analyses, and multiplex biomarker assays. The laboratory also uses radioimmunoassays (RIA), enzyme-linked immunosorbent assays (ELISA), and high performance liquid chromatography (HPLC) analysis for many special assays, such as cytokines, hormones, and adipokines. The Biochemical Laboratory routinely measures complete chemistry panels, blood and urine electrolytes, IgG, IgM, urine micro-albumin, cystatin C, HbA1C, CRP, endocrinology panels (estradiol, FSH, hCG, LH, progesterone, prolactin, testosterone, anti-Tg, anti-TPO, free T3, free-T4, T-uptake, total-T3, total-T4, ultrasensitive hTSHII), hepatitis panels, metabolic panels (active-B12, anti-ccp, B12, cortisol, ferritin, folate, glycated hemoglobin), homocysteine, troponin-I, PSA, BNP, CK-MB; protein and amino acids, ADMA, Larginine; insulin, C-peptide, adiponectin, leptin, e-selectin, SHBG, ICAM-1, vCAM-1, IL-6, 8-Isoprostane, TNF- α , and other traditional and novel CVD risk factors. The laboratory has served the Bogalusa Heart Study and other large-scale epidemiology and clinical research projects. As part of the clinical laboratory that supports storage of samples, Tulane also has a Freezer Farm with 12 ultra-low freezers (-85°C) for biological sample storage are available at the Tulane SPH. After Hurricane Katrina, the school invested sufficient funds to set up this freezer farm, which is located at the Tulane National Primate Research Center, an inland research facility which is protected from hurricane damage. All freezers have 24hour emergency power support, as well as CO₂ back up.

Molecular Genetics Laboratory

There are several faculty mentors at Tulane University with molecular genetics laboratories. These laboratories are usually 300-500 square feet and used for molecular genomic studies and high-throughput genotyping. Some laboratories are also conducting studies in functional genomics and epigenetics.

Molecular, Imaging, and Analytical Core Facility

The Molecular, Imaging, and Analytical Core Facility was developed to provide cell, molecular and biochemical services to researchers of the Tulane Hypertension and Renal Center (THRCE) that would make the performance of their research programs more efficient, convenient and cost effective. It is a state-of-the-art facility that provides research infrastructure support to all Center investigators encompassing molecular biology, semi quantitative imaging, immunohistochemistry, genomics, HPLC, and RIA of angiotensin peptides. The Molecular, Imaging, and Analytical Core Facility has three separate components:

Molecular component: DNA, RNA, protein and tissue culture work are primarily performed in this laboratory. These include DNA and RNA extractions, purification, concentration, quantification, amplification, cloning and detection procedures using PCR and real time qRT-PCR. Protein analyses include extraction, quantification and detection of target protein expression and activity using Western blot, EMSA and ELISA. Tissue culture work includes primary cultures and culture of cell lines, transfection using RNA silencing technology and analyses of specific cells using microscopy and flow cytometry.

Imaging component: This facility provides support for immunohistochemistry and immunofluorescence using an automatic robot immunostainer or manual immunoperoxidase techniques. High resolution upright light and fluorescent microscopes including an inverted microscope with an imaging capturing system and time-lapsed and chamber-incubator functionality to facilitate the evaluation of specific changes in protein expression in live cells, fixed tissues and the evaluation of histopathological alterations.

Analytical component: This facility provides assistance with the harvesting and collecting of tissues, including plasma, urine, and tissues such as heart, kidney and brain, among others. This core performs the partial purification of samples by solid phase extraction along with HPLC separation with a major focus on the measurement of different angiotensin peptides and proteins by radioimmunoassay (RIA). In addition, it provides instrumentation support for measuring other fundamental parameters such as hematocrit, Na⁺ and K⁺ concentrations and osmolality in plasma and urine, various ELISAs and Luciferase assays.

TRANSLATIONAL RESEARCH INFRASTRUCTURE

Clinical and Translational Unit (CTU):

Clinical and Translational Unit (CTU): provides research facilities with equipment, exam rooms, and support areas; regulatory, monitoring, and audit support for protocols; research nursing support for recruitment and protocol implementation; financial and contract support for negotiations with industry-supported studies; and core laboratory support for specimen processing, shipping, and/or analysis for investigators at Tulane

University conducting clinical research. The CTU staff maintains credentials and a collaborative relationship with the Louisiana State University Health Sciences Center-New Orleans' Clinical and Translational Research Center (CTRC) at the University Medical Center (UMC), sharing facility and nursing staff as needed and the core laboratory at Tulane and LSUHSC-NO protocols. The core laboratory functions play a major role in providing assistance for routine and special processing, storage, and shipping of all cellular and serologic samples; performing molecular assays including DNA, RNA isolations and genotyping, and gene expression analyses for various protocols; assisting investigators in identifying new methods that will support their research as well as in the proper validation of these new methods; training investigators, fellows, residents, medical students, and technical staff in molecular techniques, which includes both theoretical and practical training in molecular techniques in the lab.

Tulane University Office of Health Research

Tulane University Office of Health Research is a community-based research clinic and home to the COBRE Clinical Research Core in the SPH. Dr. Jiang He and Dr. Jing Chen, are co-directors of the Core and also BIRCWH mentors. The Tulane University Office of Health Research includes a reception/patient waiting area, six participant examination rooms, a clinical laboratory, two conference rooms, a dietary interview room, an intervention room, mail and copy rooms, a kitchen, secured data storage rooms, a freezer room, and offices for study staff and research coordinators. The reception/patient waiting area is approximately 350 square feet and equipped with a reception desk, telephone, magazine rack, and couches and chairs for participant comfort. Each clinical exam room is approximately 150 square feet and is equipped with an examination table, supplies, desk, a mobile stool and chairs for participants. In addition, stadiometers, digital scales, and aneroid sphygmomanometers are present for use during participant clinical visits. The Office of Health Research also has a ACUSON SC2000 ultrasound system (Siemens Medical Solutions USA, Inc., Malvern, PA), Non-Invasive Blood Pressure Monitors with AI (HEM 9000, Omron HealthCare CO, LTD, Kyoto Japan), a HDI/Pulsewave CR2000 Research Cardiovascular Profiling System (Hypertension Diagnostic Inc., Egan, MN), a SphygmoCor® CPV System (AtCor Medical Inc North America, Itasca, IL), two GE MAC 1200 STs (GE Medical Systems Information Technologies GmbH, Germany), two Nicolet Elite 100 Non-Display Dopplers (CareFusion Corporation, San Diego, CA), a Noninvasive instrument (DynaPulse 2000A) and a Non-Invasive Automatic Oscillometric Device (BP-203 RPE: Colin, Komati, Japan). The two conference rooms each include a table and chairs for seating 10 to 20 persons. Two copy machines, two fax machines, and multiple network printers are available to the staff and coordinators in the clinic. A small kitchen and a food storage room are accessible for feeding study participants who have completed fasting blood draws. The remainder of the complex is occupied by staff offices and secured data storage rooms. Each office is equipped with a desk, chair and hutch and serviced by a fast access internet connection and telephone connections. All study staff have PC computers. Two secure data storage rooms (approximately 250 square feet in size for one and 150 square feet in size for another) are furnished with file cabinets and racks for participant binders and paper forms. These rooms remain locked unless study staff must access the participant information for study visits.

DATA RESOURCES AVAILABLE TO CCTS INVESTIGATORS AND TRAINEES

The Bogalusa Heart Study (BHS) Clinic

The BHS Research Clinic is a 7,000 square foot clinical research facility located in the community of Bogalusa, LA. This 7,000 square foot clinical research facility is organized into 4 clinical suites arranged around a large central reception area with a waiting room, laboratory, and storage area. Each clinical suite consists of a separate administrative/reception area of 150 square feet equipped with a reception desk, task chair, telephone and computer for study personnel, and a waiting area of 200 square feet featuring local art and equipped with magazines, a coffee table, and upholstered chairs for participant comfort. Each clinical suite contains several exam rooms of 75 to 100 square feet in area, a kitchen equipped with refrigerator, a staff lavatory, and a private office space of 115 square feet. Each clinical exam room is equipped with an examination table, supplies, a desk, a mobile stool and chairs for participants. In addition, stadiometers, digital scales, and sphygmomanometers are present for use during participant clinical visits. Each office is equipped with a desk, chair and hutch and serviced by a fast access internet connection and telephone connections and shares access to a private fenced courtyard. A variety of non-invasive cardiovascular measurement instruments are available including a Toshiba Digital Ultrasound instrument (Toshiba Xario, SSA-660A, America Medical Systems) with multiple probes (Toshiba PSK25AT, 2.5 mHz, Toshiba PCK703AT, 7.5 mHz), a SphygmoCor® XCEL system (AtCor Medical Inc North America, Itasca, IL), multiple Non-Invasive Blood

Pressure Monitors (Omron HEM907XL, Omron HealthCare CO, LTD, Kyoto, Japan), and a HDI/Pulsewave CR2000 Research Cardiovascular Profiling System (Hypertension Diagnostic Inc., Egan, MN). The 290 square foot laboratory and freezer space is equipped with a phlebotomy chair, facilities and supplies for the appropriate storage of blood and urine specimens, a protected disposal for sharps, a centrifuge for processing blood and urine specimens (Eppendorf 5810R, Eppendorf AG, Hamburg, Germany), and includes a lavatory for obtaining urine specimens. The common central waiting area, of approximately 260 square feet in size, includes chairs and can be converted to a meeting/conference area with tables and seating for approximately 20-25 persons. Two copy machines, two fax machines, and multiple network and PC printers are available to the staff in the clinic. All study staff have PC computers. The remainder of the complex consists of storage areas. Secure information storage rooms are approximately 250 square feet in size and furnished with cabinets and racks for participant binders and paper forms. These rooms remain locked unless study staff must access the participant information for study visits. Eight staff members currently work in the BHS clinic complex, including a registered nurse coordinator, experienced and certified phlebotomists, a laboratory technician, and field research assistants. The attached in-front parking area has 45 available parking spots with an additional 17 in the rear of the clinic complex. The Bogalusa Heart Study, an NHLBI/NIA/AHA funded study, was initiated in 1972 and continues to be funded by NIH.

CLINICAL CARE

Tulane University Hospital and Clinic (TUHC)

Tulane University Hospital and Clinic (TUHC) is one of New Orleans' most comprehensive health care facilities. The hospital is a 300+ bed acute care center, including a Children's Hospital as a "hospital within a hospital," and an ambulatory care teaching facility, housed in a seven-story building adjacent to the medical school, and nearby to the Medical Center of Louisiana, New Orleans, and the New Orleans Veterans Affairs Medical Center. It operated principally as a multi-specialty regional tertiary care center, providing both inpatient and outpatient facilities for the Tulane University School of Medicine clinical faculty. TUHC attracts patients from throughout Louisiana, the Gulf South area and Latin America. Extensive state-of-the-art diagnostic facilities are housed in the hospital/clinic, including advanced radiological facilities, nuclear medicine and ultrasound units, blood flow laboratory and sleep center. The hospital offers primary patient care in all specialties, critical care facilities including a medical intensive care unit, a cardiac catheterization laboratory, a chronic hemodialysis unit and a state-of-the-art organ transplantation program including a bone marrow transplantation unit.

Tulane Lakeside Hospital

Tulane Lakeside Hospital has a bed capacity of 119 and is home to over 600 physicians and 450 employees. The Tulane-Lakeside specialized healthcare team concentrates on awareness, prevention, diagnosis and treatment to meet the health challenges of women from general gynecology to robotic surgery for Hysterectomy. Lakeside Hospital has delivered over 100,000 babies and treated well over 300,000 patients. Tulane-Lakeside Hospital's commitment to treating women and their babies has grown by expanding services and offering a wider range of healthcare options for the entire family.

GRADUATE EDUCATION AND POSTGRADUATE TRAINING

Masters of Science in Clinical Research

The School of Medicine has a structured program leading to either a Master of Science in Clinical Research degree or a Certificate in Clinical Research. The MSCR program includes: 1) formal didactic training providing tools to conduct modern clinical and translational research; 2) a clinical research and molecular medicine seminar series, providing peer interaction and mentor guidance on research topics; 3) a mentored clinical research project; and 4) an annual MSCR retreat. The goal of the program is to identify, recruit, and train the best possible candidates from diverse academic backgrounds for sustainable careers in clinical research (academia, industry, foundations, etc.)

Tulane Inter-American Training for Innovations in Emerging Infectious Diseases.

This post-doctoral training program funded by the Fogarty International Center provides post-doctoral trainees with mentored training experiences and opportunities to work together as a team to identify problems in the diagnosis, management, or control of infectious diseases in the Americas. The program effectively integrates

the four distinct disciplines of public health, science and engineering, social sciences, and medicine to provide interdisciplinary training in innovative approaches to infectious diseases for eight post-doctoral level participants from consortium institutions. The dissemination of activities associated with this program will provide broad perspectives to the PCOR/LHS trainees.

Tuskegee attained University status in 1985. Its academic programs are organized into six colleges and one school: (1) The College of Agriculture, Environmental and Natural Sciences; (2) The College of Business and Information Science; (3) The College of Engineering and Physical Sciences; (4) The College of Liberal Arts and Education; (5) The College of Veterinary Medicine, Nursing and Allied Health (CVMNAH); (6) The College of Arts and Sciences; and The Taylor School of Architecture. The colleges and schools offer 49 degrees: 35 Bachelor's, 11 Master's, a Doctor of Philosophy in Engineering and Materials Science, a Doctor of Philosophy in Integrative Biosciences, and a Doctor of Veterinary Medicine.

INSTITUTIONAL RESEARCH ENVIRONMENT & EXPERTISE IN CLINICAL AND TRANSLATIONAL SCIENCE

Tuskegee University Center for Biomedical Research (CBR) / Research Centers in Minority Institutions (RCMI) Facilities and Resources

In 1985, the National Institutes of Health (NIH) established the RCMI Program, after Congress noted stark health disparities between minority and white Americans. Tuskegee is one of about sixteen institutions that receive funding from this program for the purposes of increasing the presence of minority researchers in biomedicine and studies in minority health. This funding has been used in multiple ways, most notably for establishment of the CBR/RCMI Core Facility, which enhances multidisciplinary research infrastructure by providing the resources, services, and technical support required to stay on the cutting-edge of biomedical research and to forge new paths. Dr. Yates is currently the PI of this award and Director of the RCMI core facilities.

Shareable Instrumentation Facility

The Shareable Instrumentation Facility provides Tuskegee researchers with the equipment necessary to conduct flexible and thorough studies. It allows on-site use of an array of equipment that might otherwise be inaccessible to individual researchers. The instrumentation is divided between two locations: the Williams-Bowie Research Building (WBRB) and the Carver Research Building (CRB). Two full-time employees ensure that all users are properly trained and that the equipment is in a ready-to-use state.

- **Microscopy.** Two Olympus microscopes (BX53F and IX71) with fluorescent lamps and digital cameras are used for wide-field microscopy. CellSens software, installed on a Dell Precision TX500 computer, is used to acquire and manipulate microscope images. Additionally, Adobe Photoshop is available for image adjustments not present within the CellSens software. Three visible light microscopes (Olympus, Meji, and Omano) are also on hand.
- **Gene expression.** Within the WBRB, researchers needing to investigate gene expression have a variety of systems at their disposal. These systems include two Stratagene QPCR systems (Mx3000P and Mx3005P), two Eppendorf thermocyclers (Mastercycler Pro and Mastercycler Gradient), one Alphascreen HP (Innotech), and one CHEF Mapper system (Bio-Rad). The Mx3000P system is connected to a Dell Optiplex 380 PC, and the Mx3005P system is connected to a HP Compaq 8000 Elite SFF PC. Both systems use MXPro software.
- **Plate-reading** Two Bio-Tek devices provide absorbance and luminescence plate-reading capabilities. The Powerwave XS is used for absorbance, and the Synergy 2 is used for luminescence. Both units are controlled by a Gateway E-4500D computer and Gen5 software.
- **Flow Cytometry.** For those requiring flow cytometry applications, a BD FACSCaliber instrument is available. The unit has been upgraded to include 5 lasers and is operated using a Dell Optiplex 390 and FlowJo Software.
- **Chromatography.** A Beckman Coulter HPLC System Gold and Perkin Elmer Autosystem XL Gas Chromatograph/Turbo Mass Spectrometer with headspace sampler are utilized for chromatography. The HPLC is controlled with an IBM PC 300PL using 32 Karat. The GC/MS is controlled by Turbo Mass on a Dell Optiplex GX110.

- **In Vivo Imaging.** Housed inside the TU Animal Facility, the IVIS Lumina XR (Caliper LifeSciences) provides *in vivo* imaging capabilities. This system provides small animal imaging by fluorescence, bioluminescence, and/or X-rays. Living Image software on a Dell Precision T3500 computer is used to operate the imager.
- **Tissue Culture.** A dedicated tissue culture room contains a Nuair Class 2 biosafety cabinet, an isoTemp incubator, two upright visible light microscopes (Meji and Olympus), and an inverted light microscope (Omano).
- **Electroporation, Film Processing, and Ultra High-Speed Centrifugation.** A Bio-Rad Gene Pulser 2 is used for electroporation; film processing can be accomplished with a Konica Minolta processor; and a Sorvall RC2-B ultracentrifuge (with multiple rotor options) is present for applications that require ultrahigh-speed centrifugation.

Animal Facility and Pathology Services.

Tuskegee has a modern animal facility for accommodating rodents and large animals and a well-organized Comparative Medicine Resource Center (CMRC) for research involving laboratory animals and small ruminants. The facility provides services to researchers who have projects approved for animal use and serves the biomedical research community in the university. It is fully equipped with offices; garment changing areas; animal isolation/quarantine; housing rooms for conventional and special accommodations; and rooms for feed storage, cold holding, and necropsy. A designated attending veterinarian, a facility manager, a center director, and experienced support personnel support this work. Pathology services are provided to the clinical and research community on a fee-for-service basis. A fully equipped and staffed tissue processing facility is located in the WBRB. A board-certified veterinary pathologist and three faculty members (with Doctorate degrees in Anatomical Pathology) are available for consultation. The research complex comprises two buildings, the WBRB and the CRB.

NIH/NCI Cancer Health Disparities Partnership (U54)

Dr. Yates is a co-PI of the Partnership between Tuskegee, Morehouse School of Medicine (MSM), and the UAB Comprehensive Cancer Center, which is supported by the NIH National Cancer Institute (NCI). The Partnership, located in the heart of the Southeast, a region with a large, historically underserved African American population, has goals of attaining excellence in research focused on the basis of cancer health disparities and on reducing the cancer burden. The primary objectives are to establish productive cancer research programs, to develop a pipeline of prospective minority investigators, and to expand cancer disparity research in the Deep South.

Graduate Education Environment at Tuskegee

The Ph.D. program in Integrative Biosciences (IBS) at Tuskegee integrates basic research, education, and service to advance the creation of new knowledge, to apply existing knowledge to solve societal problems, and to educate future generations of learners in addressing the knowledge-based health, food, and environmental challenges of the 21st century. The program leverages the combined strengths of the College of Agricultural, Environmental, and Natural Sciences (CAENS); the College of Veterinary Medicine, Nursing and Allied Health (CVMNAH); and the university's major research centers in biosciences to produce graduates who are competent and skilled scientists, problem solvers, critical thinkers, excellent communicators, and team players. CAENS and CVMNAH have demonstrated, over the past eight years, the ability to generate resources, through grants and contracts, totaling more than \$20 million. The IBS program is under-girded by informational technologies, biotechnologies, scientific excellence, and bioethical principles, including respect for life and the environment. The IBS faculty, students, and staff generate resources and scientific and learning environments necessary to integrate basic and applied research and information in the biosciences in order to serve local, national, and international communities.

EXAMPLE ELECTIVE MINI-SABBATICAL OPPORTUNITIES AT TUSKEGEE

Mini-sabbaticals/Externships/Short-term Rotation Offerings

Rotation Name(Supervisor(s)/Institution)	Learning Objectives
CCTS Network Partners (example rotations)	
Bioethics in underserved minorities/Nat. Center for Bioethics in Research and Health Care (S. Warren PhD, Tuskegee University)	1) Understand the bases of racial/ethnic diversity with special consideration of bioethical debates; 2) Design a study that addresses a critical challenge in underserved populations; 3) Develop respectful and effective community partnerships to address inequities in health and health care

The University of Alabama (UA), founded in 1831, was the first public college in Alabama and is the state's premier academic institution. UA's mission is to advance the intellectual and social condition of the people of the state, the nation, and the world through the creation, translation, and dissemination of knowledge with an emphasis on quality programs for teaching, research, and service. UA has been ranked among the top 50 public universities in the nation by *U.S. News and World Report's* annual college rankings for more than a decade—ranking 51st in 2017.

The cooperative atmosphere of the campus and proximity of departments fosters the integration of research across schools and programs of study, thus ensuring assistance with project interventions are readily available and encouraging the academic/community partnerships that will be created through this project. UA supplies each investigator with a personal computer of sufficient capability to perform all tasks necessary for this project. These computers are connected through a network to all other University networks, the internet, and the University's mainframe systems. UA has a fleet of vehicles available for travel to visit rural communities. UA employees more than 6,000 faculty and staff.

INSTITUTIONAL RESEARCH ENVIRONMENT & EXPERTISE IN CLINICAL AND TRANSLATIONAL SCIENCE

College of Community Health Sciences (CCHS)

CCHS was established in 1972 to meet the critical demand for primary care physicians and quality healthcare in Alabama's medically underserved rural areas. CCHS was founded on the principle that community inclusion is essential to the health profession. The College serves as a model for community-oriented medical education and clinical training, offering rural medicine clerkships, novel curriculums that increase students' exposure to rural medical practice, and programs that guide rural Alabama high school and college students into health careers.

CCHS is dedicated to promoting and improving the health of individuals and communities in Alabama and the region through leadership in medical education and primary care, the provision of high quality accessible health care services, and scholarship. Engaging communities as partners, particularly in rural and underserved areas, and fostering innovative, community-oriented research to inform population health and support community providers central to the CCHS mission.

The College is located in a state-of-the-art 77,000 square foot facility that houses 48 physicians in training, 75 medical students, 25 graduate students, 50 faculty, and 300 staff. CCHS provides the Institute for Rural Health Research (IRHR) space for current staff and allows for growth in personnel and programs. CCHS has classrooms and space for lectures, seminars, and training workshops/activities. The College's Health Sciences Library maintains the Clinical Digital Library, which provides professional digital library services to off-site users. Nearly 800 students have completed their third and fourth years of medical school at the Tuscaloosa Regional campus and 456 residents have graduated from the Family Medicine residency as of 2016. One in 7 Alabama family physicians graduated from the Family Medicine residency at CCHS.

The Institute for Rural Health Research (IRHR)

Established in 2001, IRHR seeks to raise standards of attainable health status and quality of life for rural citizens. IRHR's efforts to reduce health disparities in rural communities is exercised through research, clinical trials, screenings, and health education that is participatory and mutually beneficial to communities. IRHR partners with UA colleges/schools and rural communities, and has participated in federal and state grants totaling more than \$25 million.

IRHR investigators have access to an outstanding research infrastructure including: office space, research lab space, conference rooms, state-of-the art computers, specialized research software (NVivo, SPSS, SAS etc.), printing and reproduction capabilities, administrative support, etc. IRHR desktop and laptop computers are configured for key personnel to work with large data sets, conduct advanced research analysis, and have adequate processing and graphic capabilities. Specialized software and software licenses allow for statistical,

data management, and GIS applications. IRHR's desktop and larger computers utilize SAS, SPSS, and SUDAAN software packages.

IRHR has its own password-protected server that allows for complex study and GIS mapping. Cameras, dictation devices, and other supplies can aid in the dissemination of data and instructional materials. IRHR has web-conference capabilities that enable efficient communication between IRHR and its partners around Alabama. Additionally, IRHR has multi-point video-conferencing capability for up to 15 sites using Internet 2. Distance conference is also available using the ITBA System. IRHR has use of UA's Center for Business and Economic Research, Alabama State Data Center (a U.S. Census Bureau repository), and the Cartographic and Geographical Information Systems Lab.

IRHR also provides a wealth of resources and infrastructure to support faculty research in the form of four 4 full-time staff in the following roles, respectively: (1) Proposal development administrator; (2) Editor and writer; and (3) Data analyst; and (4) Administrative assistant. Additionally, IRHR is closely affiliated to UAB's CCTS as part of the CCTS partner network. IRHR hosts an annual Rural Health Conference that provides a platform for academic researchers and community members to partner and share research ideas.

University of Alabama, Tuscaloosa, Alabama Life Research Institute

(PI: J. Lochman). The Alabama Life Research Institute is a newly-formed consortium catalyzing interdisciplinary biopsychosocial research by uniting several existing research centers (Aging, Prevention of Youth Behavior Problems, Rural Health, and Social Science Research), the Institute synergizes the existing research protocols with new resources for data management and analysis, grant development, and results dissemination. This new Institute cultivates, supports, sponsors, and conducts cutting-edge translational research that will be useful for KL2 Scholars.

EXAMPLE ELECTIVE MINI-SABBATICAL OPPORTUNITIES AT UA-TUSCALOOSA

Mini-sabbaticals/Externships/Short-term Rotation Offerings

Rotation Name(Supervisor(s)/Institution)	Learning Objectives
CCTS Network Partners (example rotations)	
Rural health, practice-based research (J. Higginbotham, PhD, University of Alabama in Tuscaloosa)	1) Appreciate the opportunities and challenges within Community-based participatory research; 2) Understand impact of environment (urban vs. rural) on health and access disparities; 3) Develop project that allows community members to participate in research
Alabama Medicaid research and analytics project (J. Parton, PhD, University of Alabama in Tuscaloosa)	1) Leverage Big Data to produce population-level analyses of health for one-quarter of Alabama's population; 2) Use claims and eligibility level data to define quality of care and health outcomes

The University of Mississippi School of Pharmacy (UMSOP) is home to the Center for Clinical and Translational Science (CCTS). With a presence on the University of Mississippi's main campus in Oxford and on the University of Mississippi Medical Center campus (UMMC) in Jackson, UMSOP is uniquely positioned to facilitate translational research through its extensive network of pharmaceutical researchers and clinical pharmacists.

INSTITUTIONAL RESEARCH ENVIRONMENT & EXPERTISE IN CLINICAL AND TRANSLATIONAL SCIENCE

The UMSOP is home to the Research Institute of Pharmaceutical Sciences (RIPS), which was established to discover and disseminate knowledge of natural drug products, develop and commercialize new products, and improve public health. There are currently four centers within RIPS: The National Center for Natural Products Research (NCNPR), the Pii Center for Pharmaceutical Technology, the Center for Pharmaceutical Marketing and Management (CPMM), and the Center for Clinical and Translational Science (CCTS). The recent addition of the CCTS creates the infrastructure, not currently available in Mississippi, to transition drug discoveries to clinical trials, then to practice and community settings.

The CCTS is structured to bridge research on the UM campus in Oxford and the UMMC campus in Jackson and to assist in the commercialization of new discoveries. This new Center provides a progressive infrastructure and additional core competencies in Oxford and Jackson to support the expansion of clinical and translational research at both sites.

The strategic goals, objectives, and priority areas for the CCTS have been aligned with the broader organizational strategic priorities identified in the UMSOP 2012 visioning process and the current UMMC strategic plan, *UMMC 2020*, which include the development of translational science capacity to strengthen the already significant national leadership in pharmaceutical research, aligning across missions by creating synergies between clinical, educational and research activities and demonstrating institutional effectiveness through removing operational and infrastructure barriers. The establishment of the CCTS supports the achievement of these institutional priorities.

The environment in the School of Pharmacy is highly collaborative and provides full support to scholarly activities. Personnel freely share ideas, technical expertise, and brainstorm and work towards solutions, when needed, to ensure success of research projects undertaken. Additionally, personnel often work with other departments to solve formulation and drug delivery issues.

The UMSOP has acquired all the necessary instruments and equipment necessary to support research and the research infrastructure is in place.

Additionally, the Institution supports continuous learning and scholarly activities and provides financial support for attending workshops and courses geared towards facilitating research activities. Financial support is also provided for attending international and national meetings which facilitates dissemination of research findings as well as provides a venue for the exchange of ideas and establishment of collaboration. Furthermore, the School of Pharmacy has an ongoing "mentoring" program, wherein identified senior researchers guide junior investigators in various aspects of research.

The Office of Research and Sponsored Programs at The University of Mississippi provides support in various aspects of research including training in protocols, procedures and regulations; responsible conduct in research; grant writing, management and budgetary aspects; and laboratory safety.

A Clinical Research Unit (CRU) on the Oxford campus provides suitable facilities, equipment and basic personnel support to allow low-risk studies to be performed in a Good Clinical Practice (GCP) environment. Examples of these studies are:

- Phase-0 Exploratory Study involving very limited human exposure to a drug or dietary supplement.
- Phase-1 Interventional Study normally conducted with healthy volunteers in the earliest clinical stage of drug development to explore drug tolerability and safety, and to determine how it is metabolized and excreted.
- Drug/drug or drug/herb interaction studies determining effects on drug metabolism or kinetics.
- Physical Exercise Study to measure physiological benefits of exercise.
- Study of dietary supplement products already widely utilized, in order to evaluate pharmacokinetics or impact on physiological parameters.

TRANSLATIONAL RESEARCH INFRASTRUCTURE

In 2016, the UMSOP completed the addition of a new building on the Oxford campus (West Wing of the Thad Cochran Research Center; TCRC-West), which includes more than 95,000 sf of additional laboratory space. The addition of this LEED-certified building almost doubles the school's research space. The construction of this facility was made, in part, through a grant award from NIH (C06RR030081) and cost \$40 million. The new addition will foster translation of basic research into clinical studies and commercial development as follows: 1) provide laboratories for scaling up extraction and isolation of bulk natural products in quantities that will support advanced development activities; 2) provide laboratories for scale-up synthesis and analog development; 3) provide Good Laboratory Practice-compliant (GLP) analytical facilities that will support bioanalytical research, product and regulatory package development; 4) provide Good Manufacturing Practice-compliant (GMP) facilities for production of active pharmaceutical ingredient (API); 5) provide laboratories for pre-formulation, formulation and stability studies to characterize APIs; 6) provide laboratories for cellular and molecular mechanism of action and toxicity studies; 7) provide laboratories for expansion of discovery efforts with greater emphasis on microbial and marine natural products; 8) provide Biosafety Level 3 (BSL-3) laboratories; and 9) provide a 10-bed Clinical Research Unit (CRU), which includes a procedure room, drug room, private bathrooms, sample preparation lab, an analytical lab, and a bioanalytical lab.

The CSF comprises the suite of rooms in which a clinical study is conducted (104H, 104J, 104K, 106A) and the adjoining laboratories where clinical specimens are processed and analyzed (106B, 107A). These six rooms are dedicated to the conduct of clinical studies. Adjoining areas that support the CSF but are also used for other UMSOP activities include the reception area (104), records storage (104F), conference (105C), kitchen (105A), restroom (105B), and clinical staff offices (104B&C).

A Clinical Research Unit (CRU) is located within the CSF operations in the rooms 106B and 107A, where specimens are processed and analyzed. These facilities are equipped with emergency power generators to provide electrical power in case of an interruption in electrical service to the building. Although emergency power is not provided to the entire building, the clinical facilities are provided adequate power to continue study operations.

In January 2012, a new UMSOP instructional and research facility opened on the UMMC campus which provides a state-of-the-art building in the heart of UMMC's academic corridor. The facility houses the SOP administrative offices and UMSOP faculty/staff. The building includes 17 PBL rooms and approximately 635 sf of student common space and student organization office space. There is approximately 2,000 sf devoted to clinical and basic research.

DATA RESOURCES AVAILABLE TO CCTS INVESTIGATORS AND TRAINEES

The SOP works closely with two libraries, the Science Library in the TCRC on the Oxford campus and the Rowland Medical Library in the Learning Resource Building on the UMMC campus. The Science Library, a branch of the University of Mississippi Libraries, maintains a chemistry/pharmacy collection which contains over 69,000 volumes and receives approximately 450 journals and standing order serials, including online subscriptions to Medline, Lexi Pals Drug Guide, International Pharmaceutical Abstracts, SciFinder Scholar, Web of Science, ScienceDirect selected titles, Biological Abstracts, Agricola, and ACS Web editions full text journals. The library has study carrels, study tables and three group meeting rooms with a total seating capacity of 161. Hard wired and wireless access to the internet is provided as are PCs and one networked

printer. The Science Library has access to nearly 100 electronic databases, 3,000 electronic journals and over 25,000 electronic books via the Main University Library. All offices are connected to the library via Ethernet connections.

Rowland Medical Library at UMMC provides and supports access to biomedical and health sciences resources for students, faculty, and researchers in the Schools of Dentistry, Graduate Studies in the Health Sciences, Health Related Professions, Medicine, Nursing, Population Health, and Pharmacy. The library acquires, preserves, and manages these resources and provides services on campus and through the library's website. At Rowland, the Library Faculty Advisory Committee advises the library director on the selection and provision of library resource services and materials, and assists with strategic planning and goals. The collection development policy ensures a balanced, quality collection to meet the needs of students and faculty. Core lists, recommendations, interlibrary loan requests, and usage statistics support the scope and focus of the institution and SOP.

University of Mississippi (UM) Historically Black Colleges and Universities (HBCU) Programs to Increase Diversity among Individuals Engaged in Health-Related Research (PRIDE)

(PI: B. Beech). The HBCU PRIDE program trains and mentors URM early career faculty interested in obesity disparities and chronic diseases related to obesity. The program provides skills training in research, grant writing, and scientific writing with a focus on community-based interventions to address disparities in obesity and related chronic diseases. By collaboration with the CCTS network, PRIDE participants are exposed to current challenges and cutting-edge research methods. Participants and alumni of the program will be ideal candidates for transitioning to a comprehensive, full-scale research training in the KL2. Since its inception, 26 early career faculty from HBCUs have been trained or employed through PRIDE. Of note, KL2 co-Director Lucio Miele serves as a PRIDE program mentor. The PRIDE program does not overlap with the KL2 and does not provide stipends or salary support.

CLINICAL CARE

The CCTS has a 10-bed CRU on the Oxford campus that provides the infrastructure and laboratory capabilities to administer Phase I and other low-risk clinical trials. With an initial focus in neuroscience and cancer, the translation of natural products discoveries into clinical trials will be a priority.

The Community/Population arm of the CCTS builds upon the work of the SOP Community-Based Research Program which has provided pharmacist support in underserved areas since 2008. This program provides increased access to care and evaluates care delivery models targeting improved utilization, and adherence to medications.

Areas of focus for this arm of the CCTS include: Comprehensive Medication Management (CMM); integrating Health Information Technology (HIT); improving transitions of care; and addressing health disparities. The CCTS is currently partnered with the UMMC National Telehealth Center of Excellence, the Mississippi State Department of Health, and the Centers for Disease Control and Prevention. The CCTS will continue to build collaborations with the UMMC School of Population Health and other community-focused initiatives.

GRADUATE EDUCATION AND POSTGRADUATE TRAINING INFRASTRUCTURE

The UMSOP offers the Master of Science in pharmaceutical sciences and Doctor of Philosophy in pharmaceutical sciences with emphases in environmental toxicology, medicinal chemistry, pharmaceuticals, pharmacognosy, pharmacology and pharmacy administration.

All of these programs offer opportunities to study with nationally and internationally recognized research scientists. The programs prepare students for teaching and research positions in academia, or administrative and research positions in the pharmaceutical, chemical, agrochemical, food and health care industries, as well as government agencies.

The University of Mississippi is recognized as a major research institution and is a part of the R-1: Doctoral Universities (Highest Research Activity by the Carnegie Classification of Institutions of Higher Education) group. Comprehensive in scope but relatively small in size, both provide excellent opportunities for advanced studies in a supportive and nurturing environment. Our diverse graduate community includes outstanding

faculty and students from around the globe, and their cutting-edge research and scholarship reflect tremendous vitality, impact and significance.

EXAMPLE ELECTIVE MINI-SABBATICAL OPPORTUNITIES AT UM-OXFORD

Mini-sabbaticals/Externships/Short-term Rotation Offerings

Rotation Name(Supervisor(s)/Institution)	Learning Objectives
CCTS Network Partners (example rotations)	
Plant-derived natural products in medicine and health (L. Walker PhD & I. Khan, PhD, National Center for Natural Products Research, University of Mississippi)	1) Understand role played by botanicals in pharmacology; 2) Learn bioactivities from botanicals; 3) Understand quality, safety & US regulatory issues w/ current botanical supplement products

UNIVERSITY OF SOUTH ALABAMA (USA)

The University of South Alabama (USA), the only major public institution of higher learning on the upper Gulf Coast, was created by an act of the Alabama State Legislature in May, 1963. The University is strategically located in the greater Mobile area, which has a population of more than a million within a 100-mile radius. USA offers high-quality academic, research and medical programs that create, communicate, preserve and apply knowledge in service to Alabama and the region. In pursuit of establishing a preeminent, comprehensive university, recognized for its intellectual, cultural and economic impact on the health and well-being of its community, USA thrives by promoting research innovation, stimulating academic engagement, and maintaining the highest standards of clinical practice.

INSTITUTIONAL RESEARCH ENVIRONMENT & EXPERTISE IN CLINICAL AND TRANSLATIONAL SCIENCE

State-of-the-art laboratory facilities suitable for basic, clinical and translational research are available to mentors and trainees throughout the USA Health Sciences Division. Laboratories are generally in close proximity to office and to shared-use core facilities (*vide infra*).

USA Mitchell Cancer Institute (USA MCI)

The USA MCI is a state-of-the-art facility with approximately 50% of the total assignable square footage devoted to basic and translational research and the other 50% devoted to clinical activities. There are 11 principal investigators leading research groups (consisting of graduate students, postdoctoral fellows, undergraduate research students, visiting scientists, and technical staff) focused on cancer genomics, cancer proteomics, biomarker discovery and validation, cancer stem cells, cancer metabolism, cancer metastasis, and the development of novel therapeutics. The USA-MCI has been nationally recognized for its unique design and open architecture that facilitates interactions between clinicians, clinical scientists, and basic/translational scientists. In keeping with the spirit and intent of the building, clinical and basic/translational scientists jointly participate in multidisciplinary working groups, tumor board, and clinical trial meetings. In addition, disease-specific working groups (pancreatic cancer, ovarian cancer, etc.) involving multiple investigators and clinicians (pancreatic cancer, ovarian cancer, etc.) meet weekly to discuss shared research projects, clinical trials, and translational studies.

Information Technology

USA researchers will participate in projects utilizing protected health information. Along these lines, the USA Health System maintains a unified and comprehensive privacy and information security program that protects the confidentiality, availability, and integrity of all information assets (i.e., patient, research, customer, and business data). Our health system follows HIPAA policies and undergoes review by the Joint Commission on Accreditation of Healthcare Organizations. Our security policies are overseen by an appointed HIPAA Entity Security and Privacy Officer. Further, we comply with Family Educational Rights and Privacy Act controls for student information. Our security policies are overseen by an appointed HIPAA Entity Security and Privacy Officer, and compliance with IT Security policies and local and federal laws and regulations is further ensured through review by our expert security consultants, Security Risk Solutions Inc. (<http://www.securityrs.com>).

USA Information Technology Operations

USA's security policies, IT infrastructure and connectivity are highly compatible with those of UAB and other partner institutions. The University Computer Services Center (CSC), under the direction of the University Executive Director for Information Technology, provides IT support for all University networks and core services, as well as end-user support for most main campus and general division locations. The Health Systems Chief Information Officer, reporting to senior hospital administration, leads the HS Information Technology group, which supports Hospital and Clinical systems and end users. The TRSC utilizes services and resources provided by both CSC and a third party data host, FireHost. Key components of these services and resources are described below.

Offices and Data Centers

TRSC and supporting personnel are located in offices in the Technology and Research Park building III (11,576 sq. ft.) as well as the Technology and Research Park building II (9,172 sq. ft.). Additional offices are located in the College of Medicine Basic Medical Sciences Building, the USAMC, USACW, the USA MCI, and elsewhere on the main campus. The network core and primary data center is located at the University CSC. A secondary disaster recovery site is located across campus, housing redundant network connections, directory services, virtual systems, and mirrored Network Addressable Storage. The USAMC, USACW, the USA MCI, and the CSC are connected in a metropolitan ring using leased dark fiber. There are multiple paths to the facilities, and the main campus core includes dual paths to the CSC and the disaster recovery site.

The data center currently supports 10Gbps switching. The metropolitan ring and main campus distribution fiber networks currently operate at 1Gbps link speeds. The CSC is in the process of upgrading the campus core and metropolitan ring to 10Gbps with completion expected by June 2015. The main campus distribution will remain primarily at 1Gbps per building, with upgrades to 10Gbps as required by building traffic.

The copper network wiring plant is Ethernet Category 5 or above. Edge switch ports are primarily 100Mbps, but in general, desktop gigabit could be deployed where required through an edge switch upgrade.

Network protection/security and access control

The University networks are protected by Cisco Adaptive Security Appliances (ASA), providing firewall, intrusion prevention, and botnet detection services. Various monitoring tools are in place to detect and isolate network threats. Public facilities, such as “guest” wireless and student computer labs, are contained in separate firewall zones from internal resources. Access to internal, secured resources requires internal physical wired connection or secure wireless authentication under control of Active Directory. VPN services, also controlled by Active Directory, are provided for vendor and employee remote access.

Directory Services and Access Control

The CSC manages a Microsoft Active Directory system for authentication and access control to a range of services, including Windows desktops and servers, Network Addressable Storage, secure wireless and VPN, and other internal applications. Redundant Domain Controllers and other key components are distributed through the University network system on main campus and in health care locations. The Active Directory is populated primarily with employee and vendor accounts.

Domain Name Services (DNS) are provided by a hybrid ISC BIND/Microsoft DNS configuration. The BIND servers are the authoritative source for the registered University domains and respond to DNS queries from external sources. The Alabama Supercomputer Center in Huntsville, Alabama, also hosts secondary authoritative DNS servers for these domains. The Microsoft DNS service supports internal clients and Dynamic DNS registrations.

The CSC also manages a Red Hat Directory (LDAP) system in support of a range of systems, including Google Apps and the University’s externally hosted Learning Management System. Student accounts are primarily populated here. Redundant servers are located across campus and at the Alabama Supercomputer Center.

Animal Research

Translational research often begins with pre-clinical laboratory studies. In this regard, the USAMC has state-of-the-art animal care facilities located in the Medical Sciences Building’s first floor. These facilities are approved for Biosafety Level-2 operations by the USDA, possess full accreditation by the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC International), and meet NIH guidelines for the care and use of laboratory animals. Surgical and animal manipulation rooms are available within this facility.

Core Facilities

Multiple research core facilities available to CTSA investigators include but are not limited to: Biomedical imaging (high resolution and standard confocal microscopy and electron microscopy), proteomics, flow

cytometry, gene vector development and delivery. These and other aspects of research support are provided to investigators at institutionally approved recharge center rates.

Research Cytometry Laboratory

The Cytometry Core provides a dual laser flow cytometer, two confocal laser scanning microscopes, a non-confocal fluorescence microscope, microphysiometer, and a PTI microscope-based photometer is capable of dual excitation/single emission fluorescence detection. The laboratory also has on-site tissue culture facilities.

Bioimaging Cores

The Bioimaging Cores, located in the USA CoM and MCI include three laser confocal microscopes (spinning disk, scanning confocal system and a live-cell spectral confocal systems. respectively.) These systems provide multi-label (blue to red) high-resolution fluorescent imaging for both fixed and live-cell preparations, and allow for specialized applications including high-speed, time-lapse and spectral unmixing. The facility also provides histological services including cryostat and microtome tissue sectioning and slide preparation. Transmission and scanning electron microscopy with full tomography are available thus permitting ultrastructural analysis and subcellular localization of immunogold or quantum dot particles. Finally, super-resolution light microscopy in SIM and STORM platforms are available through the USA MCI.

Mass Spectrometry and Protein Structure Laboratory

This facility is well equipped with two state of the art mass spectrometers, a Waters QTOF Ultima mass spectrometer coupled to a Waters capillary liquid chromatograph and a Finnigan Deca XP Ion Trap liquid chromatographic mass spectrometer, and associated equipment such as centrifuges, speed-vacs, and liquid chromatography equipment. The facility can assist with development of a total proteomics approach to evaluating major proteins in a cell system or gel, in a high through-put manner, and is set up as a hands-on center where students can be trained in these approaches. An additional goal of the core is to contribute to the development of methodology for proteomics.

Electrophysiology Core

This core has approximately 250 square feet of dedicated space with two independent patch clamp systems fully integrated for use. These systems are capable of combining ion channel measurements with fluorescent measurements of cytosolic calcium, perfusion studies, single channel analysis, and whole cell and perforated patch clamp.

Cell Culture Core

This core isolates, cultures, and characterizes lung macro- (artery and vein) and microvascular endothelial cells available for use by independent investigators.

Gene Delivery Core: This core has approximately 400 square feet of dedicated space used for a full complement of gene isolation and production techniques, also providing expertise for various methods of gene delivery. Among the services offered by the Core are: plasmid construction, protein expression and purification and generation of recombinant adenovirus and adeno-associated virus vectors.

Translational Biostatistics and Bio / Medical informatics Consulting Services

The University is in the process of expanding its presence in the bioinformatics area via recruitment activities in the CoM and in the School of Computer and Information Sciences. At present, Bio-Statistical and Bio / Medical Informatics Consulting services are available to USA faculty through the Biostats Service Center, directed by Dr. Madhuri Mulekar, Chair of the Department of Mathematics and Statistics, and by Dr. Daniel Roach, who is developing an Informatics Service Center on campus, respectively. Dr. Roach serves as the Director of the University's Center for Strategic Health Innovation. This service participates in the CCTS Partner Collaboratory, offering consultation services and collaborative opportunities across the CCTS Partner network.

Scientific Environment

Patient engagement and subject recruitment are important contributions of the USAMC to the UAB CTSA program. These activities will be facilitated by several highly active administrative units in the USA Health

Sciences Division, including the NIH-supported Center for Health Communities, the USA Family Practice Center, and the Center for Strategic Health Innovation.

Engagement of patients and subject recruitment will occur primarily in Mobile County. Mobile County is located in the southwest corner of Alabama and is the second most populous county in the state with a population of 412,992 (2010 US Census). It is a large county (over 1600 square miles or larger than the state of Rhode Island) but the majority of the population lies within 16-mile radius surrounding the USAMC. The population immediately surrounding the Center is 66% African American (2010 US Census) with an average per-capita income of \$21,456. Of these, 26.6% live below the poverty level (2005 US Census estimate). The county itself is a primary care physician shortage area with an HPSA Score of 13 for Mobile County (<http://hpsafind.hrsa.gov/HPSASearch.aspx> assessed 10/28/2017).

Mobile County has a poor health status when compared to peer counties and the United States as a whole (following data from 2009, Department of Health and Human Services, Community Health Status Indicators Project accessed at <http://communityhealth.hhs.gov> on 6/30/2011). Life expectancy is below the peer counties at 75.42 years. County residents regard themselves as unhealthier than those people living in the “peer counties” (counties selected because of similar age/sex/urban demographics). 20% of all Mobile residents rate their health status as fair or poor as compared to 21% of all AL peers and 12 % of the best peer. Mobilians report an average of 5 unhealthy days / month. A number of risk factors for premature death are prominent in the USAMC service area. One chief factor is obesity, which is prominent despite a weather pattern that allows outdoor activity on most days of the year and 73% of the population reporting having access to locations for physical exercise. Mobilians report a diet lacking in fresh fruits and vegetables and the obesity rate of 36% is reflective of the first two observations. Mobilians continue to smoke at a rate higher than the national average. Mobilians report a high rate of diabetes as well (<http://www.countyhealthrankings.org/app/alabama/2018/rankings/mobile/county/outcomes/overall/snapshot>). Collectively, these patient demographics present unusual opportunities for a wide range of high impact translational research.

CLINICAL CARE

University of South Alabama Medical Center (USAMC)

The University of South Alabama Medical Center serves as the region’s safety-net hospital and is the primary site for the clinical educational programs for USA College of Medicine students. The USAMC is a major referral center for southern Alabama, southeast Mississippi and portions of northwest Florida. It is home to the region’s only Level I Trauma Center and one of only four such designated centers in Alabama. Highly trained clinicians and staff manage trauma and critical care, surgical and medical intensive care, and neurotrauma intensive care. USAMC Trauma Center houses two trauma resuscitation bays that are fully equipped and staffed with professionals from nursing, respiratory care, and radiology. The Emergency Department includes a designated major operating room in the surgical suite. Support services include the Radiology Department, which houses two state of the art 64-slice, high resolution CT scanners and interventional radiology, the Clinical Laboratory, and the Blood Bank. The USAMC Burn Center is the only burn center serving the central Gulf Coast region. USAMC is noted for its remarkable stroke, cardiovascular and sickle cell disease centers. The Center admits approximately 1,500 patients a year who are Trauma Team Activations. USAMC averages 28,992 Emergency Room (ER) encounters and 6,123 hospital discharges per year. An estimated 61% of Emergency Room encounters and 48% of inpatient stays at USAMC are for patients who reside in the inner core of the City of Mobile or Prichard. The acuity of the patient population at the USAMC has been rated among the top 10% of the nation’s hospitals.

USA Children’s and Women’s Hospital (USACW)

The USA Children’s and Women’s Hospital provides neonatal and pediatric intensive care services, high risk obstetrics services as well as routine pediatrics and OB/GYN services, and pediatric oncology services. The Evaluation Center provides emergency medical services for the pediatric and OB/GYN patients. The USACW Hospital is the only designated children’s hospital in South Alabama. The hospital includes the region’s only level 3 neonatal intensive care unit and pediatric intensive care service as well as obstetrics and gynecology. A Ronald McDonald house for families of pediatric cancer patients is now affiliated with the hospital. USACW treats more than 6,000 children each year.

GRADUATE EDUCATION AND POSTGRADUATE TRAINING INFRASTRUCTURE

Responsible Conduct of Research (RCR) program

The USA College of Medicine's (CoM) RCR training program satisfies the NIH requirement for training in the ethical conduct of research in the following nine areas: research misconduct, human participants, research involving animals, data acquisition, management, sharing, and ownership, mentor/trainee responsibilities, publication practices and responsible authorship, peer review, collaborative science, and conflict of interests. Instruction in our RCR program utilizes a combination of lectures, on-line tutorials, and small group discussions.

Selected additional courses / active learning experiences

The USA CoM offers a variety of additional learning experiences for students at all stages of pre- and post-graduate training. A partial list of such activities with particular relevance to trainees engaged in patient-centered, clinical, and/or translational research includes: Effective Scientific Writing, Presentation Skills, and Statistics & Experimental Design, and Introduction to Research Methods.

Computer: All mentors, residents, prospective trainees, and members of the research teams have dedicated personal computers with internet and email access networked through the University. An interactive computer laboratory is also located in the Medical Sciences Building.

Office: All mentors, prospective trainees, and members of research teams have adequate personal office located in close proximity to the clinics, specialized care units or laboratories. Multiple large and small rooms are available for seminars, laboratory meeting, didactic instruction, etc.

EXAMPLE ELECTIVE MINI-SABBATICAL OPPORTUNITIES AT USA

Mini-sabbaticals/Externships/Short-term Rotation Offerings

Rotation Name(Supervisor(s)/Institution)	Learning Objectives
CCTS Network Partners (example rotations)	
High-resolution microscopy (M. Gillespie, PhD, University South Alabama)	1) Core competencies in specific fluorescence imaging; 2) Learn how to apply innovative experimental techniques to understand protein interactions & cell dynamics; 2) Develop & implement a pilot study using super-resolution microscopy technologies